



HAL
open science

The Environmental Violence of Volatility

Nicolas Bouleau

► **To cite this version:**

Nicolas Bouleau. The Environmental Violence of Volatility: How Neoliberal Economy Obscures Information about the State of the Planet. 2013. halshs-00835669

HAL Id: halshs-00835669

<https://shs.hal.science/halshs-00835669>

Preprint submitted on 19 Jun 2013

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Nicolas Bouleau

THE ENVIRONMENTAL VIOLENCE OF VOLATILITY

How Neoliberal Economy Obscures
Information about the State of the Planet

Translated by Martin Crossley
and Michael Eddyshaw
Swansea University, UK.

June 2013, CIRED Ecole des Ponts ParisTech, Paris, France

Website and blog of Nicolas Bouleau

Introduction

I) A non-Marxist critique

1. Free trade: an ancient idea, today hyper-institutionalized

The Akrotiri civilization • The beneficial effects of the market • The financial markets • The “Black-Scholes” Revolution and options hedging • Rate models, the securitization of debt • Practically perfect market

2. What is the ethical basis for the social pillar of sustainable development?

Socialism: a humanism of the productive world • Marx and the market • The path outlined at Rio has not been followed • The absence of distant solidarity

II) Collective blindness comes from the economy

1. Finitude

Limits to growth • The models • Causes of the neoliberal turning point

2. Individualist collapse

The IPCC, bogged down • Balance sheet: the vehicle just keeps on accelerating • Red light, green light • From denial to fatalism, or to the argument to authority • Unspoken Malthusianism • Cassandra is a Leftist... • ... but she causes people to vote for the Right • The spiral of indispensable warfare • Fuel is needed to vanquish inertia

3. The eyes of humanity can no longer see anything but prices

On the causes of ‘business as usual’ • Use value and exchange value • Vitalist economic ideology • Origin of the economic faith system

III) The teeth of the market

1. Non-marketable collective goods

Externalities • Cost-benefit analysis • The bulldozer of substitutability • Economic theory pardons irreversible destruction • Contingency analysis as a conservative political response • Tradable pollution rights • Calculations and good conscience

2. The idealized image of the market is a dogmatized fantasy

Cloud-functions • The amazing principle of least action • How can we “reduce” cloud-functions? • Two types of market • Inside or outside the model? • Why is there no economic kinetics? • Interpretation-models and commentary-models

3. There can be no speculative market without price fluctuation

The error of Léon Walras • The teeth of the market have been underestimated by the Marxists • Criticism of the financial markets on the theme of speculation is insufficient • Calming the markets?

4. Price fluctuations will consume all of nature

Back on the Rome report: simple models and their refinements • Qualitative aspects of stochastic processes • Vulnerability of the environment when subject to economic “rationality” • To consider the economic value of the market a moral reference is to turn the environment into a gambler at the casino: sooner or later, it will inevitably be ruined • An implacable logic

5. Frequently asked questions

Discussion about: volatility, speculation, arbitrage, trends, risks, technological analysis, efficiency, derivatives, price points

6. The market is inconsistent with the price signal

The fundamental problem of the economy, according to Hayek • Importance of the price signal: the case of carbon • The trends have disappeared: examples • The theorem of the unique trajectory • The fundamental law of market finance • Should there be a tax on financial transactions, and if so, what type?

7. Creating debt markets: delegating economic intelligence to agencies

The third level of financialization • The epistemological limits to the economic valuation of risks • What is lost by putting debts on a market • When faced with contradictions, consult an oracle • Two shortcomings of economic logic

IV) Dispelling the mist ?

1. What is currently happening: the default choice of economic logic

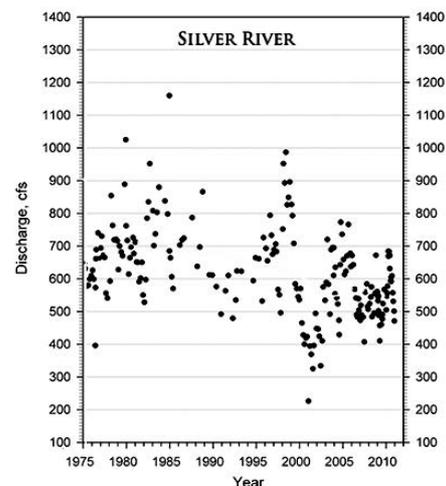
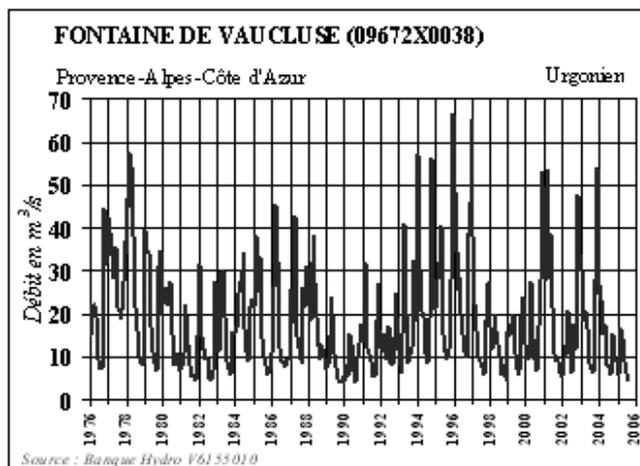
Sustainable development: an ambivalent concept that delays action • The default choice is an unequal dynamic • To take small steps towards a horrible victory or build a dignified and sustainable pluralism? • Ecologico-scepticism and beliefs

2. Seeing reality means giving up the speculative financial markets

The idea of nature and what its degradation means • And if we don’t change course? • The contradiction of achieving all possibilities • The teeth of the market will continue to work

Introduction

Many natural phenomena are irregular. The wind, certainly, temperatures, rain, floods, geysers, etc. Usually opinions are mixed about whether the changes are worsening or if they are subsiding, or even disappearing. Take the case of the French site of Fontaine de Vaucluse in Provence. The visitor cannot fail to be impressed, just as the poet Petrarch was, by the magnificent setting of this curious geological phenomenon which provides abundant pure water in glowing colours. Depending on the time of year, the basin of the spring is full and overflows in a fiery stream feeding the river Sorgue, or it looks like a partially filled hole, the water escaping through secondary springs lower down. But what is the evolution of the water-flow in this deep karst phenomenon? If one asks the old inhabitants of the country, they remember not just seasonal changes, but also extreme events, times where the level of the river was above the arches of the bridge and the little town of Isle-sur-Sorgue was flooded, or periods of low water, when people wondered if the bowl would ever fill up again. Scientists took many measurements and tried to model this complex phenomenon where rainwater travelled through unknown cracks in the limestone to feed spaces and drains underground¹. There is an approximate correlation with rainfall in the basin, with a delay whose timescale depends on where the rain fell. But on the question of changes caused by urbanization, which is significant in Provence, or by partial deforestation in the mountains of the Luberon, or changes in the Mediterranean climate itself, researchers cannot say anything very definite. The flow-rate at Fontaine de Vaucluse is too irregular for any trend to be discerned.



Records of the water-flow at Fontaine de Vaucluse do not allow any long-term trends to be easily discerned. A similar phenomenon occurs in Florida in the case of the city of Ocala, source of the Silver River. Here scientists have detected a slight decrease in the average flow, without, however, being able to tell if this trend will continue or not.

There are two types of imperceptible phenomena: very slow changes, and average trends with very irregular dynamics.

The first type is well known and is no surprise since, as human beings, we know that we only see what our senses are capable of feeling, just as the philosophers Locke, Berkeley,

¹ See, for example, P. Fleury, V. Plagnes and M. Bakalowicz "Modelling of the functioning of karst aquifers with a reservoir model: Application to Fontaine de Vaucluse (South of France)" *J. of Hydrology* 20 Oct 2007, 38-49.

Pascal and many others have wisely noted. This was why the movement of plate tectonics was not noticed for so long, and then guessed only because of the shape of continents. It has only recently been measured thanks to the precision of instruments currently available, which allowed us, for example, in 2004, to measure the drift of the Peloponnese from the Greek base during the construction of the Rion-Antirion bridge². Similarly, we do not realize that certain country houses are sinking, by the influence of alternating dryness and humidity, because the motion is so slow. In a different sphere, we do not notice how the voices of our loved ones change their timbre over time, getting deeper as the years go by.

The second type, however, is more insidious because it concerns volatile situations where we clearly see “movement”. The generic example is the sea whose waves slip onto the beach. From looking at them for a few moments, it is hard to say whether the tide is rising or falling. Another typical example is the evolution of species that has only lately been established scientifically, because the variations between individuals of a population blur the overall drift of evolution. Trends are drowned by natural fluctuations in offspring compared with their parents in a group with diverse characteristics.

For these irregular phenomena, what enables a trend to be detected is always the presence of a *cumulative indicator of the long-term effect*.

For example, in the bay of Mont Saint Michel, it is the sand. Tides and storms bring in and take out the sand. What is the role of structures such as the causeway that leads to the mount, or the dams on the adjacent river Couesnon? It would be hard to say precisely, but the sand serves as a witness, just as the sediments have testified since long ago around the city of Aigues Mortes in the Camargue. The same thing happens with glaciers. The mass of ice, the slowness of its motion and natural melting, provide a very visible *cumulative indicator* which tells us clearly about the amount snow fall and current global warming.

In the case of waves on a beach, the area of wet sand is a cumulative indicator of the rising tide, but it would be a mistake to think that the succession of maxima always gives an idea of the trend. Extrema describe the magnitude of the variability of the phenomena. We try to forget as little as possible about the extreme levels of flooding because they indicate the thresholds of danger to habitats. The ancients certainly noted vernacular knowledge on this subject before building works and creating cities, as evidenced by the Pont du Gard and the Roman Bridge at Vaison la Romaine which still stand today. But it is not the extremes which show the average slope, if this exists. In an irregular phenomenon with no trend, and average value zero, something easily described mathematically, the greater the number of maxima achieved over a long period, and the higher they are, the more complicated is their relation with possible trends. The values of extrema could well increase while the underlying trend is downward.

This is often seen in everyday conversation and in commentaries on radio or television. One sees unusual events, such as torrential rainfall in Ouagadougou in September 2009, or temperatures of 22°C in Montreal in March 2012, “We haven’t seen anything like that in ten, fifty years...” Does that mean that the climate of Burkina Faso is becoming wetter? Or that Quebec is getting warmer? If that were the case, these events would be more frequent and one would not need to go far back in time to find the last occurrence. In climate change it is hard to see the trends because it is very irregular. One has, rather, the impression that it is the irregularity that is increasing.

Thus *cumulative indicators* are essential for the trends to be detected, without such markers they cannot generally be seen. Very slow regular phenomena often constitute such indicators themselves or are accompanied by secondary damage that is easily seen. Cracks in

² the magnitude of the drift is about 1.5 cm per year, cf. Bernard P. *et al.* "Seismicity, deformation and seismic hazard in the western rift of Corinth: New insights from the Corinth Rift Laboratory (CRL)" *Tectonophysics* 426 (2006) 7-30.

the wall of a house are indicators of differential deformations in the foundations. Creep, in stone that is under stress, is very gradual and happens over many centuries, but it can be clearly seen in some of our cathedrals, such as Salisbury or Wells, because the curvature of the pillars is a highly visible indicator. However, an irregular phenomenon does not have any memory itself. It erases its past, more or less completely. And thus its underlying direction is often highly important for decision and action.

What I will show in this book is that the free market economy is a social system which, ascribing fundamental importance to the notion of market, creates values that are irregularly volatile, namely prices. And it does this so well, especially in the financial markets, that these values completely hide the underlying trends which constitute the most important and essential information for the future. These values are the basis for decisions taken by all economic players, as well as those taken by households, by large companies and, to a large extent, by governments.

In all areas where humanity influences the environment, whether that be natural resources, other living beings, waste, technological risks, etc., *the cumulative indicators* are always found outside the realm of economics, provided by gauges built not from market prices.

The very notion of fluid market today implies the *relentless* and *complete* erasure of trends in the evolution of prices. It results in the great mass of inhabitants of this planet – who live mainly trying to manage with the prices put to them by globalization – not seeing in their universe of reference, the evolution of natural quantities. Or, to be more precise man, in the current economic universe, cannot act in a way that takes account of trends, except by forgetting the economic framework, i.e., forgetting the elementary rules of community life necessary for living with the least harm and, often, necessary for survival.

The economy leads the world while hiding the trends. This is the fundamental issue. We will study its causes and analyse its most serious consequences.

I) A non-Marxist critique

It will be helpful to clarify the intellectual fulcra of this work. In this chapter, we will look over the historical genesis of the liberal economy, tracing it all the way up to the contemporary period in which the financial markets flourish. We will also investigate the highly fundamental question of how to know which bases might provide a firm foundation for sustainable development in its social dimension. Since the Rio Conference, this has been the issue at the heart of the debate.

Let us first of all make it quite clear that we are not about to deny here what Karl Marx brought to our understanding of capitalism, nor even what the Marxist current brought, via its turbulent history, to contemporary civilization. However, it must be stated that as soon as any strong, clear opposition to economic liberalism appears, it triggers an immediate outcry and, in the confusion, finds itself subject to a counter-offensive tying it to communism, to collectivism, and to the dictatorship of the proletariat. The Greens have often fallen victim to this in Europe, as have the ecologists in the United States, from the Republicans.

The position I adopt is perfectly clear. The arguments put forth in this work do not feature – at the time of writing – in the literature of the Left. This last criticizes the financial markets for other reasons, mainly those enunciated by Keynes, in that a distinction is drawn between those who gamble on markets like a casino – the speculators – and those who strive to direct the economy well – the entrepreneurs. The line of argument which I advance is different and, in fact, its sole point in common with the critique of the Left is an attack on the philosophy of market economy; however, the objectives pursued are by no means the same. As we shall see, they disagree on the most essential of issues.

It makes sense, then, to first clarify the issues involved, which is the object of this chapter. My subject is situated at the crossroads between ecology and economy, hence between nature and free trade, but also between social dignity and the rationality of profit. It was this selfsame dichotomy which was realized by the Brundtland Report in 1987, and subsequently the 1992 Rio Summit, under the label of ‘sustainable development’, with its three main aspects: the economic, using the term ‘sustainable’ to communicate an objective of growth and of economic efficiency; the social, expressing the fact that this development must take human needs as its starting point, and therefore must answer to an objective of social equity; the environmental, meaning that the objective of sustainable development must contribute towards handling, improving and promoting the environment and preserving resources for the long term. The current balance sheet resulting from this impetus is not zero, but is very modest given the objectives which had been declared and approved. It cannot be said that the term ‘sustainable development’ has not been sufficiently broadcast; nowadays, it is to be found everywhere. Here then is a sort of enigma to which this work brings a scientific response, supplementing some unfortunately rather more commonplace considerations.

For such a clarification, we must on the one hand take a step back regarding the idea of ‘market’ which currently saturates our society, and on the other hand investigate values of solidarity, both as they have been perceived in the Marxist line and from an ecological perspective.

1. Free trade: an ancient idea, today hyper-institutionalized

The market has not always existed. Today, as a mindset, it is so ingrained that one imagines nothing other than introducing it to where it still does not exist. It is seen in an equally positive light by the housewife, the industrialist and the political official. In Europe, the services of the Brussels Commission dedicate all their energies to helping it gain ground. Currently, it is at an all-time high, having been refined 25 years ago in an enormous mathematical machine: the organized financial markets. How have we reached this point? Let us examine several historical milestones in the genesis of this phenomenon.

The Akrotiri Civilization

Archaeologists today seem to agree on the fact that the stamped metallic coin did not historically appear in order to simplify commercial exchanges, as Aristotle had thought, but rather for reasons linked to the power of the State and to the payment of salaries, notably of the military. As proof, the first electrum coins correspond to a soldier's monthly salary, too large for circulation. Measures and standards existed before stamped money for the comparison of quantities based in commodities.

The coin probably made its first appearance in Lydia and Persia. In the Greek world, it emerged towards the middle of the first half of the first millennium B.C. At this time, trades were subject to psychologically rigorous social customs called 'codes of transaction'. According to J. Parry and M. Bloch³, as well as S. Von Reden⁴, the use of coins flowed smoothly into the transactional orders making up the invariants of trade: the long-term, whose aim was to contribute to the permanence of the group, and the short-term, whose approach was neutral as long as the stability of the group was not threatened. These constants structured all types of transaction, and money progressively found its place in them. On the other hand, transactions conceived as ends in themselves were doomed.

As a result, the Minoan civilization in Crete, and the extraordinary Akrotiri civilization which archaeologists are still in the process of uncovering on the island of Santorin – brought down in the 17th or 16th century B.C. by the volcanic eruption which collapsed the centre of the island and buried the city under ashes, thereby protecting it until the present day – these highly refined civilizations functioned without money. What historians emphasize, however,⁵ is that the "commercial" agreements of the time usually consisted of what we clumsily call "term contracts". In other words, instantaneous exchanges were often discovered to be unbalanced, thanks to contingent necessities, and it was necessary to remember at a later point what was owed from previous exchanges. We see that the relationship between parties was certainly not that of a "market", in which anyone can take up an offer, but rather one of trust, even honour. It is surely this which allowed the transaction of rare objects, perfumes, golden figurines, vases, or even live animals imported by sea, such as the blue monkeys faithfully depicted by the painters of the Akrotiri frescos.

We are most certainly not talking about Jean-Jacques Rousseau's 'noble savage' who lived before the social contract came to serve and service the liberty of all, but about highly evolved societies, fully implicated in the social distribution of tasks and responsibilities. Today, we are provoked to reflection by the high level of refinement of these 17th century BC civilizations, as demonstrated in the form of the vases, the furniture – a three footed pedestal table has been found which is so ornate in its decoration as to be mistaken for the Louis XV style – and the clothes and finery of the women, as depicted on the walls of ordinary houses.

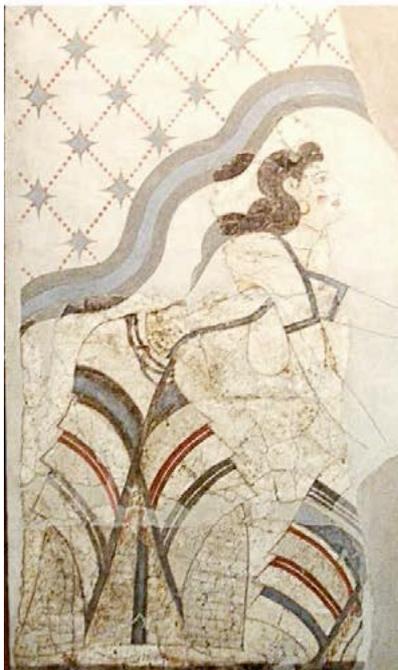
³ Parry, J. and Bloch, M., (eds.) *Money and the morality of exchange*. Cambridge University Press, (1989).

⁴ S. von Reden, *Exchange in Ancient Greece*, London (1995).

⁵ R. Descat "Monnaie multiple et monnaie frappée en Grèce archaïque" *Revue Numismatique*, 6ème s., t. 157, 69-81, (2001).



Elements of the Akrotiri civilisation



The beneficial effects of the market

Let us jump forwards in time to Europe in the 17th century AD, when thinkers on agriculture and trade, known as the physiocrats (Turgot, Dupont de Nemours, Quesnay, etc.) were discussing and philosophizing over the “causes” and the “effects” of the economy.

If demand increases, prices rise, just as if supply diminishes, and vice versa. This commonsensical idea is to be found everywhere; however, it does not clearly or automatically possess a framework allowing it to be granted the status of a scientific law. Where does this phenomenon operate? “*Just considering*”, notes Turgot, “*a single isolated sale between two private individuals, it is evident that the exchange would be perfectly equal and that neither of the two could be wronged; since the exchanged goods can have no price other than that which has been attributed to it by the desire of each of the two contracting parties and since they alone can judge this desire*”⁶ In order for supply and demand to play the role of a mechanism, it is necessary that competition should influence behaviour: “*In the case of reciprocal competition between sellers and buyers*”, he adds, “*the price is fixed by the debate between the totality of the sellers, on the one hand, and the totality of the buyers, on the other, instead of by debate between two sole individuals*”. Turgot chose to situate the phenomenon in its entirety, the whole world being the arena where competition ultimately plays out. He was already using the term ‘equilibrium’ for this situation of abstract reference: “*A kind of equilibrium is established between the value of all the products of the soil, the consumption of the different types of goods, the different types of work, the number of men occupied therein and the price of their salary [...] This being granted, if weight is added to one part of the balance, it is impossible that the result should not be a movement throughout the machine which tends towards re-establishing the old equilibrium [...] I know well that this effect will not be sudden and that any complicated machine will contain frictions slowing even the effects most infallibly proven by theory. The level, even in a perfectly homogenous fluid, only re-establishes itself with time, but with time, it always re-establishes itself. The same applies to the equilibrium of the values we are examining.*”⁷

These ideas, prudently expressed by the physiocrats, will be seized upon by more audacious thinkers, the classical economists, in the second half of the 18th century, and developed into a true realization of the important practical and philosophical consequences that can be drawn from the phenomenon of supply and demand.

There is, however, a sizable epistemological problem to overcome: the circumstances of life in society are never perfectly repeated, and even in a situation of competition, the various decisions taken follow on from each other in a specific and changing context. In the face of this difficulty, the classical economists daringly reverse the problem, postulating the

⁶ Turgot, *Plan d'un ouvrage sur le commerce, la circulation et l'intérêt de l'argent, la richesse des états* (1753-54) : "A ne considérer qu'une seule vente isolée entre deux particuliers, il est bien évident que l'échange serait parfaitement égal et qu'aucun des deux ne pourrait être lésé; puisque les choses échangées ne peuvent avoir d'autre prix que celui qu'y a mis le désir de chacun des deux contractants et qu'eux seuls peuvent juger de ce désir... Dans le cas de concurrence réciproque entre les vendeurs et les acheteurs, le prix est fixé par le débat entre la totalité des vendeurs, d'une part, et la totalité des acheteurs, de l'autre, au lieu de l'être par le débat entre deux personnes seulement..."

⁷ Letter to D. Hume, quoted by T. Vissol in *Turgot, économiste et administrateur*, ss la dir. de Ch. Bordes et J. Morange, PUF 1982: "Il s'établit une espèce d'équilibre entre la valeur de toutes les productions de la terre, la consommation des différentes espèces de denrées, les différents genres d'ouvrages, le nombre d'hommes qui y sont occupés et le prix de leur salaire [...] Cela posé si l'on charge l'un des poids, il est impossible qu'il n'en résulte pas dans toute la machine un mouvement qui tend à rétablir l'ancien équilibre [...] Je sais bien que cet effet ne sera pas subit et qu'il y a dans toute machine compliquée des frottements qui ralentissent les effets les plus infailliblement démontrés par la théorie. Le niveau, même dans un fluide parfaitement homogène, ne se rétablit qu'avec le temps, mais il s'établit toujours avec le temps. Il en est de même de l'équilibre des valeurs que nous examinons."

law and imagining the benefits which would ensue from it if society were to be stripped of all the complications holding back the free expression of this mechanism.

However, agriculture and the craft industry were already no longer the only productive activities, and the novelty of the problems required new explanations. When Adam Smith wrote *“It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages...”*⁸ it was 1776, the industrial revolution was blooming, and manufacturing based on energy from mills was being developed.

Adam Smith posits that the individual can forget society, thinking of nothing more than his own interest, because the market will translate this selfishness into a global benefit: *“He generally, indeed, neither intends to promote the public interest, nor knows how much he is promoting it. By preferring the support of domestic to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention”*. Thus Smith enunciates this principle which challenges all planned economic thought and even thought partially controlled towards a social goal, wherein we find, in embryonic form, the modern doctrine of liberalism: *“By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it”*.⁹ In other words, it is no use trying to define the collective interest and applying oneself to serving it; it is enough to optimize one’s own business, and the framework of unrestricted commercial trade will do the rest. At the beginning of the following century, Jean-Baptiste Say was to dissipate all misunderstandings regarding this veritable philosophy of life in society: *“Have we found society’s government in all this? No. And the reason for this is that the government is not an essential part of the social organization. Note that I am not saying the government is useless; I am saying that it is non-essential, that society can exist without it, and that if associates were happy to attend to their own business and leave me to my own, society could, if it had to, function without government.”* This disciple of Smith’s provides, on the same page, a profoundly significant detail for the modern reader. As Jean-Baptiste Say cannot find an example of a nation without a government, in order to illustrate his theory he chooses to cite the immigrant settlements in Kentucky – at the time, the new frontier in the conquest of the empty spaces of the United States: *“there are townships where firstly a single family established itself; then another in the vicinity of the first; then a third; eventually villages form, houses and children are produced; they are dressed, they are nourished, so far so good, many households cannot provide for themselves on Jean-Pain-Mollet road, and wait! Oh, how terrible! There is no Government”*. Here we have an instance of a conquering economy in an infinite world, an ideal example of free trade! And this allows a France emerging from its Revolution and Droits de l’Homme, then from its Empire and Napoleonic Code, to develop of a vision worthy of the “Tea Party”: *“Our government will exercise, they will say, a favourable influence on your commerce. Bah, leave me alone! What influence could be more favourable to me than my rest and my liberty! When the focus of the government is deployed internally, when the mania to regulate, to influence on actions and opinions, enters in, what a hellish vision!”*¹⁰

⁸ A. Smith, *Wealth of Nations* (1776), Book I Chap II.

⁹ *ibid* Book IV Chap II.

¹⁰ *“Avons-nous trouvé le gouvernement de la société dans tout cela ? Non. Et la raison en est que le gouvernement n’est point une partie essentielle de l’organisation sociale. Remarquez bien que je ne dis pas que le gouvernement est inutile; je dis qu’il n’est pas essentiel; que la société peut exister sans lui; et que si les associés voulaient bien faire leurs affaires et me laisser faire la mienne, la société pourrait à la rigueur marcher*

Before the idealized market could be posed as a mathematical model, as the neo-classical economists would do in the 19th century, it was essential to create a place for it in the world of ideas, by idealizing the society in which it wholly functions. It is here that the economic arguments have their value: “*the proportion between supply and demand*”, writes David Ricardo, “*may, indeed, for a time, affect the market value of a commodity, until it is supplied in greater or less abundance, according as the demand may have increased or diminished; but this effect will be only of temporary duration*”¹¹.

Evidently, the very same mathematization which would debut with Jules Dupuit and Augustin Cournot and would be continued with the equilibrium theories of Leon Walras, Jevons, Menger, Pareto, etc. – to which we shall be returning in greater detail in chapter III-2 – was instantly accompanied by a vigorous philosophical bias in favour of a social organization in which this harmony was in force. Dupuit accompanies his technical invention of marginal utility with flatly ideological intent: “*general, universal competition forms the law of society, and whosoever tries to escape it, by whatever means, violates the social pact and deserves to be punished*”¹².

The fundamental point upon which we are invited to reflect by this rather fascinating period in the history of ideas is that the phenomenon of supply and demand is not to be found in a pure state in the observable world, and has therefore been idealized. And it has been *idealized in a static fashion*. The curve of demand, expounded for the first time by Augustin Cournot, but which as we have seen underlies many of the earlier theories, does not exist experimentally, because the world unfolds in real time and time is absent from the neo-classical representations of the market. Analogously, we can compare it to what in mathematics is called a ‘projection onto a co-ordinate plane’ – that is to say, a simplifying approach which completely erases one dimension of reality, meaning that philosophically speaking we omit certain factors, certain phenomena which make sense and yet which we consider negligible.

In order that the reader might fully understand, let us immediately state that in the 19th century, at the time of the neo-classical economists, the unique nature of events unfolding in the temporal dimension was a secondary consideration and did not, in itself, disqualify their ideas. The real markets were cursorily organized, and the assessed markets were but fantasies of an ideal organization advanced by committed intellectuals. On the other hand, we shall see in just a minute that the markets currently extant in our neoliberal financial world realize the idea of the market in all its philosophical and mathematical purity and that, consequentially, the temporal has *major consequences* regarding the role of the market on the decisions of agents and the functioning of society.

The financial markets

Up until the Second World War, finance was essentially a professional practice, with all its institutional and legal aspects. It used actuarial calculations to work out credit and conversions to current value in the frameworks provided by the micro and macro-economy.

sans gouvernement... il y a des cantons où une famille vient d'abord s'établir; puis une autre dans le voisinage de la première; puis une troisième; finalement les villages se forment, on y fait des maisons et des enfants; on les habille, on les nourrit, très bien, mieux que beaucoup de ménages ne peuvent se nourrir dans la rue Jean-Pain-Mollet, et pourtant, oh ! malheur ! il n'y a pas de Gouvernement... Notre gouvernement exercera, dira-t-on, une influence favorable à votre commerce. — Eh qu'il me laisse tranquille. Quelle influence me sera plus favorable que mon repos et ma liberté ! Quand la pensée du gouvernement se déploie dans l'intérieur, quand la manie de réglementer, d'influer sur les actions, sur les opinions, s'en mêle, quel enfer !

¹¹ *On the Principles of Political Economy and Taxation* 1817, Chap 30.

¹² “*la concurrence générale, universelle, est la loi de la société, et quiconque tente de s'y soustraire par un moyen quelconque viole le pacte social et mérite d'être puni*”. Cf. O. Coutard “Jules Dupuit et la théorie économique : l'invention de la notion de surplus” *Ann. des Ponts* n°82 1997.

Since the 18th and 19th centuries, it had touched on issues of risk with problems of maritime insurance, and for this purpose it used statistics and probability calculations. From 1848 onwards – the date of the creation of the Chicago Board of Trade, followed in 1874 by that of the Chicago Mercantile exchange – term contracts on the cereal trade were quoted and exchanged. It was this role of the financial markets as a place of negotiation on speculative risks that was to take on a considerably larger scale at the end of the twentieth century.

Reflections on the 1929 crisis provoked significant developments in economic thought during the post-war period marking the third quarter of the twentieth century. Finance became the object of a robust theory, strongly marked by the American school (Arrow, Debreu, Allais, Linter, Markowitz, Miller, Modigliani, Samuelson, Sharpe, Tobin, etc.). The most significant constructions were the theory of portfolio selection, risk analysis, and market models, notably the CAPM (Capital Asset Pricing Model) and its numerous improvements. As for the institutions, the most important changes were those which followed the decision to suspend the convertibility of dollars into gold and the worldwide development of derivative markets (optional and term products), with the quotation of currency options in Chicago from 1972, then interest rates options and the opening of derivative markets in London (LIFFE 1982), Singapore (SIMEX 1984), Tokyo (TIFFE 1985), Paris (MATIF 1986, MONEP 1987) and Frankfurt (DTB 1990).

Globalization and the development of derivative products were two concomitant, overlapping phenomena – one spatial, the other qualitative – and were to imbue finance with a new power, leading to the start, under the mandates of Margaret Thatcher and Ronald Reagan, of the neoliberal period in which we currently find ourselves. We have quite rightly discussed at length the first of these phenomena, a major historical change encouraged by the collapse of the USSR and by a new ease of communication and trade with considerable consequences, and a change consecrated by the 1994 Uruguay Round with the creation of the World Trade Organization. Finance can certainly be said to play an important role within it, but is neither its only aspect nor its only cause. The scale of the theatre of relations between the financial world and the economy has changed, reinforcing the necessity to better understand market functioning and the link with economic politics. For this, however, it is necessary to further examine qualitative change, as it is this which conditions the constraints surrounding not only behaviour, but also the phenomena of opinion and risk assessment. Moreover, it is relatively unknown, and therefore merits further explanation.

In 1973, a major epistemological rupture came about, characterized by the intrusion of highly advanced mathematics into the operational knowledge of the banking world – mathematics previously taught only at the level of a Master's degree or higher.

The “Black-Scholes” Revolution and options hedging

In the 1970s in the United States, and the 1980s in Europe, there was a veritable *epistemological rupture*, in the sense described by Thomas Kuhn. It was noticed that one could fix a price for options consisting of contingent assets and “hedge” them by managing a portfolio over their duration such that the risk was completely negated. This demanded the use of relatively advanced mathematics. Brownian motion, semi-martingales, stochastic differential equations and partial differential equations, all of these made their appearance in finance. The key idea – the principle of non-arbitrage – is that true value prevents both seller and buyer from making a risk-free profit. Mathematics allows a multitude of consequences to be drawn from this single principle.

The effects of this “revolution” made themselves felt at different levels. Firstly, by the establishment of derivative markets in all the important financial centres. Contingent term contracts, or options, found themselves henceforth easily manageable and thus multiplied,

providing businesses with protection against the random fluctuations of prices, especially of currencies.

Then, we saw a transformation in the professional profiles of financial practitioners. Instead of having a background in economics and human sciences, they were recruited fresh out of engineering schools or university mathematics courses. Accompanying this were renovations in education, giving more precedence to probability theory, stochastic analysis and the differential calculus developed by the Japanese mathematician Kiyosi Itô. These improvements in the financial markets, combined with new profiling techniques, had the joint consequence of reinforcing the power of the financial world, thanks to a kind of symbiosis between the opposing social backgrounds of university research and of decision-making in the business world.

Following this paradigm shift, although it was thought at the time that all the main tools were already in place, the last twenty years have seen a curious continuation of this mathematization.

Rate models, the securitization of debt

Given that short term and long term rates are not the same and vary amongst themselves over time, the study of yield leads to the study of a two-variable function (starting date and maturity), thus representing rates by a surface – a random surface, obviously. The principle of non-arbitrage applies here as well, and allows us to propose models for the price and the management of what are termed “rate derivative products”.

In this field, mathematics is applied even more skilfully than it is to options. Certainly, the deductions made from the principle of non-arbitrage are unassailable on a theoretical level, but these models concern the rationality of agents in a distant future (when stock option duration is in general 6, 9 or 12 months) and constitute a probabilistic schema of the future which is but one vision among many possible. Moreover, these models are “calibrated” according to the data we have today, and a lot can happen in 10 or 15 years’ time...

The theoretical advances of financial mathematicians have also improved risk management for banks in the handling of their complex portfolios. We shall go into a little more detail, as this narrative is loaded with important philosophical consequences. The “improvements” brought to risk management by the application of remarkable theoretical tools – which even have a certain beauty, on an intellectual level, comparable to that of the major theories in physics – did not prevent these establishments from falling into the “trap” of the subprime crisis. How was this possible?

In order to understand risk, a very simple notion, initiated by the bank JP Morgan at the beginning of 1990s and spreading to become the most used method until recently, was founded upon the threshold principle. The “*value at risk*” (VaR) represents the maximum loss that one has probability p ($= 0.95$ or 0.99) of not exceeding at a given due date. It therefore qualifies the limits of an area, outside of which one ignores whatever happens, but inside of which one stays with the probability p . It was realized that the *Value at Risk* criteria had a fault. It does not allow the correct estimation of risk on the merger of two portfolios knowing the risk on each of the two.

To alleviate this failing, and to better take into account what happens when the threshold is crossed, the *expected shortfall* was introduced, supplementing the VaR, and able to be calculated if one knows the law of loss probability. More generally, it was able to be shown that any risk criteria confirming the commonsensical rules expected is necessarily of a certain mathematical form. Such criteria are called *coherent risk measures*. These are used to estimate the value of debts, to buy or sell them on the market, and also to calculate the risk exposure of banking establishments, keeping in mind their complex portfolios.

These techniques of risk quantification favoured the *selling of risk on the market*, a process which received the name of *securitization*. If insurance companies, or banks, are to manage the risks in their field or region, which are correlated, and if these risks are independent from one company to another, or less correlated, they have an interest in trading risks. To establish a risk market, sellers and buyers need to be capable of quantifying risk, hence the interest in mathematization previously brought up. The idea of organizing reinsurance in a market where the participants are insurance companies, and where the goods traded are risks, was an “amazing” idea which had already been studied by Maurice Allais and Kenneth Arrow in the fifties. It is equally applicable between banks, to manage all their risk. In the Arrow model, each dealer has their own subjective probabilities. Considering the fact that these dealers have different risk measurements from one to another, as they interpret the underlying realities behind each asset in a different manner, and that moreover they have differing aversions to risk thanks to their differing functions and purposes and hence behave differently when faced with the uncertain, risk-for-payment trades were found to be of interest for both seller and buyer. Prices can be calculated under ideal conditions of modelling taking into account the information to which each dealer had access.

In this way, risk markets developed, accompanied by new derivative tools, with a stronger role given to opinion on the quality of files given by rating agencies. We will return to the debt market and securitization in chapter III-7, as it demonstrates specificities distancing it from the classical image of the market.

Let us however state right now that certain configurations of derivative credit products do not incite banks to prudence. In the case of the CDS (*Credit Default Swaps*), the most current type, a bank rids itself of counterparty risk on a debt or group of debts by transferring it to a buyer of risk against payment of a quarterly premium. The bank considers from then on that its credit is riskless and that it no longer has to weigh capital against this credit. From the other angle, the bank buying up risk, as long as the possible default remains unrealized, is remunerated for an invested capital of zero, which is the *nec plus ultra*, provided that all goes well. On the other hand, if there *is* a default, a significant sum will have to be paid by the buyer of risk, who then has an interest in aiding, through supplementary intermediaries, those borrowers having difficulty with repayments. We see that, by putting them on the market, a bank which is going to rid itself of its counterparty risk tends not to attach too much importance to the fine details of the circumstances surrounding the loan it grants, and contents itself with the standard evaluations provided by rating agencies.

However, most risks have a purely semantic and interpretative component which rests on a *reading* of the economy, and, for such risks, trusting in the assessment made by general opinion – as one does by putting them on the market – is a logical error, since *the majority* of dealers base their judgements on a prior mathematization, drawn from the evaluations of agencies, and therefore bring nothing to the general shortcomings in understanding. In other words, it only makes sense to put risk on the market in perfectly calibrated and statistically informed situations.

The market is poor at playing the role of *interpreting subject* in more doubtful cases. All its methods have the innate failing of considering the interpretative process as being closed. Yet on the contrary, far from being fixed, it is in a state of permanent emergence. As soon as a new interpretation appears, it engenders new risks perceived only by those who understand it. If in 2006 no-one saw the rising property prices and shrinking in household savings in the United States as a phenomenon open to various interpretations, the corresponding risk was not perceived. The mathematization of the risks eliminates these difficulties in hypotheses concerning the extremes of the laws of probability. It is not enough to say that these last are poorly understood. They are by nature provisional, fluctuating

according to the interpretative knowledge agents provide by their understanding of economic phenomena.

Practically perfect markets

In this vast adventure we have just traced, several traits must be stressed as carrying a deep significance for the evolution of society in the modern world.

The financial world is a gigantic international institution. It reaches extremes in its political and economic power, in the hypersophistication of the techniques it uses, and in the high level of intellectual capacity it demands, irrigated by university campuses. However, it is incapable of restraining this technical nature, of not agreeing wholeheartedly with the amplification of the role of mathematical tools. It behaves in this regard like any other technology, as philosophers have astutely noted; one could compare it to the nuclear industry, in that it constitutes a theoretical and practical world in itself, perfecting itself in the esotericism of a specific language composed solely of a group of aristocratic specialists sharing a single ideology. It is this which explains how, despite all these highly evolved systems, it continues to lurch from crisis to crisis, shaken as if by tectonic plates, because its mathematics can only create a normal, monistic science, incapable of making way for a plural interpretation of the world.

It is strongly self-referential. Financial practitioners concentrate, above all, on their screens. 'Risks', for the trader, means the activity of on-screen 'spots'. No need to go and see what is really happening in businesses, nor to make judgements on the impact of the innovations foreshadowed by prototypes, let alone to keep track of the global effects of progress, of pollution, or of the degradation of natural equilibria. This excessive self-reference is the trademark of the new neoliberal period; before, banks needed engineers to *understand* what was happening in industries and services, to know the potential impact of the projects to which they were providing credit. The financial world is a kind of technical agglomeration far from the real world of the *meanings* and motivations that weave a tapestry of relationships.

The essential point we have to underline here is that the financial markets are quasi-perfect markets.

They are highly imperfect from an economic point of view. They are incomplete, which means that, with reference to economic theory, the prices that they indicate only contain partial information. In the case of the debt and securitization market, we could even say that they function based on abridged information which only takes into account a fraction of what would be useful for a correct management of loans. However, they are perfect in that they are *fluid, instantaneous, and accompanied by auxiliary markets of all predictions imaginable*.

Whilst the markets in merchandise and labour are, for Cournot or Marx, somewhat hidden phenomena, which need explanation in order to be demonstrated, the financial markets really exist, and are a place where anyone can buy or sell whatever he or she desires, prices directly following supply and demand.

Except, and this is something we need to examine in more detail, they are not at all like the classical or neo-classical economists' conception of a market. They follow very strict laws, imposed by their very perfection – the *stochastic* laws.

For the left-wing mindset, the financial markets today represent the designated adversary, the source of all evils. The themes and slogans of Jean-Luc Mélenchon's campaign for the French presidential elections of 2012 clearly express this particular reading of the international scene, of European politics and of the behaviour of business leaders forced to cut jobs and lower social benefits.

In fact, denouncing the markets certainly does not have to mean taking a position in the slipstream of a tradition constructed in an apparently limitless world of manufacturing and consumption.

Today, we can no longer conceive of problems in the same way as before. In 1987, the Brundtland report, and five years later the Rio Earth Summit, opened the eyes of all of mankind to the gravity of environmental damage and the responsibility of leaving the planet in an appropriate state for our children and grandchildren. New paradigms appeared and have been collected under the ambiguous umbrella term of 'sustainable development'. Today, this new consciousness must be taken into account if we are to tackle the moral questions that arise naturally from any criticism of liberalism.

It is therefore necessary to return to the two faces of the socialist movement: the organization of production for the material well-being of the working classes and against the private income of the wealthy; and the ethical issue of greater justice throughout the world, following a humanist philosophy which takes precedence over religion, although this latter, in fact, has hardly lost its historical importance.

2. What is the ethical basis for the social pillar of sustainable development?

The Rio Conference was a milestone in the evolution of ideas on a global scale about the importance of environmental questions and the need for quick decisions. The main idea put forward at the summit, that development could be redirected so as to not harm the environment, and even that a real synergy could be found between the true, received unanimous agreement; a new path opened up and had to be taken. The Brundtland Report, to prepare for the Rio summit, reconciled ecologists and economists. The principle of sustainable development was designed along two axes: maintaining the balance between all the factors of quality of life, and an obligation to leave future generations a social, economic and environmental situation, with enough resources, that will allow them to enjoy a standard of living at least as high as ours. This philosophy is based on the three "pillars of sustainable development": the economic, reflecting an aim of growth and economic efficiency, the social, expressing that it should be based in human needs and thus that development should work towards social equity, and the environmental, emphasizing that sustainable development must care for the environment, preserving it and its resources for the future.

We will shortly give some snapshots from the balance sheet of what happened regarding the economy and the environment. But we first need to examine the evidence of the social aspect of sustainable development. Why did the Conference emphasize that the reference should be human, that the action should be based on the objective of equity, that balance and reconsideration of the North-South relations were needed? Some believed that it was a simple question of protocol, made necessary by the UN framework, where benevolent language was required to achieve the necessary consensus. History shows that humans scarcely know how to do anything other than fight each other, so these words were merely a form of politeness whose meaning would be forgotten.

And that is indeed what happened, albeit beyond all expectations. Facing environmental concerns, the selfishness of "everyone for himself economically" was amplified to an impressive extent. With a spontaneity and facility that was disconcerting on all levels, the burden of solidarity was dropped as an unnecessary encumbrance. This was also encouraged by the economic formulation of the desire for actions. The issue became a groundswell; it became *the big issue*: the social dimension of sustainable development. It cannot go unconsidered; one cannot pass it by without examining it.

What about left-wing values in this respect?

Socialism: a humanism of the productive world

If we focus on Marxism as one of the historic roots of socialism, it cannot be said to have come originally from an ethic of solidarity. On the contrary, it fought against religion (the "opium of the people") and all the great narratives – militant, positivist, Saint-Simonian, Fourierist, Proudhonian – as well as against social experimenters – Colins, Godin, Leroux, etc. Some of these currents wanted to inherit the social cement that religion gave; others saw science as the only common basis on which a social consensus could rebuild popular beliefs into a "religion of humanity". In contrast, Engels and Marx positioned themselves very clearly as atheist materialists only concerned by the clarity of economic forces and the role of human labour in the production of history.

Marx is Hegel's heir in some ways though not in others. He retains the dialectic of the conscience and of the desire and of that of the master and the slave, the role of man and of work: "The outstanding achievement of Hegel's *Phänomenologie* and of its final outcome, the dialectic of negativity as the moving and generating principle, is thus first that Hegel conceives the self-creation of man as a process, [...] that he thus grasps the essence of *labour* and comprehends objective man – true, because real man – as the outcome of man's *own*

labour."¹³ But, of course, Marx opposed the Berlin master's idealism "Hegel fell into the error of considering the real as the result of self-coordinating, self-absorbed, and spontaneously operating thought"¹⁴ and the failure of the abstract is what he reproaches all social philosophies that indulge in utopia for: "What Hegel has done for religion, law, etc., M. Proudhon seeks to do for political economy"¹⁵.

The relationship between the various streams of socialism in the 19th century and anticlericalism, the substitution of a form of brotherhood in place of religious faith, or the vision of science as the true basis for a glorious future, are complex and much more nuanced than the binary image generally held today¹⁶. Among these social and philosophical innovations, Marx's position avoided all appeal to morality, to empathy or to anything that could lead to a matrix of good and evil:

"Next comes the humanitarian school, which takes to heart the bad side of present-day production relations. It seeks, by way of easing its conscience, to palliate even if slightly the real contrasts; it sincerely deplors the distress of the proletariat, the unbridled competition of the bourgeois among themselves; it counsels the workers to be sober, to work hard and to have few children; it advises the bourgeois to put a judicious ardour into production. The whole theory of this school rests on interminable distinctions between theory and practice, between principles and results, between idea and application, between content and form, between essence and reality, between law and fact, between the good side and the bad side.

The philanthropic school is the humanitarian school carried to perfection. It denies the necessity of antagonism; it wants to turn all men into bourgeois; it wants to realize theory insofar as it is distinguished from practice and contains no antagonism. It goes without saying that, in theory, it is easy to disregard the contradictions that are met with at every moment in actual reality. This theory would therefore become idealized reality. The philanthropists, then, want to retain the categories which express bourgeois relations, without the antagonism which constitutes them and is inseparable from them. They think they are seriously fighting bourgeois practice, and they are more bourgeois than the others.

*Just as the economists are the scientific representatives of the bourgeois class, so the socialists and the communists are the theoreticians of the proletarian class. So long as the proletariat is not yet sufficiently developed to constitute itself as a class, and consequently so long as the very struggle of the proletariat with the bourgeoisie has not yet assumed a political character, and the productive forces are not yet sufficiently developed in the bosom of the bourgeoisie itself to enable us to catch a glimpse of the material conditions necessary for the emancipation of the proletariat and for the formation of a new society, these theoreticians are merely Utopians who, to meet the wants of the oppressed classes, improvise systems and go in search of a regenerating science. But in the measure that history moves forward, and with it the struggle of the proletariat assumes clearer outlines, they no longer need to seek science in their minds; they have only to take note of what is happening before their eyes and to become its mouthpiece. So long as they look for science and merely make systems, so long as they are at the beginning of the struggle, they see in poverty nothing but poverty, without seeing in it the revolutionary, subversive side, which will overthrow the old society."*¹⁷

As many commentators have observed, Marx cultivated a subtle position between that of a neutral observer, scientifically unassailable, and that of a militant engagement for a

¹³ Marx, *Manuscripts of 1844, Critique of the Hegelian Dialectic and Philosophy as a Whole*.

¹⁴ *Introduction to a Critique of Political Economy* 1857.

¹⁵ *The Poverty of Philosophy*, 1847.

¹⁶ Cf. M. Angenot *Les grands récits militants des XIXe et XXe siècles, religions de l'humanité et sciences de l'histoire*, L'Harmattan 2000.

¹⁷ *The Poverty of Philosophy*. Chap II The Method. Seventh and Last Observation.

specific cause. This is particularly clear in this splendid expression: "they have only to take note of what is happening before their eyes *and to become its mouthpiece*", which contains the germ of all the historic ambivalence of the Communist party's actions.

In fact, there is a strong ethical choice at the centre of the economic analysis proposed in *Das Kapital*. Marx believes that it is unfair to deny the worker the benefits of his work and that it is inevitable that, sooner or later, this will lead to an economic catastrophe in the world. It is thus essential to organize the economy to ensure a fair allocation of the worker's salary. But Marx wants to hide this humanism, one could even say that he represses it, in an economic argument showing the inevitable collapse of capitalism and hiding the *values* underlying this reading as much as possible.

In this critical argument, is Marx identifying the market as a key element of the deleterious device of exploitation of the proletariat ?

Marx and the market

The stock exchange had existed for a long time in Paris and London, but Marx did not put the financial markets the heart of the economy's dysfunction¹⁸. However, he often uses arguments about the mutual effect of supply and demand. He saw the responsiveness of prices to supply and demand, like most economists who at this time were between the classical and neo-classical views, as a governing principle in all things, and not as a detailed mathematical law.

He saw this "law" operating slowly through a change in the decisions that are made, for example when the supply of one commodity decreases, capital will irrigate one sector less: "Except in the case of a branch of industry which has become obsolete and is therefore doomed to disappear, the production of such a commodity (that is, its supply), will, owing to this flight of capital, continue to decrease until it corresponds to the demand, and the price of the commodity rises again to the level of its cost of production; or, rather, until the supply has fallen below the demand and its price has risen above its cost of production, for the current price of a commodity is always either above or below its cost of production."¹⁹

Marx does not see the dynamic interplay of these changes as an evolution similar to that of a damped spring that oscillates towards an equilibrium, but as being made of irregular movements; the price of one commodity can go above or below the cost of production. "But it is precisely these fluctuations which, viewed more closely, carry the most frightful devastation in their train, and, like an earthquake, cause bourgeois society to shake to its very foundations – it is precisely these fluctuations that force the price to conform to the cost of production. In the totality of this disorderly movement is to be found its order. In the total course of this industrial anarchy, in this circular movement, competition balances, as it were, the one extravagance by the other."²⁰

This also applies to the price of labour. For Marx, those who offer their labour, the workers, also have their production costs, to feed their family, to learn and train, etc. And the adjustment is made also by disruptions such as those caused by industrial disputes or other changes.

Clearly for Marx the fluctuations in the market are mechanically due to variations in supply and demand but these do not explain the actual prices reached for a given level of goods. "You would be altogether mistaken in fancying that the value of labour or any other

¹⁸ We even know, from a few lines in a letter addressed to Lion Philips on June 25th, 1864, that Marx had dabbled on the stock exchange "I won £400 in this way and I will start again when the confusing political situation opens a new field of action. This way of working does not take much time and it is worth taking some risks to extract money from one's enemies." *Marx et Engels, Correspondance (1862-1864)* volume VII, Ed. Sociales 1979.

¹⁹ *Wage Labour and Capital. By what is the price of a commodity determined?* (1847).

²⁰ *ibid.*

commodity whatever is ultimately fixed by supply and demand. Supply and demand regulate nothing but the temporary fluctuations of market prices. They will explain to you why the market price of a commodity rises above or sinks below its value, but they can never account for the value itself."

Like many economists, Marx thought that behind the oscillations in the market there were some "underlying" fundamentals, which could be determined, not only in the large, as one might get an idea of the climate of a region based on its daily weather, but with precision. For that he relies – repeatedly – on a logical argument about the case where supply matches demand, such as if there are ten houses for sale and exactly ten buyers. Marx replies that the sellers cannot sell for less than the cost of production and that this cost will therefore be the price. "Suppose supply and demand to equilibrate, or, as the economists call it, to cover each other. Why, the very moment these opposite forces become equal they paralyze each other, and cease to work in the one or other direction. At the moment when supply and demand equilibrate each other, and therefore cease to act, the market price of a commodity coincides with its real value, with the standard price round which its market prices oscillate"²¹. Or again, "it must be borne in mind that, despite the fluctuations in the prices of commodities, the average price of every commodity, the proportion in which it exchanges for other commodities, is determined by its cost of production"²².

We see that Marx understood the market of goods and work in a very different way to the way we understand financial markets today. He thinks that when supply and demand reach a state of permanence and equilibrium, then the value is visible and there will be no further oscillations. One has found the true value. This is what most economists of the time thought. Even today liberal doctrine believes that free trade works with real markets, which are variants, due to various discrepancies, of pure markets which would give the true economic values of which they are approximations. This is not at all what happens on the finance markets, which are the purest realization of the concept of a market. One never knows if the "underlying trend" is flat, rising or falling, that cannot be seen objectively, the only true value is the spot price and this is inevitably volatile. So to precisely quantify the underlying prices of the "real" economy is highly problematic. We will, of course, come back to this.

The famous notion of surplus value is based on this analysis, the prices of goods being in reality above the cost of production thanks to the fact that wages are kept low by unemployment. Marx then explains, over many pages of careful reasoning, how this leads to the *accumulation* of capital.

The fact that Marx's analysis of capitalism is very relevant and is confirmed by some very recent events in the process of wealth-accumulation, is rather a hindrance to turning political concerns towards problems other than those of the production of objects for consumption. This is a situation that causes a real obstacle to change in the current political life of western countries. Because the struggle between employers and trade unions is *obviously not a zero-sum game*, the two camps both benefit when there is growth. The fight is not to decide a fair division of the benefits given by society to one or other, within the framework of constraints on resources and environment, imposed by the finiteness of the world. Managers and employees agree that when there is strong growth, the dialogue is easier for the two sides at the negotiating table. Also socialists in general and left-wing parties, except for the Greens, are in favour of promoting growth whether by public investment, reducing interest rates, or by any other means of *recovery*. The Greens advocate alternative energy and green development rather than directly arguing for the decrease which is currently

²¹ *Value, Price and Profit. Chap IV supply and Demand* 1865.

²² *Wage Labour and Capital. The General Law that Determines the Rise and Fall of Wages and Profits* (1847).

inaudible. There is growing criticism of the market today, in that its technical excesses are contrary to the good operation of the economy, especially with Keynesians, who see competition as creating instabilities that need regulatory action by public powers. Environmentalists find support in Keynes's complaints about speculators who interfere with an appropriate distribution of funds, in that those speculators do nothing to help achieve the changes needed to deal with long-term concerns.

One could say that the aim of pure universal solidarity, which existed at the start of social philosophies and of socialism, has found itself so insignificant in the balance of power and collective organizations in historic struggles, that its trail is left to others, to charities, humanitarian NGOs, etc. and that it will take a long time to be revived to carry some new effectiveness.

Let us return, then, to the three pillars of the Earth Summit. What conclusions can we draw and what is that famous social aspect?

The path outlined at Rio has not been followed

The ideas of sustainable development were based on numerous studies. We relied a) on a decrease in the *energy intensity* in the countries of the North, i.e., of the energy necessary for the production of one unit of GDP, by an improvement in the yields of machines, a reduction in waste and the use of raw materials that needed less energy. b) It was thought that developing countries would be able to use new technologies whose energy efficiency would be similar to that of the most recent discoveries. c) A virtuous expectation that would make renewable energy quickly profitable was forecast.

These studies only aimed to show feasibility. But the correlation between the development trajectory of a country and its energy consumption was underestimated, whereas it is actually very strong.

Indeed, the situation of the Third World has been dominated by a violence increased by economic forces. Vernacular economies in competition with global demand in a global market are weakened, and the intense exploitation of the soils and subsoils has not benefited human development in these countries. Pollution has grown and urban life has deteriorated. Today we see that the peasants of the Third World have fewer choices; if they are to survive they cannot also protect the environment.

Within the principle of sustainable development, there was the idea that conflicts of interests or opinions about risks, damage and pollution would be handled with public debate and precaution. This represented a serious change from the one-track thinking of western civilization. It was a much more revolutionary aim than the talk of balance and synergy would lead one to think. It admitted, ultimately, that there was a need for political management of the diversity of the socio-natural realms, and for a new form of coexistence. Yet neither behaviours nor the economic principles have really changed, they are still dominated by consumption and technology.

Instead, in twenty years, the consensus about competition has strengthened. The difficulty in balancing the natural pregnancy of economic logic has not been calculated. The obstacle lies in the funds necessary for the redirection towards a more proactive and united international cooperation.

The absence of distant solidarity

It was widely believed, in the West, that the economy was an activity of relation and interest that could serve as a basic principle to promote coexistence. It was this basis that John Dewey used as the foundation for democracy in a country, the US at the start of the 20th century, that was segmented by languages, by race, by the most diverse immigrant religions,

adding, however, the importance of education²³. The same idea is used today for liberal globalization. It appears to many political scientists and sociologists as a means of opening up, a way of using the practical convenience of manufactured objects to enter into daily life and, thus, to open up behaviours that are otherwise governed by immovable religious rules. This is undeniable, and it is even likely that it is one of the approaches that could actually, in time, change the place of women in traditional societies – and thus influence demographic trends – especially if one considers the length and difficulty of establishing legitimate international bodies to act for global aims²⁴.

When it concerns not only objects but services and media, the effect can be faster but this rapidity causes more clashes with deeply held religious reference points. The 19th century atheism and anticlericalism of Schopenhauer, Marx, Comte, Mill, Proudhon, Renan, etc. established a new political legitimacy of secular life. Then, in the 20th century, Max Weber and the philosophers (Heidegger, Habermas, Jaspers, Jonas, Ellul, etc.) insisted on the strength of *disenchantment* and were worried by the invasive and uncontrolled power of technology. But what do we see today? Beliefs are stronger than ever. Everyone balances, every day, between an individualism conforming to the models of economic theory and a strengthening of the links with a local community sharing our feelings. Humanity finds the physical limits of our objective material condition. One hesitates to think that these limits are absolutely final. They are present in our minds, but simply felt as an increased difficulty in managing our life as before.

Among the competing interests on the global environment, what is lacking is solidarity, and the globalized economy does not provide this. Instead it is an apprenticeship in individualism where there was little before.

Solidarity has never been very strong; it has never played a decisive role in history, of course. The new fact is that it is dormant also at the level of ideas, those philosophies, doctrines and wisdoms, which gave it the right to speak, have been gradually silenced. And this has not come from an adherence to a different vision. Nobody really believes in Nietzsche's superhuman fantasies or the transhumanists they inspired. What interests us in Nietzsche is his contribution to the formation of ideas, how the pursuit of this quest led him to relativism of knowledge and to see the world as an infinity of interpretations. The end of his life, where the will to power resembled the visions of President Schreber²⁵ and recalled the perverse empathy that dictatorships rely on, was a morbid delusion that sends chills up the spine.

Solidarity has withered when we most need it to give an operational structure. This is the real disaster of our time; everything revolves around this problem. We discard the efforts of philosophers to make man something other than a generality, and we build a "we", small, pretentious and cruel.

What is solidarity now? Is there any left? Without repeating the genesis of this fragile idea – to keep things simple – let's say that it is still alive today

a) in some left-wing thinking, which is not based solely in balances of power and is not ashamed of its altruistic ethical basis,

b) in the universalism of Christianity, which is only one part of that body of beliefs,

²³ Dewey J., *Democracy and Education* 1916.

²⁴ About the obstacles the traditions and religions pose to political dialogue, see Latour B., Gagliardi P., eds, *Les atmosphères de la politique, dialogue pour un monde commun*, Les empêcheurs de penser en rond 2006. See also Paul Heelas et al. *Detraditionalization* Blackwell 1996.

²⁵ D. P. Schreber (1842-1911), a German judge affected by paranoia, who had described his own delirium in a book used by Freud as the foundation for his psychoanalytic interpretation of paranoia.

c) in the ecological vision of mankind at the heart of the biosphere. That is to say, the idea that man is not the philosophical reference point as the victorious species in a competition that picks out those humans who will continue this selection without mercy, but as one of the expressions of what this sphere of life can allow in the constraints and interrelations which characterize it and which increasingly show it to be hugely fragile.

We have already discussed this first point. The second deserves clarification. It is possible that man needs religion like he needs sunlight, that it is a characteristic of his emotional configuration, *pace* Freud, to have a sentimental and social bond which relieves him of his guilt and of his moral distress at his own desires and actions. But this religious dimension, which resembles an exchange, which speaks of redemption, of a benevolent god, of god's love, which establishes a warmth among the faithful alone, this religion-comfort only tends to strengthen the status quo. Universalism is a social project. *Distant solidarity* can only be based on ecology, i.e., a view of man with the other living species in a system, sensitive and fragile, linked to time scales that the economy does not understand. The adventure of technological progress does not, in itself, work towards solidarity.

I do not say that it will be easy to establish distant solidarity. Certainly not, we will see in the last chapter. I think instead that people in distress and in growing misery are brought to live by their wits and that this makes the young more receptive to ideologies of courage and of unwavering dedication, so that they are easily exploited by networks of extremist ideologues, totalitarianists or mafioso.

Where is the economy in all this? Here is the question that really concerns us. It appears as a dissimulation device. It hides its intentions, its responsibilities, the damage it does to the environment. In this book we discuss one of the reasons for this dissimulation, linked to the formation of market prices, which has a major role at the level of major global issues. But similar phenomena concern other aspects, in particular the organization of credit, etc. We have chosen to focus on one single point, *because it is insoluble*. Capitalism, as sociologists have often noted, is extraordinarily adaptable. Criticisms of it often help it change its practices, as is relatively easy, the rules which it follows being fundamentally just provisional pragmatic conventions between interests recognized as such and thus adaptable through negotiation. But "the teeth of the market" are the market itself in its intrinsic logic. The problem raised in this book is so constitutive that it escapes all reform. No rule intended to settle capitalism down, or make it moral, can be sufficient. Why insist on a question currently without solution? Because, as a mathematician, I know that it is the most difficult problems that produce the really new ideas.

II) Collective blindness comes from the economy

When the Club of Rome's first report appeared in 1972, there was already an acute awareness of the problem of governance of technology. War, the arms industry, extermination camps and the Hiroshima and Nagasaki bombs had all shocked minds, like uncontrolled outbursts of barbarian impulses. Faced with such extremities, philosophers contemplated the weakness and fallibility of the quest for philosophical wisdom, and averred that the dangerous toys of science were fostering mankind's foolhardiness. Heidegger saw the technological system (Gestell) as imposing itself through its own insidious logic, imperilling civilization (*Essays and Conferences* 1954). Karl Jaspers abandoned his wise professorial restraint for a violent appeal to reason against nuclear technology (*The Atom Bomb and the Future of Mankind*, 1963). A number of thinkers engaged in a critical analysis of the technological adventure and its uncontrollable consequences on social organization and the environment. Among these was Jacques Ellul (*The Technological Society*, 1954).

In parallel with the philosophers, scholars developed their understanding of the relationships between physics and living beings, notably making the rather surprising discovery that the great issue of explaining the apparent gap between inert matter governed by the law of increasing entropy and living beings capable of stockpiling information, a duality which had long been a major dilemma for the moralists, found a simple resolution in the concept of the *open system* as shown in the works of Ilya Prigogine (*Thermodynamic Theory of Structure, Stability and Fluctuations*, with P. Grandsorff, 1971), which underlined the importance of *flux* (of energy and of matter). Some were already calling attention to the failings of the current body of economic theory in view of the breadth of the problems with which it concerned itself. Nicholas Georgescu-Roegen stated that the economy would never manage to seize the historicity of economic changes (*The Entropy Law and the Economic Process*, 1971), and bases his argument on the finite nature of the planet as a battleground against the laws of entropy as they relate to pollution.

No sooner had the Rome report appeared than Dennis Gabor, physicist, Nobel Prize winner, and member of the Club, raised the problem of the governability of technology given the democratic and liberal structure of Western societies (*The Mature Society*, 1972). In France, René Dumont pitched his candidature for presidency of the Republic (1974) around the theme, "What world will we be leaving to our children?"

The reception of the Club of Rome's report was highly negative among economists on both the right and the left, and it was nearly accused of sparking the petroleum embargo decided upon by the member countries of the OPEC in 1973, which brought on a heavy recession. The term 'Malthusianism' was used in a pejorative manner towards these views,²⁶ and the theorists behind them were criticized for not practising real economics, not taking into account prices which, thanks to their regulatory role, would modify these forecasts.²⁷ Democrat Jimmy Carter was aware of this global crisis, and had the courage to broach it: "The symptoms of this crisis of the American spirit are all around us. For the first time in the history of our country a majority of our people believe that the next 5 years will be worse than the past 5 years. Two-thirds of our people do not even vote. The productivity of American workers is actually dropping, and the willingness of Americans to save for the future has fallen below that of all other people in the Western world".²⁸ He lost the 1981 elections, and

²⁶ Let us make the point that Malthus does not tackle the issue of the ultimate limit of resources; for him, the problem is that resources grow linearly and populations exponentially.

²⁷ For example, W. Nordhaus in two articles in 1973 and 1974 criticised the works of the Club of Rome as purely "theoretical" and puts himself back in real economic logic by carrying out neo-classical calculations on the prices of exhaustible resources, in the tradition of Hotelling.

²⁸ 20 July, 1979.

his successor, the republican Ronald Reagan, saw the crisis as temporary, like all economic crises, and undertook a vast program of deregulation, following the example of Margaret Thatcher in the United Kingdom, in order to create more competition and suppress monopoly positions. This policy, coinciding with the historical boom of the financial markets and the expansion of international commerce, marked the beginning of the neoliberal period in which we find ourselves still.

However, public opinion was gradually swayed by the breadth of damage caused by material imprudence; the series of technological catastrophes seemed unstoppable: the Torrey-Canyon shipwreck (oil spill) in 1967, the Amoco Cadiz shipwreck (oil spill) in 1978, the Three Mile Island accident (nuclear) in 1979, the Seveso accident (dioxine) in 1976, the accident in Bhopal, India (pesticides) in 1984, the Chernobyl catastrophe²⁹ (nuclear) in 1986, the Pepcon accident (explosion) in Nevada, 1988, the Aznalcollar mining incident (pollutants) in Spain 1998, the Erika shipwreck (oil spill) in 1999, the Ievoli Sun shipwreck (pollutants) in 2000, the AZF factory incident (explosion) in Toulouse, 2001, the Prestige shipwreck (oil spill) in 2002, the Tasman Spirit shipwreck (oil spill) in 2003, the Probo Koala affair, Abidjan (toxic waste dump) in 2006, etc.

Ulrich Beck showed that our society is constructed in such a manner that it produces risks affecting more than just the creators of the initiatives. There are two major sources of *faits accomplis*: industrial innovation within the framework of the liberal economy, and science itself, in the current functioning of research (*Risiko Gesellschaft: Auf dem Weg in eine andere Moderne*, 1986). Moreover, science does not have an exclusive claim to reason. Science is implicated through the patent system (the GMO problem). It is essential to be able to defer decisions releasing discoveries to commerce when science has still not explored the consequences of these innovations. The principle of precaution is contested, and French economists are mostly in opposition to it; nonetheless, it was written into the French Constitution in February 2005.

²⁹ The Chernobyl cloud, thanks to its meteorological circumstances, demonstrated to the world the global nature of the damage and risks involved.

1. Finitude

In addition to issues of technology, the question of the *finite nature* of mankind's estate is steadily becoming an issue of public awareness and the focus of debates both philosophical and political.

In his remarkable work, cited above, Georgescu-Roegen listed several fundamental problems from a scientific point of view, notable among which is the eponymous issue of entropy – the question of dispersion. We can recycle telephones and used cars, recovering the materials by careful handling, notably by favouring an economy of functionality in which goods are not sold but merely lent for use, but ordinary pollution disperses, coins erode and we cannot recover the metal. The scale of time over which biological processes have created sediments, rocks and mineral veins is beyond human horizons. This question of entropy is real and incontestable. However, it is not this that is seizing humanity by the throat. It will become one of the chains constraining us, but later. For now, the problem is exponential growth coming into collision with the limits of material magnitudes.

When Nicholas Georgescu-Roegen wrote *The Entropy Law and the Economic Process* in 1971, we were approaching, though had not yet reached, the end of a long period spanning roughly a century in which we were wondering how living beings seemed to be governed by laws different to those of inanimate material.

This began towards the end of the Third Republic in France, when Claude Bernard described his method for approaching living beings as a physicist. It was noticed that animals and plants are often composed of dissymmetrical molecules (stereochemistry) which are not to be found in the mineral world. Distinctions were made between chaotic complexity and organized complexity, and attempts were made to incorporate statistical determinism (Boltzmann, Gibbs) and quantum indeterminism (Bohr, de Broglie, Heisenberg, Dirac, Fermi, etc.), the improbability of the appearance of living organisms (Charles Eugène Guye, *Physico-chemical evolution*, 1947) which contradicted the laws of thermodynamics thanks to some specific faculty, a kind of intelligence (Brillouin's negentropy) or vital spirit (Bergson, *Creative Evolution*, 1907), in which humanity would have a specific place (Teilhard de Chardin, *The human phenomenon*, 1955). From the date of Boltzmann's formula on the probabilistic interpretation of entropy (1875) until about 1975, there was heavy pressure for research to explain the specific nature of living beings, a specificity which would explain why they were not dragged down by the phenomena of degradation or increasing entropy, conforming to the second principle of thermodynamics. Many religious people throughout this period sided with a specificity of life making it incommensurable with inert matter. We are still very strongly marked by this dualistic mentality which constituted the accepted framework in the time of our parents and grand-parents.

This great question, however, found itself resolved by the study of open systems in the 1970s, to which the name of Ilya Prigogine is notably attached. Living systems in no way breach physical laws, but are simply systems outside of the equilibrium subject to material and energetic flux; moreover, they have the property of being reproductive open systems, thanks to the interplay of a macro-molecule with a double-helix structure – DNA.³⁰ A simple response, which drew acceptance less from Prigogine's calculations on fluctuations outside of equilibrium than from numerous examples of open systems possessing curious properties similar to living beings although formed of inert material.

The result was a different way of viewing the problem. The specific properties of self-organization found in a living organism are not due to a particular gift or faculty inherent to it and allowing it to develop infinitely (against entropy); they are absolutely dependent upon

³⁰ whose central role had been detected before the epistemological breakthrough (Cf. E. Schrödinger *What is life?*, McMillan 1946).

energy flux and therefore upon the sun sustaining the planet. We also know that violent radiation destroys molecules, and that we therefore depend upon a narrow range of conditions. The notion of *ecological footprint* is an overly-simplistic expression of these constraints. This also shows the artificial and risky nature of nuclear power, a source of violent radiation weakened only by the very specific circumstances of the terrestrial atmosphere and ionosphere.

Whilst finitude is obvious to certain scientific minds, who refer once again to Aristotle, it remains unthinkable for liberal economists, who see in it nothing more than a crude strategy for the installation of a policy of planned economy. The term 'limit' is argued over. Old mathematical debates are revived, on the subject of actual infinity, potential infinity, Kronecker's finitism against Cantor's transfinite. What should we make of it all? Mathematicians have many concepts; we say 'finite' for the expressed magnitude of a real number, 'bounded' for a region coverable by zooming out to view the neighbourhood of a point, etc. Another fundamental mathematical notion is that of a *compact* set, whose definition is more subtle but in simple cases means *closed and bounded*, that is to say, limited and including its boundaries. Environmental finitude means that usable space is limited and available energy finite (stocks are finite and the flux is finite). It insists on the fact that problems cannot be thought of simply as a pack of equations "floating in the air". Symbolic representations make no sense if we do not specify the *boundary conditions*, especially in economics where this is generally not done, either because they are not known, because they are thought not to influence reasoning, or because it is thought that some invisible hand will take care of them.

These considerations, however, do not prevent humans from being able to carry out activities lacking in intrinsic limits if these are unrestricted by the limits of their material realizations. It was this that the Club of Rome itself aimed to underline in writing *No Limits to Learning*, 1979³¹, in which it insisted upon the crucial importance of education for limiting population growth. In fact, this epistemological non-finitude extends to all categories of knowledge or practices of a combinatory nature. It thus concerns language, literature, philosophy, chemistry and medicine (molecularly combinatorics), information technology (formally combinatorics), mathematics via its contemporary representation in the language of formal logic, and therefore also the sciences which concern both language and mathematics.

These clarifications being made, the general realization as shown by the Club concerns the approaching end to all activity of conquest on this planet. When the most up-to-date version of the report made by the MIT Meadows team (*Limits to Growth: the 30-year update*, 2004) appeared, an enormous body of work confirmed this preoccupation with limits to growth and even to economic decline, among which must first be cited the IPCC, an epidemic of associations and NGOs, and numerous independent or affiliated authors: Lester Brown, Jared Diamond, André Gorz, Jean-Pierre Dupuy, Amartya Sen, Nicholas Stern, Will Steffen,³² Tim Jackson, plus the political parties and a myriad of lesser-known authors who have entered into the debate via the invention of new economic possibilities.³³

³¹ *No Limits to Learning: Bridging the Human Gap*, J. W. Bodkin, Pergamon Press 1980.

³² whose team working for the Climate Change Institute at the Australian National University published the important *Global Change and the Earth System, a Planet under Pressure*, Springer 2004.

³³ Replying to a highly pertinent point from Georgescu-Roegen: "One may think then that the first task of economics is to establish some general criteria for classifying all known economic systems into genera, species, and varieties. Unfortunately, our economic knowledge in this direction is so little that even an economic Linnaeus would not be able to design a system of classification." *The Entropy Law and the Economic Process*, Harvard Univ. Press, 1971, p330.

Limits to growth

Let us examine in more detail this collective work from the Club of Rome. Such an examination is highly important to an understanding – which is our goal in this work – of why this modelling has had so little effect until today.

At the time of the report in 1972, most economists, and many industrialists and politicians, saw it as an aberration that there could be limits to growth. But subsequently this idea, based on solid foundations, has carved out a path. Today, we have been able to see that the 1972 report has conformed closely to the events that unfolded over the next thirty years.³⁴ The first report was reworked a few years ago in order to better take into account certain interactions and more accurate and recent data. The variety of different potential futures identified and the quality of the commentary lend this study a certain force. Currently, the reproaches made towards the team centre more around the fact that these scenarios were not assessed in *dollars*, and therefore could not serve as a basis for any economic prospective, as other integrated models do. It was a voluntary choice of the modelling. As the authors explain, they considered that it was not clear that one currency could be a reliable unit of measurement for conceptualizing the future, especially if one wants to be able to envisage economic decline. Firstly, because currencies fluctuate in relation to each other over time, and secondly, because to calculate today what the “national accounts” will be for the whole world come 2050, using as a unit the current value of the dollar, is a highly risky enterprise, upon which economists disagree even amongst themselves.

The balance-sheets established by the Meadows team are relatively independent from subjective economic interpretations, by virtue of being based on calculations of quantity, energy received from the Sun, cultivable areas, population, etc., leading the authors to express themselves in terms of specific indicators which they describe quite clearly, these being “human welfare” and “ecological footprint”. The general conclusion is that without a highly vigilant collective policy, we will always arrive at an “overshoot-collapse” pattern – that is to say, excessive growth followed by a large subsidence. The major question, prudently left unasked by these authors, is what happens after these collapses.

Let us now explore several scenarios presented by the Meadows team, all following the *overshoot-collapse* pattern.

1) Society continues on a traditional trajectory as far as is possible without major political changes in comparison to the 20th century. The lack of investment in goods and services other than non-renewable energies causes a decline in production and leads to decreases in nutrition and health.

2) Allocations to renewable resources are doubled and improved extraction of primary materials (gaining an extra twenty years) is assumed. The population levels off at 8 billion in 2040 then shrinks, thanks to pollution and a decrease in cultivated surface area.

3) Stricter control of pollution achieves a reduction of 4% per year. The profile follows the same path, extended over a longer period of time; food production ends up insufficient.

4) A host of technologies are thought up, significantly increasing agricultural yield per hectare. The quantity of agricultural land diminishes nonetheless, and the regime cannot sustain itself.

5) Techniques to preserve agricultural land, by limiting the extension of urban areas, are applied; this postpones the collapse to the end of the 21st century.

³⁴ Cf. G. M. Turner "A Comparison of *The Limits to Growth* with 30 years of Reality" *Global Environmental Change* 18 (2008) 397-411.

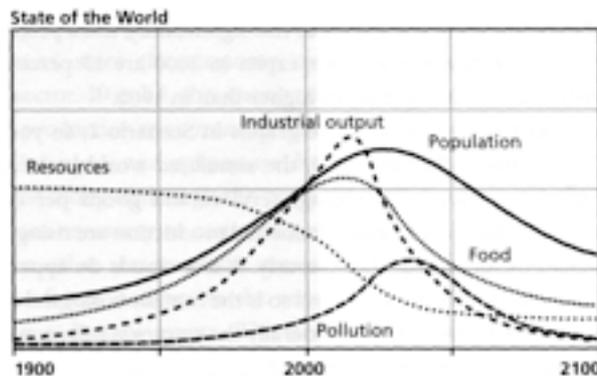
6) Stress is placed on new technologies to reduce pollution, increase agricultural yield, preserve cultivatable land, and also economize non-renewable resources. Too high an increase in the cost of these technologies renders them unworkable.

These scenarios are just illustrations. The principal thesis, well demonstrated, is very simple: surface area and available energy are finite, indefinite growth is impossible, and current exponential growth, whatever the sector of activity in question, leads to a population collapse and a peak in pollution.³⁵ The authors take care to stress that their modelling can only be completely indicative after the moment the summit is reached: "we do not describe the behaviour of any model element after the point where one significant factor has started to collapse. Clearly a collapse of population or industry in the "real world" would change many important relationships and thereby invalidate many of the assumptions we have built in the model" (p153). The "comedown" details, after the period of exponential consumption of available resources, is where these works are notably silent. Policy must take over and imagine the plurality of eventualities. Let us stress that the prospective analyses carried out by this team do not take into account *biodiversity* as such, and that the economy they model *has no military sector*.

The inertia of the economic supertanker is enormous. Private or public agents are only replaced at the rhythm of recruitment and retirement; everything involving good management, competence, performance, and methods of evaluation is currently difficult to change.³⁶

The models

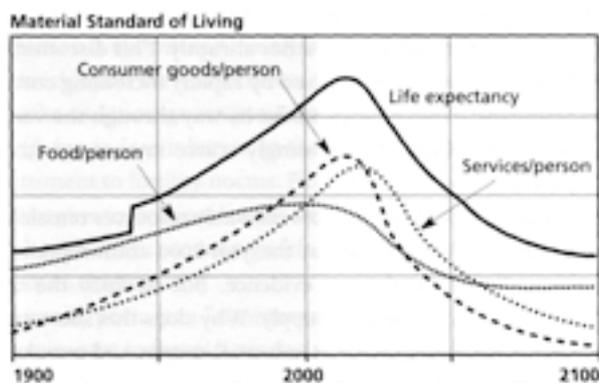
The results obtained for the first scenario have the following shape. As we have mentioned, figures in dollars are nowhere to be seen.



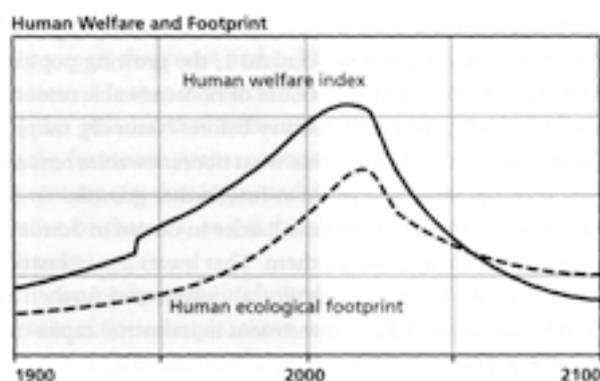
scenario 1

³⁵ We must "cut the bump with a tunnel", an image taken up again under the term "energy tunnel" in the press and association sites, cf. on this point and on sociology and the "off" debates of the Party Conferences, A. Dahan "Entre Poznan et Copenhague : le régime climatique au milieu du gué" *Natures Sciences Sociétés* 17, 2009.

³⁶ Statisticians do not want to modify their time series: the INSEE's *Tables of the French Economy* dedicated in its 2008 edition two out of 88 articles to the environment. Changes in indicators take time to be updated, cf. Bovar, O., et al. "Les indicateurs de développement durable" INSEE 2008 and the report <http://www.stiglitz-senfitoussi.fr> de septembre 2009.



scenario1



scenario1

The other scenarios are similar.

I draw the reader's attention to one essential point: *the curves are smooth*. We get the impression that they are regular, differentiable functions. They have in fact been created by mathematical equations which provide regular solutions. This is normal, given the objectives of such a model to represent real quantities and to show evolutionary trends. What does 'real quantities' mean here? It means aggregates which have been simplified to make them more meaningful and to resemble management tools; for example, 'industrial production', 'resources', 'population', 'pollution', 'food'. What is of interest to us in such models is the logic of quantities which influence each other.

Causes of the neoliberal turning point

The first report from the Club of Rome was in 1972; the Berlin Wall fell in 1989. The years from 1980 to 1990 mark the beginning of what is customarily called the 'neoliberal' period, with the first consequences of the deregulation policies in Britain and in the United States, the globalization of trade on a worldwide level, and the creation of organized financial markets as discussed in the first chapter of this work.

It is vital not to underestimate the importance of this turning point if we want to shed light on some of the difficulties in which we find ourselves today. During the Cold War, there was already an acute awareness of environmental problems, and even before the Club of Rome and the Stockholm conference on humanity and the environment in June 1972, authors such as René Dumont,³⁷ Jacques Ellul,³⁸ Gunnar Myrdal³⁹ in Europe, Barry Commoner⁴⁰ and

³⁷ Candidate for the presidential election in France in 1974, on the theme "For another civilization: What Earth will we leave to our children? Indefinite growth is impossible", and author of a score of books on the protection of the environment.

³⁸ *Le système technicien* Calman-Lévy 1977.

³⁹ *The Challenge of World Poverty, a World Anti-Poverty Program in Outline*, Pantheon 1970.

Nicholas Georgescu-Roegen⁴¹ in the United States, to cite but a few,⁴² had arrived at the unambiguous conclusion that technological and economic development could not continue as it was. The issues of pollution, of the polluter-payer principle, of externalities and how to attribute a value to “common goods”, had already been raised. Moreover, the direct responsibility of profit and economic competition in the exploitation of exhaustible natural resources was absolutely clear, and explicitly alluded to. Commoner wrote in 1968, “no economic system can be regarded as stable if its operation strongly violates the principles of ecology. To what extent is this true of the present economic system? In the case of the private enterprise system, this question has already been answered in part, for there does seem to be a tendency for that system to enhance productivity — and therefore profit — by means of technologies that also intensify environmental stress. A more theoretical basis for the incompatibility between the private enterprise system and the ecosystem relates to the matter of growth”. This biologist had already realized a profound incompatibility, seemingly somewhat overlooked today, which is that ecosystems have different rhythms from one to another: “the natural turnover rate of a soil system is considerably lower than the intrinsic rate of an aquatic system (e.g. fish farm).” As a result, businesses based on one or the other will not have the same rate of yield, and in the competition of the market, the rapid cycle will prevail over the slow cycle: “an enterprise which is based on an ecosystem with a relatively slow turnover rate is *necessarily* economically “marginal” – if it is to operate without degrading the environment. Such enterprises are of obvious *social* value, but, given the profit-maximizing tendency of the private enterprise system, are not likely to be operated for long”⁴³.

All the ecological ideas were already present, just with less factual data on disquieting damage. However, the Cold War, and materialist and productivity-oriented competition between the two blocs, prevented any transformative policy regarding environmentally friendly technology on a large scale, for fear of being overtaken by the other bloc. Ecologists’ propositions were not well received by policy-makers, as they were read as arguments aiming to clandestinely benefit the other side. Progress, under these conditions, was impossible. The *negative* reception of the Club of Rome’s 1972 report was largely due to such interpretations.

After the surprising end of the USSR, unarguably due to the lucid and independent personality of Mikhail Gorbachev, this geopolitical issue disappeared, and it would be reasonable to expect that ecologists’ arguments would gain gradual acceptance. The situation was virtually unique in history: the very real dominance of a single country, whose academic and scientific world was the most advanced globally, and which therefore had all it needed to act as a responsible leader in this field, for the constitution of a *Mature Society*, to use the title of Dennis Gabor’s work.

However, this is not at all what happened. On the contrary, competition was exacerbated in the West and extended to the rest of the world, as if the most important concern was to preserve the system of free trade and even revive it, rather than seriously consider the exhaustion of resources and the finite nature of the planet. It seemed that, the adversary being defeated, it was necessary to find replacements to continue the fight.

⁴⁰ *Science and survival* Viking Press 1963 and especially *The Closing Circle, Nature, Man and Technology*, Knopf 1968.

⁴¹ *The Entropy Law and the Economic Process*, Harvard Univ. Press 1971.

⁴² Let us also mention the collective works organised by Urban G. R. *Can we Survive Our Future?* St. Martin’s Press, 1972

⁴³ Commoner B. *op. cit.*

Suddenly, twenty years later, superpowers such as China, Brazil and India have been thrust into the same race, a race we no longer know how to stop.⁴⁴

The environment is seen as a battlefield.

⁴⁴ The world's savings now come from developing countries which, by their placement among the richer countries, accentuate the pressures of production-consumption.

2. Individualist collapse

As soon a money-related crisis comes about, those in control of our society immediately take action. The subprime crisis triggered a media circus surrounding systemic risk – a type of risk known in principle for some time, but which financial establishments had never seriously studied, despite their considerable means. In rapid succession, the public was alarmed, the governments helped the banks back to their feet, and the main fires were quickly extinguished. State debts became worrying, and the subject of constant discussions.

The situation is very different for climate change. For over twenty years now, we have been aware of the upheavals awaiting us, scientists have examined the issue from all angles, and nothing has been done. As for the crisis of resources and growth limits, its simple arithmetic is well-known, but all turn a deaf ear to the issue.

Regarding these upcoming crises, state and business interests run contrary to the general interest. Logically, we are talking about a no-sum game involving divergent interests, of the ‘prisoner’s dilemma’ variety.⁴⁵

Where the climate is involved, international negotiations make no real progress. Proposed actions are suspected by some to be inequitable for historical reasons, and by others to be ineffective because of being deferred until a future time. No real discussion has yet engaged the topics of growth, resources and the asphyxiation of the environment. Policies in this area are unsystematic and, to greater or lesser extents, primarily concerned with their own back yard. The economy, in the time of globalization, allows guidance of the behaviour of billions of individuals. The real question is whether, using this leverage, an international accord can produce satisfying collective results for the climate, for the problem of mineral and energy resources, and for the deterioration of the environment.

Let us firstly examine climate change, a domain in which considerable work has been carried out and which is symptomatic of the new conflicting situations.

The IPCC, bogged down

What an impressive accumulation of intelligence, at once conscientious and without naivety, has been mobilized since the creation of the Intergovernmental Panel on Climate Change in August 1988! Four reports have been accepted and disseminated, with a fifth in progress, bringing together the opinions of scientists, across numerous countries, carrying out measurements and creating models, all taking slightly different approaches in processing considerable amounts of data.⁴⁶ These works have served as “common knowledge” for the successive meetings of the United Nations Framework Convention on Climate Change (UNFCCC), whose delegates from the 192 signatory countries should have defined how we follow up on the Rio Earth Summit and the Kyoto Protocol.

Firstly, physical models were created. Originally, they were met with disbelief. As precision of measurements (of glaciers, ice floes, etc.) improved, there was less reticence, and now, the responsibility of mankind in this field is almost universally accepted. In parallel with this, the second group of experts examined the consequences of the phenomenon and the third group drew up models and economic scenarios in order to put decision-making tools at the disposition of governments.

During the twenty-four years the IPCC has existed, the works it has co-ordinated have essentially consisted of modelling. Some economic hypotheses have reached the ears of the

⁴⁵ Cf. B. Walliser, *Théorie des jeux*, e-thèque 2006, p26 *et seq.* If everyone follows their own interest, the result will be worse for all concerned than if all work together.

⁴⁶ via the global integrated models IMAGE, DICE, TARGETS, GUMBO, IFs, etc. (cf. R. Costanza et al. "Integrated Global Models" MIT Press 2007) or lighter modelling targeting certain phenomena or specific scenarios.

wider public, such as the question debated at Kyoto of whether it is better to act on prices, via a tax increasing the cost of carbon, or on quantities, by rationing out or auctioning off potentially marketable rights of emission, and by progressively reducing emissions worldwide in order to reach objectives on the concentration of greenhouse gases in the atmosphere.⁴⁷ These two methods are not equivalent, thanks to uncertainties which translate differently in each of the two cases. The economic modelling is highly complex and sustains an immense academic literature on problems of conversion to current value, on optimal choices in the face of uncertainty, and on reaction speeds in behaviour and in technological transfers.⁴⁸ Experts try to capture the behaviour of households, of businesses, and of states. Individuals, economic agents, will however be led by *their own interpretations* of the situation and of the future, interpretations which we do not know and which many try to hide. The economic perspective is highly sensitive to the intentions of actors, intentions which constantly change and depend in an unknown manner on physical and social modifications. We are advised to concentrate on what is ‘politically possible’, an incredibly ambiguous expression which mixes physical and economic quantities.

The only explanation for the absence of reaction is that the economy – by a mechanism that it makes sense to clarify – by governing behaviours, prevents us from seeing reality. Agents are dazzled, seeing only prices.

Balance sheet: the vehicle just keeps on accelerating

Worldwide emissions of carbon dioxide are not decreasing. This is the major fact. Carbon dioxide has a very long lifespan in the atmosphere, which means that the effects of global warming worsen progressively, becoming more and more aggravated year on year. Global emissions, currently in the region of 50 gigatonnes of CO₂eq,⁴⁹ have increased by roughly 3.5% annually in recent years. *In absolute terms*, grosso modo, we could say that the rich countries that represent a quarter of the global population emit as much as the rest of the world and make up three quarters of the GDP. *In terms of trends*, the increase in annual discharges is mainly due to a group of Asian countries (India, China, Taiwan, Hong Kong, Korea, Japan, etc.). This asymmetrical situation poisons international negotiations. Any dialogue immediately stumbles over the issue of responsibility: on the one hand, the developed countries, listed in the Kyoto Protocol’s first annex, admit that the present situation is, historically, largely due to their own economic development; on the other hand, they wish that China, notably, would participate in the diminution efforts in a give-and-take compromise.

Two very different natural phenomena serve to complicate the affair. Firstly, the “distance” between the potential actions which would be taken by governments and what will really happen, the “quality” of governance being highly disparate between countries. Secondly, the fact that a significant portion of the energy expended in developing countries goes towards making products for consumers in developed countries. The concept of carbon footprints is an attempt to tackle this phenomenon. Lastly, Russia is in a special position: the recession from which it has suffered since the 1990s has reduced emissions, and the country might possibly not be bothered by a slight warming of the climate.

What is of utmost importance in the case of climate change and should be seriously considered is that the effort required is *minimal*. This will certainly not be the case for the crisis of economic decline, but where climate is concerned, as Nicholas Stern stated in his

⁴⁷ Action on quantities is also known under the term “emissions trading”, or “cap and trade”.

⁴⁸ Cf. the recent theses by R. Crassous <http://pastel.paristech.org/4809/> and O. Sassi <http://www.imaclim.centre-cired.fr/spip.php?article28>.

⁴⁹ CO₂eq denotes a weighting for the representation of all greenhouse gas emissions.

famous report,⁵⁰ only a very slight lowering in standards of life is needed for the countries of the OECD, and even less for developing countries. The calculations are carried out by economists via comparisons with the evolution of the GDP. The curves showing the GDP of regions and countries have to be represented according to time as growing, even accelerating. These last five years, the global GDP has grown by 2.5% - 4.9% per year. In the high hypothesis (the most costly) of the Stern report, the angle of the curve would still be growing and accelerating, just lightly shifted downwards by 5%. In a country whose growth is at 2.5% (that of the US in 2010), the disruption – although more complex – is on a scale comparable to stopping growth for just two years.⁵¹ In a country growing at more than 5% per year, like China currently, a stationary regime is returned to for less than twelve months. These figures should be compared with natural fluctuations in the GDP. That of the whole world is fairly regular, but those of individual countries are much more varied, relatively speaking. Germany's GDP remained stationary between 2001 and 2002. The GDP of the US fell by 1% in 2011. Moreover, the ups and downs felt by households are even more significant given the variability in return on different sectors of activity.⁵²

It will not be the same for the “comedown” after the period of exponential consumption of available resources. In the case of global warming, it would be incorrect to say that no political decision has been made. The US and Europe in particular have committed to a series of measures, among which is the putting in place of negotiable rights of emission (cap and trade), which will allow the brakes to be applied in the forthcoming years.⁵³ In fact, for now, the restrictions are planned from 2012, and it is doubtful that the Brussels Commission and the Washington Congress will be very attentive to the state of progress in international negotiations before tightening the belt.

Red light, green light

It is worth spending an afternoon watching children play this subtle game. Sometimes the rhythm is regular, “red light, yellow light, green light!”, and seems to authorize a regular progression; sometimes a brusque turnaround, “red light.... yellowlightgreenlight!”, catches more confident players red-handed. The game amuses girls and boys alike, and the best strategy is unclear. You have to be able to instantly freeze, becoming perfectly motionless. But how then to still arrive first at the wall you are all aiming to reach?

Talks on energy and climate have been set up in a game where everyone is told to slow down but where being first to finish still means victory.

According to physical models on the greenhouse effect, the IPCC has quickly become involved in economic studies. It obviously seemed enlightening to better know what the costs were and to be able to compare strategies and efforts in economic terms. That it is necessary to pose the problem in economic terms has become an axiom for the IPCC. We know now that the climate will deteriorate. This has already begun. The question is the breadth of this degradation and its unequal repartition according to region. If we think of negotiation in purely economic terms, be it a globally managed coal price or an absolute limit on emissions

⁵⁰ Stern Review on the Economics of Climate Change, http://www.hm-treasury.gov.uk/sternreview_index.htm

⁵¹ In the United States, within the framework of energy policy (the American Clean Energy and Security Act of 2009) aiming to "promote to the United States an economy of clean energy", the Environmental Protection Agency has conducted studies and comparisons of models in order to assess the trajectories of reductions in emissions as envisaged in the document Waxman-Markey Discussion Draft. It reaches comparable orders of magnitude.

⁵² To give an idea of the orders of magnitude involved, let us note that the savings rates of households in OECD countries ranged from 2.7% to 12.7%.

⁵³ On the European climate and energy package, see http://ec.europa.eu/environment/climat/climate_action.htm

and marketable rights, or any other mix-and-match formula, it is clear that the health of a nation-state in 20 or 30 years time, faced with the real, serious, even dramatic difficulties which will arise, essentially depends on the vigour of its development from now until then. In other words, the “economic all”, which again thinks of the future as being organized solely according to the rules of current liberal globalization, necessarily leads to generalized *dissimulation* behaviour.

Why, in our capitalist system, are agents strongly encouraged to carry out business as before? The general atmosphere is given by economic media, which are more resistant to any form of regulation and contest the justification behind any change not dictated by profit. For example, an editorial from the edition of *The Economist* dated May 18th to 22nd, 2009, opposed regulation of the system following the sub-prime crisis: “Smarter regulators and better rules would help. But sadly, as the crisis has brutally shown, regulators are fallible. In time, financiers tend to gain the advantage over their overseers. They are better paid, better qualified and more influential than the regulators. Legislators are easily seduced by booms and lobbies. Voters are ignorant of and bored by regulation. The more a financial system depends on the wisdom of regulators, the more likely it is to fall catastrophically.”

In more concrete terms, the breadth of uncertainties we face wherever the environment is concerned prevents us from trying new approaches. If we base our figures on estimates from the IPCC, for a goal of stabilizing CO₂eq at 550 ppm,⁵⁴ the marginal costs of reduction in 2030 would be between \$5 and \$80 per tonne, an interval ratio of 1:16. Under these conditions, any industrialist attentive to the energy-carbon calculations of his business must evaluate investments whose marketability, even with various supports, is extremely uncertain when compared to a long-term interest rate of the type with which the financial markets provide him today. Rather than being the first among his competitors to throw himself into such an adventure, he is practically forced to wait for the range of prediction to narrow.

I am not insisting on the system planned since the Kyoto Protocol, known as the *Clean Development Mechanism* (CDM), which authorizes industrial countries committed to reducing emissions to invest in projects which reduce emissions in developing countries as an alternative to onerous reductions at home – a reasonable idea, but one which opens the door to various hard-to-control schemes of diversion, denounced today as “carbon leakage”.

The key point here comes from the fact that public policies create and buy *intentions*. Regulatory paths of action compatible with a liberal economy are essentially incentives, and the key today is agreements, paid in financial aid, on future behaviour of businesses. If the compensations are hypothetical advantages down the line, the uncertainties become paralysing, as we have seen; if they take place from the beginning, the risks are real and asymmetrical. Objectively, the notion of intention is blurred and even impossible to define. Years go by and the question of knowing whether or not the initial ruling is being followed becomes problematic.⁵⁵ Public expenditure or a fiscal advantage against a promise of action, meaning a mitigation of emissions, always carries the risk of non-delivery on the public side. Over the ten or twenty years to come, many things could happen: mergers, splits, buyouts of failing businesses, relocations across borders, changes in legislation due to political and social necessities, all of which means that the transmission of commitments is not assured. The owners of an enterprise – in other words, stockholders – are not the signatories of such agreements, so commitments are in constant play with new constraints, and in any case non-profitable actions will not be implemented. Capitalism allows various ways to keep promises

⁵⁴ ppm meaning ‘parts per million’.

⁵⁵ Knowing whether someone is following a rule of conduct or not is not simple. The philosopher Ludwig Wittgenstein showed that observation of behaviour is not usually enough to say. See Ph. de Lara *L'expérience du langage, Wittgenstein philosophe de la subjectivité*, Ellipses 2005, p83 *et seq.*

made – the term used is to “cover” commitments – by means of new promises.⁵⁶ The most flagrant and spectacular proof of this is the fact that many countries, including the US, have for a long while lived above their means with a balance deficit, *perennially*. “Sustainable development”, then is founded on a system of debts corbelled on each other like bridges built over a void, held up by successive voussoirs.⁵⁷

Leaving as much freedom as possible to economic interplay in climate negotiation is a path besmirched by iniquity, as it is the industrialized countries who have most polluted and who owe a great deal of their current prosperity to said pollution. However, it would be similarly unjust in terms of the future. If we compare GDPs, it would mean that one quarter of the world would be able to buy up the largest portion of emissions remaining between now and stabilization.

In any case, economic reasoning slows the intelligence of actors. Paralysed and obsessed, they become incapable of applying the brakes.

From denial to fatalism, or to the argument of authority

Firstly, there are claims made following the pattern, “I am a scientist and I think everyone is mistaken, therefore climate change is not a scientific reality”. These modern equivalents to Herostratus do not deserve any more citation here, given that journalists already give them undue attention in the name of a “balanced” discussion.⁵⁸

Also worth mentioning is the particular style of encyclopaedias which prefer to take the position of listing a sequence of objections rather than assume the responsibility of venturing an opinion. I think that anyone willing to change their habits and do their best to combat the greenhouse effect on a daily basis would have only to read the Wikipedia articles on the subject and they would revert to their old habits as if nothing had happened. It is a mockery of knowledge based on multiple speculations: it becomes impossible to speak of a bay horse without one person calling it darker, and another lighter, than chestnut. The result is a lack of unity, thanks to minor details which take on an excessive importance; for an example, see the “hockey stick” controversy surrounding graphical reconstructions of chronological histories of temperature, which gives the impression that the whole subject is similarly shambolic.

Seeding doubt is another explicit strategy practised by a number of economic actors. David Michaels showed, remarkably, how scientific controversy is perverted towards purely commercial ends in the United States in the matter of harmful pharmaceutical products or those with serious side effects.⁵⁹ Naomi Oreskes and Erik Conway established that these marketing techniques, which insinuate themselves into scientific uncertainties, have been simply and directly ported across from the case of the tobacco industry to the case of global warming, and by the same people.⁶⁰ Nor is the current wave of climate scepticism, highly vocal in France and recently experiencing a vigorous resurgence among Republicans in the US, without links to the economic interests of subjects related to oil production.⁶¹

⁵⁶ Cf. P.N. Giraud *Le commerce des promesses*, Seuil 2001.

⁵⁷ The fact that this situation has now spread to most of the countries of the OECD (cf. the IMF April 2012 report on global financial stability) renders this “equilibrium” even more “metastable”.

⁵⁸ I refer for example to the article by J.C. Hourcade and V. Journé, “Monsieur Homais, les guides de montagne, le maître nageur” *Critique Internationale* 2003.

⁵⁹ Michaels D., *Doubt is their product, How Industry's Assault on Science Threatens Your Health*, Oxford Univ. Press 2008

⁶⁰ N. Oreskes and E. Conway *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, Bloomsbury Press 2010.

⁶¹ See Zaccai E., Gemenne F., Decroly J.M., *Controverses climatiques sciences et politique*, Presses de Science-Po 2012, as well as the series of conferences from the University of Lausanne <http://www.unil.ch/gse/page89167.html>

Even more explicit, and worthy of more attention, are those pseudo-pragmatic positions of the type which claim “whoever tries to be an angel will act like a fool”, calling for vigilance against lowering our guard vis-à-vis international competition. Such is the case of President Valéry Giscard d’Estaing who writes, “Once these fossil fuels have been extracted from the ground, they will be consumed in any case, and will produce emissions of carbon dioxide. If it is not us who do so, it will be others, and the level of emissions will remain exactly the same. The only solution would be to limit the extraction of oil, natural gas and carbon, but there is no worldwide consensus allowing the proposition of such a thing”.⁶² Let us insist upon three points:

1) Renewable energies cannot provide the power (energy over unit of time) of the resources currently consumed.

2) The argument “if it not us who do it, others will” is unacceptable because it encourages all kinds of barbarity: corruption, child labour, trade in organs, opium farming, etc. The relaxation of ethical principles being a source of profit, it finds itself already the beneficiary of much neoliberal reasoning.⁶³

3) Petroleum resources of varying ease of extraction, bituminous sands, shale oil, natural gas, lignite, and coal all form a considerable continuum which, if exploited with our current voracity, will mean a climactic catastrophe on a much larger scale than those envisioned by group II of the IPCC, and will lead to massive disruption of human colonies and natural fauna at an unprecedented rate.

We also find analyses which are perfectly valid, but lead to such an overly poetic emphasis that the issue seems to actually pass us by.

Finally, we come to a line of argument which permeates far more deeply into Western society and the academic world, and which arrives at its economic position by returning to its traditional core – neo-classical theory. For example, William Nordhaus, an expert on the economics of climate change and a professor at Yale, has long believed that the best solution would be to internationally agree an objective, a temperature rise not to be exceeded,⁶⁴ because the DICE model responded to this constraint in the least onerous scenarios, despite the fact that political reality would not allow the problem to be approached in this way. Jean Tirole, for his part, supports a quantity control for negotiable rights of emission, with questions of equity being resolved by initial allocations of quotas.⁶⁵ However, Nordhaus believes today that this procedure is ineffective and speaks in favour of an internationally harmonized tax.⁶⁶ In all these cases, little place is left to politics. It is seen as a toolkit for putting economic truths into action.

Economists are incapable of seeing the economy’s responsibility in this matter. We fall into a ‘red light, yellow light, green light’ scenario, supplemented by a handicap system based in initial allocations or on taxes.

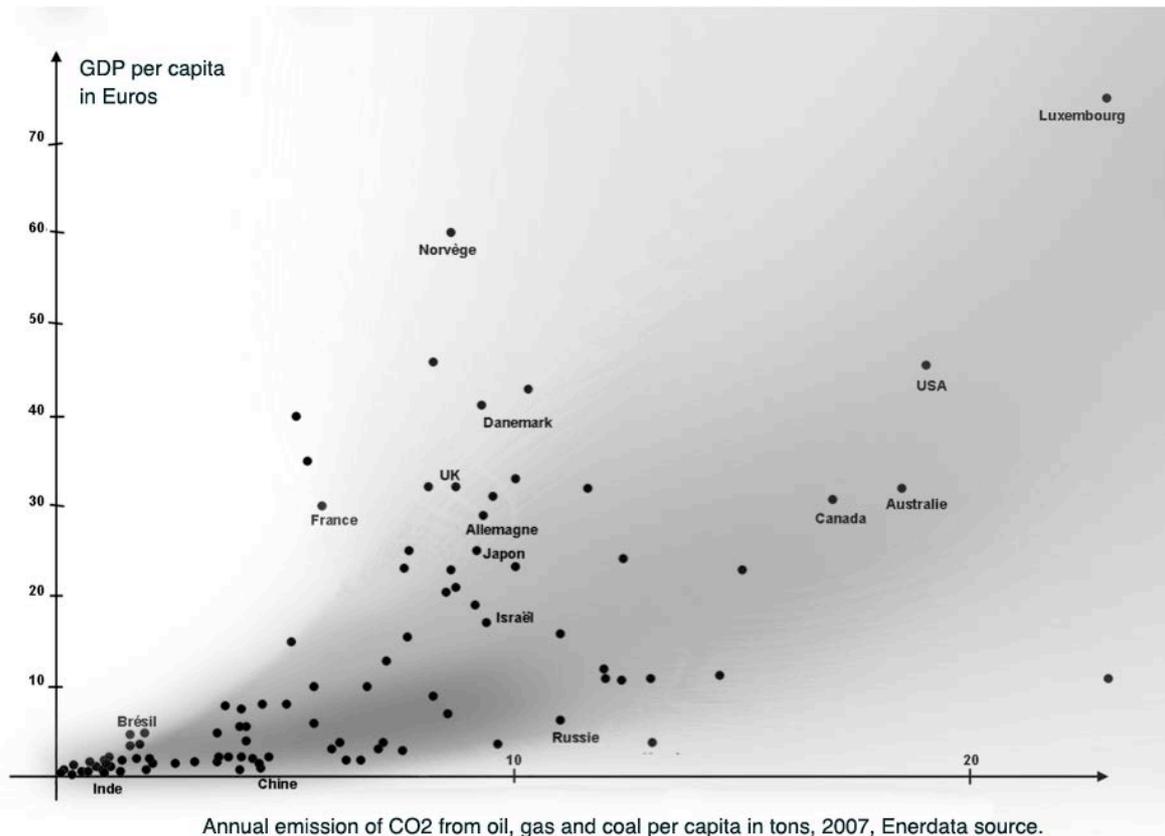
⁶² Preface from Ch. Gerondeau’s *CO₂: un mythe planétaire*, Toucan 2009 : “Dès lors que ces énergies fossiles sont sorties du sol, elles seront de toute manière consommées, et produiront des émissions de gaz carbonique. Si ce n’est pas fait par nous ce sera fait par d’autres et les émissions de gaz carbonique resteront au même volume. La seule solution serait de limiter l’extraction du pétrole, du gaz naturel et du charbon, mais il n’existe aucun consensus mondial pour le proposer”

⁶³ For example, a recent edition of *The Economist* recommends legalizing trading in kidneys in order to shrink waiting lists and avoid the black market (Nov 16th 2006).

⁶⁴ W. Nordhaus "Discounting in Economics and Climate Change, An Editorial Comment" *Climate Change* 37, 315-328, 1997.

⁶⁵ J. Tirole *Politique climatique, une nouvelle architecture internationale*, Doc. Française 2009.

⁶⁶ W. Nordhaus "Economic Issues in a Designing a Global Agreement on Global Warming" Keynote available on the Internet, March 2009.



Each point represents a Nation-State. The diagram shows that the cloud of points tends towards zero tangentially with the x-axis (most of the population is under the line which connects the origin with Russia). This shows that making everyone pay the same price for carbon across the world is a harsher constraint on the way of life of poorer countries. This amounts to a tax which takes more from low incomes than the tax on personal income does in the countries of the OECD.

Unspoken Malthusianism

The positions Malthus took towards the end of the eighteenth century met with a harsh reception, partly for being an explicit dissociation with the poor, and partly because they did not inspire confidence in progress as a solution to problems. In his *Essay on the Principle of population* (1803), he writes that “the perpetual tendency in the race of man to increase beyond the means of subsistence is one of the general laws of animated nature which we can have no reason to expect will change”, and that this is the cause of misfortune and vices. His principle theory is that “Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio”. This theory is flawed in a growing economy, as has been shown by both economic theories and figures from periods of expansion such as that from which we are still yet to emerge. Malthus was opposed to the *Poor Law Amendment Act*⁶⁷ of 1834: “it appears to me that we are bound in justice and honour formally to disclaim the *right* of the poor to support”. He published his metaphor of the world banquet and denied the right of the poor to children: "A man who is born into a world already possessed, if he cannot get subsistence from his parents on whom he has a just demand, and if the society do not want his labour, has no claim of right to the smallest portion of food, and, in fact, has no business to be where he is. At nature's mighty feast there is no vacant cover for him. She tells him to be gone, and will quickly execute her own orders, if he

⁶⁷ Cf the interesting introduction by J.P. Maréchal to *Malthus, Essai sur le principe de population* t1 and 2, Garnier-Flammarion 1992.

does not work upon the compassion of some of her guests. If these guests get up and make room for him, other intruders immediately appear demanding the same favour. The report of a provision for all that come, fills the hall with numerous claimants. The order and harmony of the feast is disturbed, the plenty that before reigned is changed into scarcity; and the happiness of the guests is destroyed by the spectacle of misery and dependence in every part of the hall, and by the clamorous importunity of those, who are justly enraged at not finding the provision which they had been taught to expect. The guests learn too late their error, in counter-acting those strict orders to all intruders, issued by the great mistress of the feast, who, wishing that all guests should have plenty, and knowing she could not provide for unlimited numbers, humanely refused to admit fresh comers when her table was already full."⁶⁸

Malthus was wrong in both his intentions and his recommendations when he thought it necessary to instruct the people that man has no *a priori* right to food: "it is not the duty of man simply to propagate his species, but to propagate virtue and happiness; and that, if he has not a tolerably fair prospect of doing this, he is by no means called upon to leave descendants".⁶⁹ His extreme utilitarian ethics, dividing up and sharing out a "moral arithmetic", and the religious clothing with which he covers it, are naught more than justifications of the privileges of the old regime in the face of the ideas of the French Revolution. Marx and Proudhon are for once in agreement when they denounce this sycophant in the service of the ruling classes: "The economists were the first among us to, by an inconceivable blasphemy, elevate the theory of Malthus to the level of holy dogma. I am not accusing them any more than I am slandering them. The economists are in this acting in the best faith, with the best intentions in the world. They would love nothing better than to bring happiness to the human race; but they cannot conceive how, without some organized system of homicide, equilibrium can exist between population and subsistence".⁷⁰

Proudhon did not realize when writing these lines to what extent the limits of the planet proved his subject right. Malthus, the economic priest, the simplistic moralist, had advanced using bad arguments an idea which was two centuries ahead of its time. Is it not that which Malthus advocated which is now in full progress?

For this to be possible when all civilized minds condemn his theories, it has to happen *without anyone really wanting it*. Here the economy comes in as the great dissembler. Modern liberal society *applies* Malthus with the utmost efficiency, that of unawareness.

Cassandra is a Leftist...

The denialist programme is especially noxious when you take into account the fact that it clearly harms the weakest among us. In addition to the material difficulties from which many peoples of the southern hemisphere suffer, they also have to bear the weight of a growing number of insidious criticisms: 1) their economy is "dirty" because it produces a higher amount of CO₂ in relation to their GDP, 2) their forests are shrinking, 3) their governments are inefficient, even incapable, when it comes to applying economic measures. (It is unclear how this could not be the case, given that these governments represent a

⁶⁸ *Essay on the Principle of Population*, 2d edition 1803.

⁶⁹ *ibid* book IV chapter IX.

⁷⁰ Pierre-Joseph Proudhon, *Les malthusiens* (1849) : "Les économistes ont les premiers parmi nous, par un inconcevable blasphème, érigé en dogme de Providence la théorie de Malthus. Je ne les accuse pas plus que je ne les calomnie. Les économistes sont en cela de la meilleure foi, comme de la meilleure intention du monde. Ils ne demanderaient pas mieux que de faire le bonheur du genre humain; mais ils ne conçoivent pas comment, sans une organisation quelconque de l'homicide, l'équilibre entre la population et les subsistances pourrait exister."

negligible financial presence, powerless compared to multinational firms, except in the case of dictators).⁷¹

I believe, in the vein of Jean-Pierre Dupuy, that alarmism is all in all more useful than dyed-in-the-wool optimism. The population is subjected to endless optimistic ramblings in order to *inspire confidence* in them. Is the goal to keep them behaving in the same fashion as they already are? The great turning point of this is that optimism becomes unreliable footing, “rotten floorboards”, when it comes to collective morality. Many systems of thought which praise progress for the sake of progress, regardless of its destination – and they are numerous – find themselves at odds with this.

... *but she causes people to vote for the Right*

Alarmism, in a strongly mediatized democracy, worries people and reinforces the propensity towards possession for self-protection. It draws middle-class, and even working-class, votes towards the Right.⁷² The major media generally take the individualist point of view and try to give the best advice to allow households to avoid inconvenience. Since its inception, capitalism has implanted a highly effective popular mindset, which thinks of daily life in terms of a small, well-directed business with its assets and its accounts. This has become the immediate understanding of everyone, from old ladies in Paris or London, to vendors in North-African medina quarters, to Brazilian or Russian ministers.

The attitude of difficulties and decline will, in all likelihood, reinforce an attraction towards the upper classes and accentuate the value of *comparative goods*. Although this means a convergence towards a regime in which everyone limits their environmental footprint, privileges of all kinds will tend to become marketable goods acting as a form of insurance.

Elections in democratic countries obstruct the emergence of political powers whose programme consists of restrictions to help the planet. Objections in Europe and current political debates advance extremely scattered criticisms of liberalism, falling into either the historical camp of Marxist and socialist arguments in favour of growth, or into that of the nationalist Right which advocates an economic development just as it was before globalization.

In the corridors of the meetings of climate-change experts, the argument repeated ad infinitum can be summed up in the following formulation: “The Chinese and the Indians understand nothing but the economy.” To this, suspicion is added regarding the capacity of the governments of these countries and those of the third world to really govern. Agreements with them would be worthless and would not modify the way of life of these populations.

The only issue would be to “find a virtuous economic mechanism”.

Here, we find a fundamental contradiction, which we shall examine in more detail in chapter III:1, regarding common goods. It constitutes a misunderstanding of the reality of divergence of interests, thought of in an economic framework. We cannot look to desire to prevent a system founded on desire. This is an oxymoron and, like all contradictory injunctions, is paralysing and buries problems without resolving them.

The future depends on the potency of a non-Marxist critique of liberalism.

The spiral of indispensable warfare

Scholars can see a sombre future ahead – catastrophic, if nothing is done. Blowhards denigrate it, acting on all kinds of motives. Finally, each human being comes to perceive the

⁷¹ Some directors of large firms earn more, on a personal level, than the GDP of certain African countries.

⁷² This complex phenomenon was analysed in detail in the case of the State of West Virginia in the work of Thomas Frank *What's the Matter with Kansas? How Conservatives Won the Heart of America*, 2004.

general problem and finds him or herself caught up in personal constraints and anxieties. Situating collective talks in an economic framework via *negotiations* (“I’ll give you some of my rights to pollute, you bring me a bit of clean technology, we’ll agree on the price and both win...”), whatever the terms might be, leads to an impasse, as it can only accentuate the imbalance of interests in favour of individual views and to the detriment of collective visions. Following the agenda of *trade*, few societal advances would have seen the light of day: the abolition of slavery? Or of the death sentence? Minimum wages? Etc. For humanity to realize that it is necessary to limit economic reasoning and make way for collective politics – hence endowed with power and means – are we going to need the next two generations to live through some highly eventful years?

Ecological footprint is an indicator. Originally introduced by Mathis Wackernagel to evaluate how much nations use from nature, it has been adapted by the Meadows team to qualify how much a human being uses in terms of square metres of soil for his food needs, material goods and services, and for the clean-up his consumption generates. This assessment can be carried out in various ways, notably in accordance with the role played by nuclear energy. As a simplistic and evocative image, we can say that ‘ecological footprint’ indicates the shadow each human casts on the Earth, once everything is taken into account. Undoubtedly, many uncertainties pervade this kind of calculation, but it seems clear enough that the countries of the OECD are, by the quantities of non-renewable resources they consume, living above and beyond the means of what the planet can support on average.

As a result, it seems highly probable that people from poorer countries will *never* become well-off in the same way – with the same ease – as we currently are. There are not enough resources. This remark, present in the initial works of the Club of Rome, did not echo widely enough. It shows as mistaken the idea that population control can be realized through a process of behaviour modification due to increasing standards of living, similar to what has happened in Europe, but following more the type of restrictive rules we see nowadays in China. A complete reversal is in the process of occurring. This reinforces what was said above about the injustice of setting a fixed price on carbon, as some experts stubbornly advocate.⁷³ Whilst until now, in general, commerce was an appeasing factor in hostilities between peoples, in a situation of shortage, the setting-up of trade eats even more into rare resources. Social imbalances and instabilities tend to worsen: economic development risks exacerbating the causes of discord.

Economists have a tendency to believe that, by noting that *man is not good*, they justify the methods and arguments of their discipline. But this argument does not work. Without doubt, modern man, his intelligence multiplied by communication technology, is less inclined to compassion and altruism insofar as he senses the correlation between problems and the number of his fellow creatures. However, he is appealing more and more strongly to an effective political structuring which can save him from this slippery slope. Recently, the worldwide Union for the conservation of species published a quadrennial report, the most exhaustive representation of planetary biodiversity ever realized, which confirms a fall in the number of extant species between a hundred and a thousand times faster than those of the great periods of extinction of the past: “We can only state that the international community which, in 2002, set itself the goal of curbing this tendency by 2010 has failed”. This failure is widely felt to be the result of economics as a whole.

Two recent facts, which attracted numerous comments, are telling of a new attitude towards economic difficulties. Firstly, the demand made to taxpayers to bail out banks in

⁷³ In addition, poorer countries are relatively more vulnerable to damage due to climate change, cf B. Quenault, "Changements climatiques et risques sécuritaires multiples" in *Une économie politique de la sécurité*, Cl. Serfati ed., Karthala 2009.

distress under the pretext of safeguarding against systemic risk, and then secondly, the proposition made by certain firms (British Airways) to their employees of working for free out of altruism towards the company.

The appeal to the argument of extreme necessity and this type of blackmail, using threats of unemployment, show that economical logic can go tremendously far in influencing behaviour.

Since Rio, negotiations on climate have been directed towards the field of economics. The agreement, by stating that we should get involved “to allow economic development”, blocked any collective decision which could have restricted growth. Political principles have not been built equally for everyone in the boat *but only according to the value of what each castaway possessed*, because political institutions were and are gravely insufficient. We know that we are facing a huge crisis and we pretend not to see it. *Some think, without saying so out loud, that the worst is reserved for others and that the more time passes, the more they will be proportionately better off, so that if conflict erupts they will emerge dominant.*⁷⁴

But such an idea, historically, does not stand up. It has a gaping flaw, which is the impossibility of knowing the nature of the reactions that frustrated and humiliated people will have.

At this point, it would be helpful to reread the remarkable work (his first book) published by Keynes in 1919 shortly after the signing of the Treaty of Versailles, in which he warned of the ill-considered risks with which this treaty was weighing down the future: “A policy of reducing Germany to servitude for a generation, of degrading the lives of millions of human beings, and of depriving a whole nation of happiness should be abhorrent and detestable – abhorrent and detestable, even if it were possible, even if it enriched ourselves, even if it did not sow the decay of the whole civilized life of Europe”.⁷⁵ The issue, recall, was that Germany should pay *compensation*, assuming sole responsibility for the war and for all the damage done to the civil populations of the Allies and their property. Following the principle of “Germany must pay”, the representatives at the conference proceeded to carry out economic evaluations which Keynes reports and discusses in detail.⁷⁶ His aim was above all to consider the future consequences of the Treaty’s economic decisions...⁷⁷

For very old civilizations like those of India or China, and not forgetting Iran, the great leap forward carried out a century and a half ago by the West can be seen as an adventure, the damage caused by which should be repaired by the trouble-makers who led it – in any case, powerful ideologies can feed off this kind of reasoning. When parts of Bangladesh are underwater and India and Pakistan are faced with legions of millions of incoming migrants, the calls for *compensation* will be even more vigorous.

Refusing to participate in the indispensable economic effort will lead us into a spiral of “justified hatred” similar to the Israeli-Palestinian conflict, and our children will ask us how such a thing could ever have been born.

⁷⁴ And, symmetrically, the technological and operational superiority of NATO control exactly what developing countries can sign, using the argument: who will come and force Europe and the US to respect their commitments if they do not comply? The problem was expounded upon by Anil Argawal in 1998, cf. “Réinventer la solidarité” *Courrier de la Planète* 44, p33-34. So, in effect, an important part of the Kyoto commitments have not been kept.

⁷⁵ John Maynard Keynes, *The Economics Consequences of the Peace*, 1919

⁷⁶ The costs of destruction to houses, railways, etc. were quantified and evaluated, as was the contribution Alsace and Lorraine would have made to French production.

⁷⁷ For example, Germany was prevented from taking out patents. For the text of the treaty, see <http://www.herodote.net/Textes/tVersailles1919.pdf>

A new orthodoxy reunites “the neo-classical analysis of conflict” and neoliberal thought. It sees war as the result of pre- or anti-capitalist groups, and the solution as lying in the globalized neoliberal system, hence the need for war since its earliest beginnings in order to create beneficial conditions (rogue states and terrorists) and the interest in maintaining high military spending.⁷⁸ However, people in distress will not abandon their beliefs or the hope for descendents in the way that the Native Americans took the Spanish for the beloved of the gods. They will fight to the death because history validates them, and can sacrifice part of the population in order to exert influence. All sides will believe they have the “best” reasons for using force to defend the environment and survival.

What leads people into such traps? The conviction of being in the right. The question is not only how to dismantle the false claims of the economy, but also whether this mindset is capable of accepting other interpretations of the world.

Fuel is needed to vanquish inertia

We are at an impasse. The importance of the crises to come is not inspiring the forces of society to action. The necessary general awareness has not arisen. The new concerns we face resist integration with the economy, and do not penetrate it. Partial solutions can be found, but global problems are accumulating and we still arrive at the conclusion pronounced in 2001 by the Secretary-General of the United Nations, Kofi Annan: “We must stop being so economically defensive, and start being more politically courageous”.⁷⁹

In fact, it would be necessary henceforth to undertake a constructive project of global governance. Never in history have such good arguments been presented for this. The current organization of the United Nations and its constituents was established to ensure lasting peace following the Second World War; the issue now is of taking notice of the incapacity of states to act together in the long-term to undertake a political process of world government. The first matter of urgency is to acquire means of efficiently collecting accurate information and objectives on pollution, water, forests, soil erosion, population, renewable and non-renewable resources, etc. This means the formation of an international scientific and technical network of observers led by the UN. We already know much, but the system of measurement is a basis of credibility. In parallel with this, a pragmatic and open study must be conducted on the paths to follow if we are to arrive at *legitimate* political institutions – this being the key word here. A group similar to the IPCC would be set up, consisting of lawyers, political scientists and historians from all countries, which would work out syntheses of various procedural options and decisional stages to be taken by the UN, the only current international body possessing even a hint of legitimacy. Numerous works can serve as points of departure, such as those of Pierre Calame and of the Charles Léopold Mayer foundation.⁸⁰ It is clear that, in order to be useful for anything, worldwide political authorities must be *legitimate*, which means certain procedures will be needed as an obvious condition a) for them to be entrusted with a control and intervention force to ensure decisions are followed, and b) for them to be able to carry out *a restructuring of taxation*, working with states where internal processes are concerned, and in its own name for the preservation of collective goods – oceans, glaciers, fauna, etc.⁸¹

⁷⁸ See the analysis carried out by F. Coullomb and J. P. Dunne: "Economics, conflicts and war" *Real World Economics Review* no.46, 2008.

⁷⁹ "Containing Climate Change : a Global Challenge" Opening address at the Fletcher School of Law and Diplomacy at Tufts University, Medford, Massachusetts, May 2001.

⁸⁰ "Refonder la gouvernance mondiale pour répondre aux défis du 21ème siècle", Report led by P. Calame, Ch. L. Mayer Foundation for the Progress of Mankind, Oct. 2001.

⁸¹ Cf. L. R. Brown: *Eco-economy*, 2003.

So, in pursuit of resolution of the climate dilemma, we have come to this (even more difficult) issue, the setting-up of global government. The supra-nationality in the European construction already shows the reticence demonstrated by a large part of the population. Leaders and the elite have similar reservations, fearing an end result of an enormous bureaucratic machine run by a restrictive executive, poorly informed when it comes to social and local realities. And, above all, the worry is that the legitimacy be hijacked and power captured by one or another particular category.

We arrive at the conclusion that the only means of action likely to demonstrate efficiency equal to the level of difficulties posed by this enormous problem is to *use the money of the rich*, for the pure and simple reason that money is needed to get things moving.

A recent report from the World Bank arrived at the same conclusion.⁸² It goes further, showing that a pragmatic taking-into-account of this commonsensical fact dissipates the logical conflict paralysing the system in the prisoner's dilemma: it is also in the best interest of developed countries.

The reasoning is as follows. As those who are most responsible for the situation, developed countries cannot do nothing, but their action alone is in any case insufficient. They must therefore set in motion a process of significant reduction of emissions *and* help developing countries rapidly move towards economies which do not produce extravagant amounts of carbon. A partial climate agreement concerning only industrialized countries leads, necessarily, to a temporal discrepancy in global results and therefore to additional costs for reductions – costs which will be borne by the richer countries. As a result, it is in the interest of these countries to create motivations for *all* countries to take on projects of reduction as soon as possible. All this can be calculated, and is sketched out in the report. The central point (already stressed by multiple authors) is that the increase in cost due to procrastination is a wasteful dead loss, bringing no increase in well-being. We must then get used to the idea that rich countries must dedicate sufficient amounts of funds to actions benefitting countries outside Annex I, so that these latter might see their developmental economy differently and consider it possible to take on objectives in 2012 rather than waiting until 2020.

The World Bank poses the problem in a lucid manner. It is not at all a case of increasing development aid, development being thought of in the classical fashion. However, there remains a double difficulty: a) the dilemma exists both between rich countries and within these countries, an immense difficulty in societies where competition is king, and b) supplementary expenditure⁸³ (in relation to the efforts made to reduce their own emissions) to aid the transformation of countries outside Annex I needs, in order to be implemented, a whole programme of efficient political and economic systems, in order to stop, notably, deforestation and corruption – up to now, globalization has actually been aggravating these phenomena.⁸⁴

The category of 'the rich' can be thought of in several ways: on a state level, on the basis of GDP, or on the accumulation of value via successive annual GNPs. A team from the universities of Harvard and Princeton, high places of management, just published a note to the American Academy of Sciences explaining the concept of 'the rich' as being the people with

⁸² *World Development Report 2010, Development in a Changing Climate.*

⁸³ On this subject, see the recent work co-ordinated by Nicholas Stern, *Meeting the Climate Challenge: Using Public Funds to Leverage Private Investment in Developing Countries*, 2009, cf <http://www.lse.ac.uk/collections/granthamInstitute/publications.htm>.

An estimation of expected aid, in addition to "official development assistance", is put forward by N. Stern in the article "Managing climate change and overcoming poverty : facing the realities and building a global agreement", 2009, same website.

⁸⁴ The lack of stability in the Third World, notably due to turbulence in global prices, makes it difficult to reduce corruption, because of the advantage it has in being able to make rapid decisions to seize opportunities.

the highest revenues in each country, and proposing basing the climate problem on their finances.⁸⁵ Whichever one of these variants is adopted, the only issue seems to be thus financing *all transitions towards a lasting economy, that of the rich, the less-rich and the poor*, on the conditional of having an effective international check under the aegis of the UN and to make use of this dynamic – which at last possesses a fuel source – to drive towards the progressive foundation of an authority of legitimate global government.⁸⁶ Even if the rich dedicate a significant part of their annual revenue – let us remember that the government of the United States, to save the banks in a highly relative ‘situation of peril’, did not hesitate to spend between \$1,400 and \$1,700 billion dollars, more than 10% of the GDP – this will certainly constitute, upon reflection, the best choice for the future.

Situating *a priori* the international climate discussion within the standard economic framework of commercial negotiations, in the spirit of that which the West has set up and practiced for mineral and fossil resources useful to its material development, is a severe option. Its consequences can only be extreme. Apparently “obvious” and effortless in the minds of most, it is in fact immature. It does not allow us to escape the rut we are in, the dilemma of divergent interests. By continuing the dissimulation it has engendered, it endangers the environment much more than is generally thought and progressively leads to conditions of armed conflict.

⁸⁵ Sh. Chakravarty, A. Chikkatur, H. de Coninck, St. Pacala, R. Socolow and M. Tavoni, "Sharing global CO₂ emission reductions among one billion high emitters" PNAS 2009.

⁸⁶ On mounting such a North-South financial project, see A. Pendleton and S. Retallack, "Fairness in Global Climate Change Finance" Inst. for Public Policy Research, March 2009.

3. The eyes of humanity can no longer see anything but prices

The philosopher Karl Jaspers makes a fundamental distinction between belief and reason, essential, in his eyes, to an understanding of the workings of the world: “The mindset of *belief* invents and creates. Its prescriptions can be executed, and multiply its achievements by repeating them indefinitely. The result is an organization of the world in which some minds construct machines, creating what might be termed a second universe wherein the masses subsequently serve as executing agents.” Belief is that which does not involve the will of the people to decide what will give sense to their lives; its operative rationality is what allows utilitarianism to function. “The other way of thinking, that of *reason*, allows no execution dependant on instructions given to the masses, but demands that everyone think as a free man, returning to the origin of things. Here, truth is not revealed by a machine, reproducible at will, but is attested to by choice, by decisions, by the actions each person accomplishes in their own right, in this way realizing a common spirit with others”.⁸⁷ Reason, like belief, irrigates society but in a different way. It provokes citizens and associations to action in order to achieve goals and political action.⁸⁸

The issue we face is that the economy is well on the way to completely replacing reason with belief. “How much does it cost” governs all behaviours, including the strategies of governments. The most immediate observation when it comes to non-renewable resources or to greenhouse gas emissions is that nothing is done. Business continues as before. Nothing important happens. Copenhagen, Cancun, Durban – the only real novelty is that negotiators now openly admit that they have no desire to take any action.

What the French refer to by the English phrase “*business as usual*”, and is related to what in English is called “*laissez-faire*”, is thus a considerable force, and one which has been greatly underestimated. The immense quantity of whistleblowers goes unheeded. What I am trying to explain is that the economy is a *paralysing anti-anxiety agent*.

On the causes of ‘business as usual’

As we have already seen via the illustration of the game ‘red light, green light’, in the alliance of nations, or any system of competition, the injunction of a global slowdown is contradictory. Each participant still has an interest in easing off the brakes to gain an advantage against the other participants and find himself in a better position when the difficulties become tangible. Typically, the injunction is of a dual constraint kind, as described by Gregory Bateson. When a mother tells her adolescent son “it is time you became independent, stop doing what I tell you”, the youth is paralysed, trapped in a universe with no way to act freely. It is the same with economic decline; there is an immobilizing fascination, like that of a rabbit trapped in headlights, or of Al Gore’s frog sitting in a pot. The temperature is slowly raised, and the frog sapped of the energy to escape.

The economy does not know how to harmoniously guide contraction. If we take our foot off the pedal, the vehicle topples over. Of course, in the past there were highs and lows in the economy, depending on people and period, and the recessive phases often led to violent phenomena such as war and dictatorships. However, these dramatic episodes, such as famines, industrial or financial crises, were originally sparked by lack of foresight, imprudence, or unpredictable natural disasters – in other words, by negative phenomena and not by a smooth running of the economy and the wealth of nations. What is new is that all the precepts of the ‘classical’ economists – those 18th century thinkers who defined the basis for the organization of society for the following two centuries, and who developed Francis

⁸⁷ *The Atom Bomb and the Future of Mankind* (1958).

⁸⁸ A similar distinction is made by Martin Heidegger between “calculative thinking and meditative thinking”, cf. *The Principle of Reason* (1957), in which he also expresses his reservations regarding “the atom”.

Bacon's ideas on progress through new reflections on production and trade, ideas which are today entrenched in individual behaviour – these precepts reinforce the *business-as-usual* attitude. These authors, Smith, Malthus, Say, Ricardo, and possibly adding Bentham and Mill, took the position of welcoming in new values to replace the moral rules of, notably, Catholicism and aristocracy. They stated that one had the right to say that favouring trade was a good thing, that it benefitted society and established moral principles which could rival the religious precepts so clumsily enacted far beyond what faith dictated. It is these same sturdy ethical bases for utilitarianism and pragmatism which are today being brutally called into question.

However, the 'classical' moral bases are omnipresent. The day-to-day strains imposed by modern society, such as study, intelligence, compromise in order to maximize our children's health, leisure, travel, professional work, all prevent us taking a philosophical pause to reflect on finitude. We live as in a dream of excess activity, saturated with worries. The deep anchoring of these values can be seen in the mundane fact that accounting optimization spreads its behavioural influence by spite. Whosoever does not know that he can negotiate when it comes to his loans, his rate, his overtime, profit from promotional offers, take advantage of rising house-prices, employ an under-the-table worker, etc. – in other words, whosoever has not discovered how to extract personal advantage, that person is stupid. In discussions on street corners or Internet chat rooms, friends and neighbours share information on how to get by and shrewdly slip through the system. The ignorant person, or the person who lets himself be guided by general ideas, is a fool, and too bad for him. And, vice versa, he who optimizes his personal affairs is intelligent, one admires his lucidity, and if he does especially well, he is a genius. Aptitude at economic optimization becomes synonymous with intelligence. However, this is a purely self-centred game – that is, one cares nothing for the collective, and even less for the universal. Sooner or later this selfishness clashes against other selfishnesses and it becomes an issue of victory, of conquest, and of the whole ideological paraphernalia of warfare, as old as barbarism.

Use value and exchange value

This distinction is extremely old. Marx traced it back to Aristotle. The classical economists, Adam Smith and Jean-Baptiste Say, spoke with varying levels of clarity about it. Proudhon too, although he used particularly confused and emphatic terms, such as the 'ceremonial forms'.

Marx is very clear on the subject, distinguishing the two notions in the very first pages of *Das Kapital*, and his subsequent analysis of exploitation invokes only exchange values, which endows it with a much larger strength of conviction. This was because use value is a difficult notion, as delicate as 'sense' or 'interest'. It is related to the meaning an asset has for the user who professes a desire for what it is. This triggers one of the largest problems in philosophy. It appeals to the Kantian *thing-in-itself*, a notion considered as contradictory by the philosophers of the 19th century because the noumenon exists only since if it did not "appearance would exist without anything which appears", but we can say nothing about it because only phenomena are accessible to us. This thing-in-itself was then to become the Will in Schopenhauer and subsequently in Nietzsche. This concept of use value provides economists with an explanation for propensities to buy or sell, but the calculations are always done working from the idea that the exchange realized gives an economically significant value.

One point, however, is to be noted for taking on a new significance today. The use value of an item is multidimensional. This characteristic allows it to be clearly distinguished from market value. Marx, a materialist, was not interested in the multiplicity of interpretations which can be attached to an item depending on personal experience or on symbolic

significances from family or life in the city. However, he speaks of the various units of measurement used for different goods, of which there were still many at the time: “Different use-values have different measures appropriate to their physical characteristics; for example, a bushel of wheat, a quire of paper, a yard of linen”.⁸⁹ These ancient measurements, many still in use in the UK, the US and the countries of the Commonwealth, were evidence of a comparability linked more directly to a category formed by history and customs than to the interplay of abstract and general monetary value. Marx adds that looking at an object itself does not show us the social process of its production – “From the taste of wheat it is not possible to tell who produced it, a Russian serf, a French peasant or an English capitalist” – and this is the reason why “use-value as such, since it is independent of the determinate economic form, lies outside the sphere of investigation of political economy”.⁹⁰

Today, however, in the efforts which have been made to escape the rut of globalized liberalism, the multidimensional character of use value (due to the fact that tastes and opinions cannot be classed according to a sole criterion) is the basis behind ideas of introducing multiple currencies into a single economy, according to various categories of goods or services, in order to provide more efficient levers for ecological transition.

Not only did the classical and neo-classical economists stress the importance of use value, but American pragmatic philosophy at the turn of the 19th and 20th centuries even took up the challenge of removing all intrinsic consistency from use value by bringing back its usage to the possibilities of actions in the economic world. I am thinking of Charles Peirce and John Dewey rather than William James, who remained attached to pluralism in an almost pantheistic sense. The key work here is *The theory of valuation*,⁹¹ written by Dewey in 1939, well after his fundamental works on democracy and education. First, there was a philosophical forcing of a positivist nature, started by Peirce in his article “Logic of Science: How to Make Our Ideas Clear”,⁹² which consisted of thinking the possibilities of an individual’s actions to be objectively knowable. Then followed the idea that observation of behaviour sufficed to “understand” or to “direct” communal life; this experimental determination was recognized as difficult by Dewey, but seemed to him possible in practice for all most subjects. Without saying so as such, Dewey was not far from thinking of use value as a function of utility (a plunge which had already been taken, of course, by the neo-classicists). A reading of this treatise clearly shows that *cost-benefit analysis* (of which we will speak more later) fits perfectly as an application of pragmatist ideas, and we find in this operational neo-pragmatism the features of unique scientific truth, of the confusion between belief and interpretation, of the mistrust for the real base capacities of man to envisage choices based on ideas – the same features found in the monist positivism of contemporary neo-liberalism.

By dint of believing man incapable of determining his behaviour regarding abstract objects, we create a society where Jaspers’ separation of belief and reason can no longer operate. In more concrete terms, we no longer see anything but prices.

Here we must again distance ourselves from Marxist thought. A fundamental theme of Marx’s philosophy was attributing to the materiality of life the real role of history on the consciences of men – unlike Hegel, who saw history as writing itself through ideas in constant dialectic interplay. Everyone knows this famous reversal: “For Hegel, the process of thought, which he even transforms, under the name of the Idea, into an independent subject, is the demiurge of reality which no longer constitutes anything but its external appearance. For me, inversely, the ideal is nothing other than the material translated and transposed in a

⁸⁹ *Critique of Political Economy* Part I.

⁹⁰ *ibid.*

⁹¹ *The theory of Valuation.*

⁹² Appeared in French in the *Revue philosophique de la France et de l'étranger*, VII, 1879, 39-57.

human mind”.⁹³ Nevertheless, the very history of Marxism leads us to think that Hegel had the right of it, and that it is ideas which move men. Today, the materiality seen by man is purely economic. The ozone layer, the level of CO₂ in the atmosphere, the melting of the permafrost, the using-up of fishing resources, the shifts in ocean currents caused by an influx of fresh arctic waters, the pollution of ground water, none are perceived by humanity.⁹⁴ We hear only highly indirect allusions to them in scientific discourse, and must decipher the message by stripping it of all the clever phraseology of profit-led communication. So, we can agree with Marx when he writes, “The question of knowing whether there is a place for recognizing an objective reality in human thought is not a theoretical question, but a practical one. It is in practice that man must prove truth, or reality, and the power of his thought, in this world and for our time. The discussion on the reality or unreality of a thought which withdraws from practice is purely scholastic”.⁹⁵ However, this reflection, in the present circumstances, is merely bringing water to the liberal-productivist mill and its *business as usual* approach. Marx believed that the conscience of the proletariat was concealed by the dominant bourgeois ideology and that the real conditions of the workers would necessarily cause it to emerge. We can consider him as correct, but it is not the conditions of the working class which will reveal what is hidden today, nor even those of the third world. It is ideas that we must value. Mankind has a responsibility of knowledge, and the intellectual elite have one of altering the causes of this blindness.

It is necessary to restore a space of *symbolic values*. The collective interest disappears because we cannot ‘reward’ it. However, man has a base desire that the global framework of his life should not deteriorate, he wants to be able to act at this collective level. The issue is of the values which liberal society prevents us from taking into account. If Peirce, Dewey and William James had lived a century later to see the impasse in which we now find ourselves, I am convinced that they would be especially sensitive to this contradiction, these men who drugged themselves on logic, like Bertrand Russell, and whose philosophy was based around constructing general ideas to improve communal life.

Vitalist economic ideology

The theoretical and real importance of Darwin and his theory of natural selection and evolution (1859) for liberal economists is well known, and has been the subject of numerous works. In this theory, they found not only a legitimization of competition, but also the conviction that, by organizing goods, services and work in *markets*, they were carrying out a *natural* task, ontologically of the same essence as that which produced the most wonderful and beautiful examples of fauna and flora.

However, a second threshold was then crossed in this process of justification a little over a century later, in the period of the 1970s, marking the beginning of the neoliberal era. Discoveries were made relating to the thermodynamics of systems outside of equilibrium and showing that the specific nature of living beings, a subject which had been heavily philosophized over, was essentially due to the fact that they were systems, receiving and ejecting matter and energy. These discoveries served to corroborate the natural standing of globalized liberalism, wherein man finds himself needing to ‘eat’ and spend money in order to live. Money thus becomes completely substituted for the archaic physical quantities of animals and plants. Man, through his intelligence, has constructed an extension of nature following its selfsame principles.

⁹³ *Das Kapital*, book 1, postface of the second edition.

⁹⁴ Nor does it perceive risks, hence the sociological importance, highlighted by Ulrich Beck, of this *abstract* notion.

⁹⁵ *Theses on Feuerbach*.

Consequences ensue and the human, the consumerist animal, always wants more. Criticism of the consumer society (Thorstein Veblen, Henri Lefebvre, Victor Lebow, Jacques Ellul, Noam Chomsky, Jean Baudrillard, Ivan Illitch, André Gorz, etc.) constitutes a misunderstanding of the essential nature of man. This last is demonstrated by, for example, the rebound effect. If, following the advice of ecologists, someone buys a car which consumes half the fuel his previous vehicle did, his nature will in the long-term, in perfectly good conscience and knowing himself to be in the right morally, lead him to drive much more than before.

We thus arrive at a point where economics comes to touch on the major metaphysical questions: who are we? Where do we come from? Where are we going? In other words, we come to the domain of the religious.

Origin of the economic faith system

If we define religion as a collection of beliefs which influence behaviour through enlightening the individual on good and evil, then we first have the revealed religions, founded upon texts produced by supernaturally inspired sages or prophets, following a process received by believers as a superior spiritual heritage. But we also have non-revealed religions, similarly definable as a collection of beliefs directing the individual towards doing good, but produced by the *careful reasoning* of minds pursuing the goal of analysing exactly what actions are desirable.

What is the difference between a “philosophical system” and a “non-revealed faith”? They are fairly close, both approaches being founded on reflection and reason. One factor distinguishing them, however, is the way in which they approach the novice. Philosophical texts aim to convince by appealing to *reason*, independently of the particular situation of the individual concerned, and hence possibly clashing with his particular customs. For example, Kant evokes situations of categorical imperative, “you must, so you can”, which could potentially trouble the conscience of the initiate and cause a distancing. Non-revealed religion, on the other hand, always tries to welcome current customs as being part of what is acceptable, and the focus is more on peripheral improvements.

An example is to be found in the positivism of Auguste Comte, who has the benefit of openness because his creation is explicitly a religion, a cult. Comte carefully provides an inclusive vision: religions are in the nature of man, and it is possible to reconcile them. Citizens can be led to a cultural practice and an educative movement thanks to science, this being positive religion: *the religion of humanity*.⁹⁶ Hence the sneers of the “true religious” towards this *ersatz*, this *facsimile*, and their concern for keeping the widest possible gap open between science and morality. What certain sociologists of the sciences today term the “great divide of the modern” is largely the result of this concern to contain science, to keep it as harmless knowledge which does not threaten religious, political and cultural values. It was the pursuit of this concern which led intellectuals to spend over a century worrying about the ontological rupture between the living and the inert, seeing it as the most fundamental question there was, with major consequences for what it meant to be human. Many did not hesitate to use episodes of progress in physics to consolidate the mystery of these two “irreducible” worlds.

However, when the aforementioned solution of open systems arrived, the battle against the religious pretensions of positivism had already been won. Apart from a few traces in Brazil, the religion of Auguste Comte had been forgotten. Moreover, serious difficulties had appeared regarding the pertinence of the positivist doctrine, even in the domain of

⁹⁶ A century later, the pragmatist philosopher John Dewey would take up again this interrogation of the religious as faith without institutionalised religion, and propose a similar solution: transmit to future generations the values of human civilization in its interactions with nature (*A Common Faith*, 1934)

science. After the subtleties introduced by quantum mechanics, as discussed by Bohr, Heisenberg and their colleagues, after the epistemological contributions of Bachelard, Popper, Lakatos, Kuhn, Feyerabend, and especially after the new global awareness of the damage science and technology were causing to the world, positivism was seen as moving too fast and too superficially, unabashedly lauding the benefits of science by defining it as the consensus between the different fields of knowledge. Positivism's "desire to be a religion" was too flagrant, and it could no longer function as a non-revealed religion. It subsisted only as a minimal epistemological doctrine, able to render certain basic services but generally unenlightening as a whole due to its limited character and its adaptability.

The second branch of positivism, that of John Stuart Mill, was much more perceptive; instead of plotting philosophical limits to scientific knowledge as Comte had done by discarding first causes and ultimate goals, instead of declaring that science was the discovery of *laws* governing nature and society, he trusts in the real social practices and intelligence of people. Mill established the foundations of a non-revealed religion which *remained incomplete* in its precepts but which was sure to function where its anchoring in the day-to-day was concerned, as long as society allowed a certain freedom of expression and individual action. This is what is striking about Mill's *utilitarianism*. It works without offending anyone in any political system which leaves the individual a sufficient margin of freedom to think, to express himself and to act within the classical limits of not impinging upon the freedom of others. For this, it is necessary that cults do not gain juridical nor political power – terms which mesh well with Protestantism but in fact do not exclude any obedience bar violent interpretations of revealed dogma.

Why did Mill's positivism not experience the same decline as that of Comte? Unlike Comte, and Marx, Mill did not seek to define the organization of a harmonious society. He does not take the dialectic progression all the way to synthesis. Moreover, his *System of Logic; Ratiocinative and Inductive* was not a binary logic but a plural one, since it appeals to diversity in points of view.

Mill is the author of a moral and political doctrine compatible with mid-19th century life in Europe, giving a valuable reference for political action in a time where the risks of societal rift due to industrialization were enormous. But where the philosophy of Marx concludes in favour of changing the world, because history is the result of transformations in material conditions realized by man, where it calls on workers to seize the means of production in the political movement of Communism, where Comte considers that only science can be a valid foundation for society and that it produces a wisdom as valid as that of any religion, Mill does not elaborate upon any ultimate utopia. Instead, he defends, with biting and sarcastic eloquence, the sole idea that the possibility of pluralist debate is in itself more important than the conclusions of political sparring.

By leaving open-ended questions to one side – an important characteristic which Popper would take up in his diatribes against communism – Mill's positivism did not collapse, and in fact barely even aged, because it could be relayed by liberal economics.

Today then, we find in it a gargantuan doctrine, a temporal and spiritual powerhouse which succeeds as a non-revealed religion where other attempts failed. The problem is obviously that it succeeds too well, preventing us from seeing problems outside of the field in which it was conceived. Comte and Marx are dead, but John Stuart Mill continues to impose on us his solutions to the problems of the 19th century.

What is the *god* of this religion? The entity positively conceived, which turns up and sorts things out through its mere presence, is obviously *the market*, upon which we project all that is left unsaid about hope, regulation and wisdom.

III) The teeth of the market

We shall now tackle the key issue of the dangerous absurdities arising from the financial neo-liberalism with which we wrestle today. It will be seen that there is an insurmountable reason why the world cannot continue with its present economic structure. Some believe a catastrophe to be imminent, perhaps in the form of an implosion of the financial system.⁹⁷

What I am going to show is that nowadays, given how finance functions, the market should not be considered an angel that provides for human failure, but as a shark that knows only how to use its teeth.

We will handle the problems step by step, beginning with the question of externalities, before then studying the origins of this rationality known as neo-classical language, and finally investigating exactly what the financial markets can do and what is completely forbidden to them by their very design.

⁹⁷ Cf for example Yves Cochet “Devant la catastrophe” in *Où va le monde ?*, Mille et une nuits 2012.

1. Non-marketable collective goods

Garett Hardin's famous text "The Tragedy of the Commons", published in the 1968 edition of *Science*, presents as a generic and archetypal situation a shepherd who selfishly takes advantage of communal fields that are free to use, and ends up exhausting this resource, acting in his own interest in order to increase the size of his flock for his own private benefit; meanwhile, the disadvantage arising from the rarefaction of the grass is a shared problem for all who use it.

We can exploit this observation in multiple ways. From the point of view of an economics which would, as Georgescu-Roegen asked, set out to understand and classify the various systems possible, the most interesting question is how the system of communal lands was able to survive for so long, and under what social rules it could both fulfil its duty and not succumb to the greed of one or another person who had obviously understood the issue raised by Hardin.

Common assets and, more generally, non-marketable goods pose a question to those who imagine a society governed solely by an invisible hand, like that modelled by the equilibria of neo-classical language.

When the "collective" was viewed as what was happening on the other side of the Iron Curtain, and general interest incarnated by the communist party of the Soviet Union, it was relatively easy to denounce this abuse, to show that it was via force, and sometimes propaganda, that certain people had taken power whilst pretending to represent the common interest. However, after the (surprising) collapse of this stratocracy and the fall of the Berlin Wall, there was no longer anyone claiming to represent the collective but the fragile and disparate United Nations. Hence, political forces in favour of liberal economy found themselves directly confronted with the lack of collectivist thought and the serious consequences this brought up for the environment. The solution most commonly suggested is to somehow find a way to include common assets in the ad hoc laws of economic dealings.

Externalities

To reach this kind of economization of the environment, it is enough to consider it as an external resource not governed by the market. This resource being limited, the will of agents must be susceptible to the creation of prices reflecting the propensity to preserve it, as happens with all rarities.

Those whose mentality is completely immersed in the language of economics do not even reason in terms of environmental preservation but denote as 'externality' a certain term of linkage in economical equations, in that the action of a particular agent has repercussions on others without these last having had any say in the matter. This situation can require the State or a community to play a role in correcting these effects.

It is stunning that, in the face of the current dramatic inertia noted and denounced on all sides, people still dare to reason about the environment by considering humanity as a planet-wide enterprise with an internal heritage and an external heritage, governed by a *production function*, a small parametric equation (two parameters in the case of a CES function – constant elasticity of substitution), of the type used to calculate the balance sheet of a business in micro-economics. Even today, this is still the *modus operandi* of many of the highest academic bodies. For example, in 2010, extending Nicholas Stern's teachings on climate problems, a symposium was held at the Collège de France, in Paris, on the economy and the environment, and the above approach was presented in all seriousness by eminent researchers. This is a sham. Economic logic is functionally incapable of conceiving its own limits. It tries to choose the cheapest policies, a clear demonstration of its prior assumption that the

preservation of economic science takes precedence over any other consideration.⁹⁸

In any case, it is not enough to construct models. Prices must be assigned to all things social, significant and interpretative, things which are neither bought nor sold – this is the object of cost-benefit analysis.

There is a deeper philosophical argument, often found implicit in the numerous arguments pleading the case for “economizing” common assets and assigning a monetary value to them. It is founded on the idea that the environment is not a clear notion in itself, but is defined by man and depends on historical society and linguistic developments. The difficulties we face with context depend on politics and the economy, which contribute to the definition of this context, qualifying and modifying it. Hence the only real context is an economic framework acting throughout history to create society.

This argument convinces some, but I personally find it highly ambiguous and dangerously capable of justifying any behaviour. The strength of the *damage reports* already published seems to me in any case to be worthy of public awareness.

Cost-benefit analysis

A revelatory welcome greeted the report published by Nicholas Stern,⁹⁹ who made use of all his talent as an economist to sound the alarm, and who had the courage to produce daring and striking new summaries, such as comparing the climate problem to the cost of World War II in order to alert journalists and provoke media discussion. Immediately, numerous articles appeared in the so-called A-ranked journals, accusing Stern of overestimating the costs of damage caused by climate change and underestimating those of a conversion to clean technologies when compared to what a “standard cost-benefit analysis” would have concluded. What then is this method, so well-established in the academic world, which allows a more scientific handling of communal decisions?

Cost-benefit analysis, henceforth referred to as CBA, was originally a tool used by the administration to make the most efficient use of state funds. In France, the Bridges and Roads Corps has made use of it since the 19th century (Jules Dupuit, 1848); in England, the economist Alfred Marshall developed a formal framework for it; in the United States, the Corps of Engineers set similar motions in practice. The golden age of this technique was 1970s France, in the time of the *Rationalisation des Choix Budgétaires* (Rationalization of Budgetary Choices) or RCB, based heavily on the American “Planning Programming Budget System”, or PPBS). It revolved around the economic selection of projects. How to decide between improving an extant motorway or setting up a motorway extension which would be more expensive, but would save quarter of an hour for millions of commuters per year? The problem is compounded if human lives are involved, or if there are significant impacts on the environment. A CBA takes the *totality* of criteria into account.

The main difficulty is in assigning prices to non-marketed commodities, but this is not the sole issue when environmental changes are concerned. Economists have suggested multiple methods within the framework of “the neo-classical economy of well-being”,¹⁰⁰ to

⁹⁸ Robert Solow had already reasoned thus: “if the elasticity of substitution between exhaustible resources and other inputs is unity or bigger, and if the elasticity of output with respect to reproducible capital exceeds the elasticity of output with respect to natural resources, then a constant population can maintain a positive constant level of consumption per head forever” cf “The Economics of Resources or the Resources of Economics” Ely Lecture, *The American Economic Review*, Vol. 64, No. 2, (1974), 1-14.

⁹⁹ Stern Review on the Economics of Climate Change, http://www.hm-treasury.gov.uk/sternreview_index.htm

¹⁰⁰ See D. Pearce, G. Atkinson, S. Mourato “Analyse Coûts-bénéfices et environnement, développements récents” OCDE 2006, a document without any critical discussion.

evaluate immaterial impacts and non-market goods or, in other words, to internalize externalities.

The first is that of *revealed preference techniques*, which uses various approaches to extrapolate these values from the prices of market products. For example, one would approach the cultural commodity of “being able to see the sea” by means of the difference in pricing between hotel rooms with or without a sea view. Or, as another example, one would make use of the figure which represented the total expenditure of households or users to protect themselves from nuisance. Thus, to evaluate the service provided by green spaces, statistics are examined on the pricing difference between properties situated by parks and forests and those in similar urban locations but lacking in green spaces.¹⁰¹ Other methods for analysing the costs of pollution raise the issue of costs due to illnesses, etc.

However, this approach is insufficient when the project has truly new characteristics, when there is nothing to compare it with. Here the method of *stated preference techniques*, also known as *contingent valuation*, is brought in. It is based in questionnaires which ask individuals concerned how much they would be prepared to pay to enjoy certain advantages or avoid certain nuisances, or how much they would be prepared to receive to accept the nuisances or miss out on the benefits. Using this information, plus a certain number of *aggregations* and discountings to match it to current monetary values, we are in a position to estimate and classify any kind of project.

Cost-benefit analysis in the modern world has become a political force in its own right. The weaknesses and the primary feature of this packaging – creating artificial markets for goods neither bought nor sold (such as good health, a long life, or clean air) – have often been denounced.¹⁰² Numerous aspects of this approach often translate in practice to “abuses of power”:

- the rich are prepared to pay more to avoid the same inconveniences.
- there is no “statistically” average user. The transition from a multi-criteria situation to a valuation uses an average here or there, but the result depends on the importance accorded to various parameters. Replacing a category or sub-category of the population by some nebulous “average” under the various criteria is not only crass, but generally speaking self-contradictory: a man of average height is not necessarily of average weight.¹⁰³
- Individuals, in fact, want to take care of other individuals, and are not guided by simple selfishness. There is a rejection of the principle of trading in moral values.
- Irreversible damage cannot be compared to losses of money.
- The future is trivialized in today’s discussion columns.

I refer the reader to the article by Ackerman and Heinzerling,¹⁰⁴ which contains examples so excessive that they reveal the distrust of society that is behind this primary approach. A general point worth stressing here is the reductionist simplification with which the *temporal dimension* is treated. Philosophically, time is what changes. Thanks to mathematics, not only through price adjustment but also through the very fact of fixing tastes as monetary totals, preferences are frozen in advance according to lists of categories. This leaves no room for adaptation to incorporate new information, issues or threats. The principle of a deliberative

¹⁰¹ An example of this immense literature : Morancho A.B. (2003). A hedonic valuation of urban green areas. *Landscape and Urban Planning*, 66(1):35-41. We have not yet, to my knowledge, used the price of lands purchased by foreign companies in Africa to “economise” the ecology of this continent.

¹⁰² See, notably, N. Hanley, “Are there Environmental Limits to Cost Benefit Analysis ?” *Env. and Resource Economics* 2 (1992) 33-59, and especially the remarkable article by F. Ackerman et L. Heinzerling “Pricing the priceless : Cost-Benefit Analysis and Environmental Protection” *Univ. of Pennsylvania Law Review* Vol 150 (2002) 1553-1584.

¹⁰³ Cf. A. Desrosières *La politique des grands nombres*, La Découverte, 2000.

¹⁰⁴ F. Ackerman and L. Heinzerling “Pricing the priceless : Cost-Benefit Analysis and Environmental Protection” *Univ. of Pennsylvania Law Review* Vol 150 (2002) 1553-1584.

process is inherently flawed. The philosopher Mark Sagoff reports that his students, when interviewed about a proposed ski station to be built by an area of wild country, were opposed to the idea as citizens, but as consumers expressed a desire to make use of the station if it were built.¹⁰⁵ There is no contradiction. Voting is not the same as buying. Where risks are involved, CBA falls into the basic trap of formalization, of fixing signifiers in mathematical writings so that they gradually become more and more separated from the actual risks they are supposed to signify.¹⁰⁶ There is a bypassing of the political institutions intended for the representation of citizens.

The use of CBA remains tempered by other considerations in the framework directives of the European Commission but for ancillary reasons, thus preventing a clear denouncement of the simplistic nature of these practices. Developments in environmental sciences and in the sociology of public decision-making have shown that decisions relating to urban areas are of such complexity that these methods are essentially useless, and that topics such as the disruption of natural areas, or water management, need much more elaborate decision-making procedures. Nevertheless, a network of active supporters continues to defend CBA as a solution to all societal issues,¹⁰⁷ and we still teach future engineers that we can use the economy to predict happiness levels long in advance.

The bulldozer of substitutability

Since the problem arose of how to internalize externalities, CBA, previously a method for selecting public projects, found a new use: the economization of the whole environment. This was for a long while the great idea of the liberals. In 1990, Claude Allègre wrote *Economizing the Planet* ('Economiser la planète'), in which he began the process of planting seeds of doubt around the works of scientists who did not agree with his views. In France, following the end of their Eleventh Plan, the General Commissariat of the Plan sought to unite ecological thinking and "economic rationality".¹⁰⁸ This was contemporary with the Rio Summit and the rise of the idea of sustainable development. Since then, CBA has been the subject of continuing works, including the particularly tricky question of biodiversity.¹⁰⁹

Under the enlightening title of *Millennium Ecosystem Assessment*, it is seen as THE solution when it comes to thinking of the ecology in economic terms: "The economic evaluation of biodiversity is characterized by three stages. The first stage is the modelling and evaluation of the role of biodiversity in the providing of *ecosystemic services*. The second stage is an estimation of the biophysical impact of changes in the level of biodiversity on the quantity and quality of these *ecosystemic services*. The third and last stage refers to the assessment of welfare following changes to the level of supply of *ecosystemic services*, depicting these changes in *monetary terms* wherever possible"¹¹⁰

¹⁰⁵ M. Sagoff *The Economy of Earth : Philosophy, Law and Environment*, Cambridge Univ. Press 1988.

¹⁰⁶ Cf N. Bouleau, *Risk and Meaning, Adversaries in Art, Science and Philosophy*, Springer 2011.

¹⁰⁷ Recently, on an programme on France-Culture on July 20th, 2009, the director of a joint INRA-CNRS laboratory, who was in favour of GMOs, called for a cost-benefit analysis to decide on the moratorium concerning Monsanto 810 maize.

¹⁰⁸ *L'économie face à l'écologie*, prefaced by Bertrand Collomb, Group Report chaired by Christian Stoffaës, La découverte/ La doc. française 1993.

¹⁰⁹ Cf B. Chevassus au Louis, J;-M. Salles, J;-L. Pujol, *Approche économique de la biodiversité et des services liés aux écosystèmes - Contribution à la décision publique*, Rapport du Conseil d'Analyse Stratégique, La découverte 2009.

¹¹⁰ <http://www.maweb.org/fr/index.aspx>; "Dans cette approche MEA, l'évaluation économique de la biodiversité est caractérisée par trois étapes. La première étape est la modélisation et l'évaluation du rôle de la biodiversité dans la fourniture de *services écosystémiques*. La deuxième étape est l'estimation de l'impact biophysique des changements de niveaux de la biodiversité sur la quantité et la qualité, de ces *services écosystémiques*. La troisième et dernière, étape se réfère à l'évaluation du bien-être des changements dans les niveaux de l'offre des *services écosystémiques*, dépeignant autant que possible ces changements en *termes monétaires*."

In these works, and in those just published by France's Strategic Analysis Centre (*Conseil d'Analyse Stratégique*), quantification is based on a division into two categories of species. On the one hand, *remarkable biodiversity* denotes those considered on an *ad hoc* basis to be *threatened*; for these, costs of maintenance and upkeep are calculated as with historical monuments. On the other hand, we have *ordinary biodiversity*, comprising all the other species; for these, we calculate the *ecosystemic service* they provide, from prokaryotes such as bacteria to eukaryotes (more complicated species), using the classical methods of cost-benefit analysis. This leaves us in a position to buy and sell any section of nature, or to exchange it against goods and services already quantified by the economy.

Some works are more elaborate, more nuanced, and show traces of multiple viewpoints. Economic logic is more diluted within them, but although harder to detect it remains the sole reference presented as intersubjective. The section "Sustainability and Well-being" in chapter 3 of the MEA report is pure *politeness* towards a few authors and leaves the issue unresolved.¹¹¹ The dominance of economic logic is reflected in the asymmetry between on the one hand a CBA analysis, presented as a utilitarian but perfectible approach, and on the other hand a multitude of irrational viewpoints: "Non-utilitarian value proceeds from a variety of ethical, cultural, religious, and philosophical bases". These works were continued in the TEEB study (The Economics of Ecosystems and Biodiversity), which demonstrated a desire to apply CBA when context makes it easy, and to keep a value which is not a "zero price" in other cases. The concept of *value* follows, throughout these texts, the line of early 20th century pragmatist philosophy discussed earlier.

On the erosion of biodiversity and the inertia with which the problem worsens, the data are overwhelming. I will not reproduce them here, but instead refer the reader to websites on the CBD (Convention on Biological Diversity),¹¹² notably, where the five *principle causes* of this erosion are discussed: demography, economic activity, level of international commerce, *per capita* consumption linked to individual wealth, and scientific or technological change.

Most important to examine in more detail are the *causes of laxity* in this area – in other words, the reasons why we do not change course. The growth in human population is one cause of erosion but the demographic factor is not, in itself, the real explanation for this incapacity to alter our approach. This can be seen in the fact that if current population growth were to stall but no other changes occurred – i.e., the same economic principles on increases in production and wealth were followed – everything leads us to believe that this erosion would continue unabated. Certain traditional beliefs are obviously a factor behind inertia, as in any area, but this effect should be qualified, as some common beliefs can actually be, according to the circumstances, the *most* respectful towards biodiversity. On the other hand, if we take a historical perspective, a look at the data reveals that modernity and technological development can certainly not be exonerated. Hence the question: are there not, in the course taken by Western civilization, historically and even now the most influential civilization, *too many good reasons for believing the irreparable to be reparable?*

The exact point I am trying to emphasize is that we must draw a parallel between the inefficiency of these international reports when it comes to halting the erosion of biodiversity and the inability of economic logic to perceive its own limits.

Economic theory pardons irreversible destruction

As knowledge, it remains intimately interwoven with beliefs. The economy, calling upon the reasoning of neo-classical theory, demands adherence. It proposes a mindset which needs to be trusted in. However, when faced with windfall profits and the aforementioned damage, its

¹¹¹ <http://www.maweb.org/documents/document.301.aspx.pdf>

¹¹² <http://www.greenfacts.org/fr/perspectives-mondiales-biodiversite/index.htm>

confidence-capital tumbles. Let us now clarify a few points:

It can no longer be believed that the scarcity value of the environment can protect it. It is not a market commodity. So, even if we use clever analyses to assign a value to it, it cannot be resold nor generate profits: take a specific area of marshland in destructive competition with a deposit of fossil fuels, and you will see that the two rarities do not evolve in the same fashion. There are lively, random fluctuations in the progress of the fossil fuels (anticipatory speculation) and progressive adjustments in the calculations of “ecological services”. The deposit will one day or another eventually be listed higher than the clever estimates calculated for the swamp.

We can no longer believe in the relevance of institutions for the economic assessment of “ecosystemic services”. As with rating agencies, they can only see problems *a posteriori*, by which time the damage has already been done.¹¹³

We can no longer believe that the economy leads to good behaviour, be it for managers of powerful international corporations or for the small-time fisherman in Oceania who scrapes the seafloor with his trawl-net.

Money is a convenient way to manage household life, to organize production, work and certain collective decisions. We could, nevertheless, imagine a very different financial system. However, we can no longer believe it possible to conceive of life on this planet as an interplay of free enterprise open to anyone with means. This idea is deceitful.

Instead of seeking to mathematize everything in order to extend the reign of economics, we must, instead, curb its domain. The idea of “ecological services” calls up a nomenclature of chemical and biological effects, some of which could be achieved by other means, technical, artificial and cheaper. Cost-benefit analysis gradually justifies all these substitutions on the basis of technocratic pseudo-equivalences.

To this is added the pressure exerted by patents. Artificial products are susceptible to appropriation by private enterprises, which will then use all the means at their disposal to see that these substitutions are accepted. The limits to patenting are constantly pushed back because the authorities making this decision have no other ethical reference in mind but the logic of economics.

From an epistemological point of view, technical innovation, highly rewarded in our current economical structure thanks to the patent system, depends on a conception of science which should be more intensely questioned. The idea, following Popper, that we have the right to try out theories just “to see” shows a spirit of conquest and adventure under whose spell we no longer fall. It inspires fear. If there is one thing we should mistrust, it is the domineering temperament and audacity of humankind. Instead, we must develop a scientific understanding which accompanies and cares for natural equilibriums, and which takes into account knowledge constructed by the social groups in question. *A higher quality of understanding*. In other words, an understanding which inspires greater confidence given the current social and geopolitical situation of mankind without writing out a blank cheque to specialists passionate about their field.¹¹⁴

Contingency analysis as a conservative political response

Use of cost-benefit analysis to estimate non-market commodities is destined to fail where the price of artificial services is concerned, thanks to the teeth of the market. Carrying out estimates for collective assets, even if periodically readjusted, will sooner or later put them in a situation of competitive weakness.

¹¹³ On the role of credit-rating agencies in the subprime crisis, cf. F. Lordon *Jusqu'à quand ? Raisons d'agir* 2008, p45.

¹¹⁴ Cf N. Bouleau “On Excessive Mathematization, Symptoms, Diagnosis and Philosophical bases for Real World Knowledge” *Real World Economics*. n 57, 6 September 2011, 90-105.

This argument is absolutely fundamental for management both long- and medium-term. Currently, however, liberalism is in the driving-seat, and we must use modern methods to react to the damage caused by mere profit-seeking. The serious accidents of pollution due to risks calculated according to schema in which the environment does not matter, the impacts resulting from lucrative projects, and the various *faits accomplis* arising from innovation seen as desirable as long as it has a market, all these situations demand operational responses in the framework of legal procedures currently in force. For lawyers of districts sullied by oil spills to be able to assert a polluter-pays principle, it is imperative that we have quantitative weapons to bring weight to bear on capitalism where it is most sensitive: the invoice.

In these struggles, contingency analysis can provide minimal values for estimating compensation, as long as the damage done to the environment is easily repairable. In the case of serious accidents, the costs of restoration will be much higher than the lack of ecological services as evaluated by method. Therefore there can only be a lasting policy of preservation if it is the cost of restoration which must be paid.¹¹⁵

The problem stems from the fact that there also exist situations of irreparability. As an ongoing strategy for the long-term management of non-market commodities, we need permanent credits to allow the operation of a system of measures and indicators, and to establish an overseeing, caretaking body to make sure that these ever numerous changes remain compatible with the equilibriums of the biosphere. Obviously, the capitalist does not follow the Kantian adage of acting according to principles one would desire to be universal laws; he does not follow it because he consumes far more energy and resources than he should, and because he selfishly contributes to the tragedy of the commons. In addition, the role of the State finds itself once again legitimized as necessary for the establishment of these policies of care. In the United States, the federal government clearly assumes this responsibility for the preservation of Alaska, the Union's "wild" state.

Tradable pollution rights

Certain economists working on environmental politics believe that a major theoretical step was taken with the invention of tradable rights to pollute. This highly debated notion surrounding carbonic gas emissions is nowadays well-known, and currently being implemented in Europe. The idea is that the State, or an international entity, puts quantifiable rights of emission up for sale, with economic actors able to buy or sell these rights amongst themselves, as long as the total global allocation is not exceeded. This allows a progressive reduction in these global rights of emission and favours changes in businesses' energy policies, with an interesting flexibility in that those who pollute very little can profit by selling their rights to those who have not yet been able to effect these changes. Being fairly delicate in its operational application, the method needs very careful controls and initial inventory.

The question we are faced with is whether this idea can be considered to allow a perfect *economization* of externalities in the case, for example, of the greenhouse effect. Have we managed to introduce the market where it was previously unable to reach because of collective non-market commodities?

We must be precise here. We have not exactly achieved a market in the commodity

¹¹⁵ Jean-Jacques Friboulet, in a highly convincing article, concludes that "no price system can take into account the irreversibility which marks the evolution of the biosphere. Market mechanisms are equally incapable of assessing the free services provided by our natural heritage. We must then supplement monetary estimates with quantitative and qualitative indices of flow and resources [...] Market economics are not capable of regulating through their logic alone the links between the economy and the biosphere". ("La théorie néoclassique et le développement durable, intérêt et limites d'un modèle" *Chaire d'Histoire économique et d'Economie du Développement* Univ. Fribourg 1993).

itself, we have installed a tax, and it is this tax which can be passed on, sold now or later, upon which we can speculate as with the financial markets. Negotiable rights to pollute must be thought of as an arranged tax. It is useful, even essential, as the works of the IPCC clearly show. But it is administratively difficult to control, especially when the unforeseeable occurs – material or economic accidents such as bankruptcies, etc. – and to such an extent that William Nordhaus, initially a fervent supporter, now favours a simple tax.

The leading role played by collective institutions crucially differentiates this from market spontaneity, as we will see in the rest of this chapter. The extension of the idea to the environment as a whole is impractical and not seriously considered by any economist. For the preservation of the rainforests, of territories and of ecological systems, the economy of free exchange has only one response: improvements to cost-benefit analysis.

Calculations and good conscience

Beyond cost-benefit analysis itself, there is also the more general rationality of accounting optimization. It has become extremely sophisticated among managers, who are reluctant to spend money unnecessarily.

In this way, texts on the deterioration of the environment inviting action, such as the Stern report, have developed an entire literature on *option values* which, in cases of uncertainty, bet on a higher technical performance which will cause useful changes to be less expensive later in time... hence an argument in favour of *business as usual*. Our current knowledge, upon which we found risk analysis, is what it is for now, but will improve in the future, hence leading to re-adjustments in the probability laws we have selected. Believing that results are random is not the same as believing that it is the law of probability itself which depends on chance and time; this allows us to carry out economic calculations using, as always, functions of utility and of production, which in certain cases show that it could be cheaper to wait.

Curiously, however, the economy is incapable of reasoning otherwise. In other words, it cannot consider the possibility that during the time before the deadline hits we might discover that the care we provide to contaminated patients, or the cleaning and filtering of polluted water, is much more expensive than currently estimated, thanks to the discovery of new complications or new problems with the remedies available today.

By assuming that progress will always be on its side, the economy cheats reality. In this way, it perpetuates the mindset of the private businessman who seeks profit via technological innovation, pulling ahead of analysis and expertise on environmental consequences and their translation into the legal corpus, and then, when the *fait accompli* effect fades and profits fall, simply abandons the business for another. As Barry Commoner put it: how is it that the entrepreneur does not worry about the perennality and durable nature of his activity? Because when the goose that lays the golden eggs is killed, he has the means to simply buy another.

The calculation easily convinces those who think only in monetary terms when it advises a lack of action.

It is however often founded on poor arguments, and in particular on *incremental optimization*. This is very important for ecological time-scales; there is a huge difference between carrying out annual improvements thinking of the year to come and taking into account the results of our actions in 25 years time, for multiple reasons:

- Firstly, because it is clear from an algorithmic point of view: from the base of the tree-branch, climbing ever higher, one can arrive at the tip of a branch without ever approaching the actual top of the tree.

- Then, there is irreversible damage, invisible on the level of individual incremental action. We do not see why continuing to pollute as we have already done should irredeemably destroy a species.

- Finally, and it is related, as with the environmental damage arising not in a progressive, gradual way but in an irregular and largely random manner, recovering causes after the effects is not automatic even when the causal chains that might exist are known. We can never be sure that other phenomena are not the real cause.

How can it be that calculations of cost-benefit analysis and of readjustment, despite their reductive character and various defects, suffice to leave defenders of the market economy feeling that they are acting in good conscience?

The first to follow this line of thought was obviously Blaise Pascal with his famous wager: *“Not to wager that God exists is to wager that He does not. Which then will you do? Let us weigh up the gain and loss of assuming that God does exist. If you gain, you gain all; if you lose, you lose nothing. Wager, then, without hesitation that He is. “That is very fine. Yes, I must wager; but I may perhaps wager too much.” Let us see. Since there is an equal risk of gain and of loss, if you had only to gain two lives, instead of one, you might still wager”*.¹¹⁶ Pascal was carrying out a CBA!

And it is worth re-reading what Voltaire wrote on the subject: *“It is evidently false to say that “Not to wager that God exists is to wager that He does not”: as he who doubts and seeks enlightenment most certainly does not bet either for or against. Moreover, this article seems somewhat indecent and childish; this idea of the game of winning and losing is not appropriate to the gravity of the subject. In addition, the interest I have in believing something is not proof of existence of that something”*.¹¹⁷

This last point is sound, already reflecting on the idea of performativity John Austin introduced in the wake of pragmatist philosophy and which would subsequently be extended throughout science – that is, the fact that science mixes its object of study with its action as intervention in social matters – including the economy, via the sociologists of science.¹¹⁸ For example, I have an interest in believing that I was “born under an auspicious star”; this encourages me in my undertakings but does not actually prove that I “enjoy divine grace”. We find here the exact same paradox which Jean-Pierre Dupuy calls ‘the paradox of Max Weber’, referring to the works of this sociologist on the role of puritan protestants in the birth of capitalism, these “saints overflowing with self-confidence”.¹¹⁹

Is it so surprising to mix religion and cost-benefit analysis in this way, in the end? Certainly, Christianity is probably the only religion at this point turned towards the universal, towards paying attention to the other, towards charity and open generosity; it confides in man a concrete and responsible task for the future of all. Historically, it has played a role of inauguration: “The concept of tolerance *stricto sensu*”, writes Jacques Derrida, “belongs firstly to a kind of Christian domesticity [...] In this way, in addition to the *Aufklärung*, the Enlightenment was essentially Christian”.¹²⁰ However, we cannot fail to be struck by the fact that it should be the main religion in those rich countries which display the highest level of

¹¹⁶ “Ne parier point que Dieu est, c'est parier qu'il n'est pas. Lequel prendrez-vous donc? Pesons le gain et la perte en prenant le parti de croire que Dieu est. Si vous gagnez, vous gagnez tout, si vous perdez, vous ne perdez rien. Pariez donc qu'il est sans hésiter. Oui, il faut gager; mais je gage peut-être trop. Voïons, puisqu'il y a pareil hazard de gain et de perte, quand vous n'auriez que deux vies à gagner pour une, vous pouriez encore gagner.”

¹¹⁷ Voltaire, *Lettres Philosophiques* (1734) Vingt-cinquième lettre : “Il est évidemment faux de dire 'Ne point pariez que Dieu est c'est parier qu'il n'est pas' : car celui qui doute et demande à s'éclairer ne parie assurément ni pour ni contre. D'ailleurs cet article paraît un peu indécent et puéril; cette idée de jeu de perte et de gain, ne convient point à la gravité du sujet. De plus, l'intérêt que j'ai de croire une chose, n'est pas une preuve de l'existence de cette chose.”

¹¹⁸ Austin John. L., *Quand dire c'est faire* (1962), Seuil 1970.

¹¹⁹ J.-P. Dupuy, *L'avenir de l'économie*, Flammarion 2012, p237 et seq La foi de la mauvaise foi et le choix calviniste.

¹²⁰ J. Derrida “Foi et savoir” in J. Derrida et G. Vattimo (dir.) *La religion*, Seuil 1996 : “Le concept de tolérance *stricto sensu* appartient d'abord à une sorte de domesticité chrétienne [...] A cet égard autant que l'*Aufklärung*, les Lumières furent d'essence chrétienne”

selfishness on the planet...

Let us return to the method. It consists of 1) acknowledging that the liberal economy treats the environment as an externality, 2) noting that this overwrites truly ecological and environmental objectives, 3) concluding that it is therefore necessary to internalize. For this, CBA in matters of biodiversity is based on an economic assessment of ecological services. This “taking into account” by the economy seems desirable, at first sight. However, it is a double-edged sword, and means that the same service when provided for less cost by artificial/chemical methods is necessarily better – leaving the door open to all sorts of destructive abuses.

What must be clearly seen is that the environment, “economized” in this way, is a *weaker* configuration than the rest of the economy. These artificial procedures are slow and technocratic. The force obviously lacking is *the market*.

2. The idealized image of the market is a dogmatized fantasy

Given the omnipresent nature of this notion today, in newspapers, on television, on the Internet, in political agendas, and so on, it requires only the least of wisdom – or curiosity, even – to wonder what exactly is covered by this term, ‘market’. We will proceed by mentally putting ourselves, insofar as is possible, in the position of the 19th century economists, those neo-classicists who attempted to state in mathematical terms what had already been understood by the philosopher-economists of the preceding century, the classicists.

The historical direction of their ideas would demonstrate the power of reference to *mechanics*, a highly elaborate and accomplished science at the time, and one which served as a canonical model of scientism.

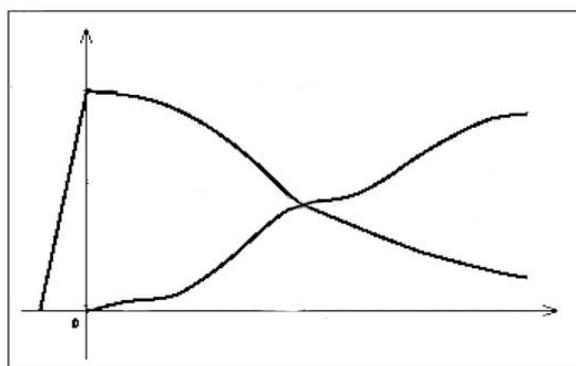
The economy models itself on mechanics by a very close parallel, the equations being identical to those used in the balancing of heavy bodies, but the work remained unfinished and incomplete because the neo-classicists never managed to develop economic laws relative to time. They limited themselves to mathematical representations of an instantaneous state – or rather, a variety of instantaneous states, for each one of which they stated the direction of its evolution but without ever stating exactly how this evolution happened. As for the kinetics of economics or the equations governing economic systems in relation to time, the page was left blank.

This deficiency was not a small oversight or accidental negligence of some kind. It has a crucial epistemological importance, intimately linked to the problems debated in this very work.

Cloud-functions

In order to better understand the epistemology of neo-classical economics, we will begin with a completely different domain, so as to demonstrate how a conceptual contribution came about thanks to a highly specific type of mathematization of reality.

In a very well thought-out work, the paediatrician Aldo Naouri examines the relationships between father, mother and child.¹²¹ One of the important ideas he advances is that the influence of the mother diminishes as the child gains in years, and that, conversely, that of the father increases. For obvious reasons, the mother has a nine-month head start in the matter, and Naouri illustrates his theory with the following diagram, in which the ascending straight-line represents the period of gestation.



¹²¹ *Le couple et l'enfant*, O. Jacob 2005.

Since the father's influence is rising while that of the mother decreases, the two curves must eventually cross. This defines an important moment in development which Naouri assigns to adolescence, a time when references shift dramatically and adult attitudes and childhood tastes find themselves mixing together. Naouri then traces an intermediary line between that of the father and that of the mother, representing parental influence as a whole, which passes through the point of intersection and is decreasing, but more slowly so than the line of the mother.

This is interesting, and highly suggestive. However, we must keep in mind that these curves *are not actually there*. If we were to elaborate an experimental protocol to give an idea of what these dependencies might be, following a child and its parents over twenty years and questioning them, either explicitly or by indirect observation, we would obviously obtain a *scatter plot*, or cloud of points, and not these rising and descending curves. As the influence of one of the parents can only be appreciated in the context of a particular situation, it is perfectly possible that this influence changes enormously over the course of a single day, depending on the activity of the youth. *Naouri's Law* is a very general one, found "behind" an observable reality which is by necessity widely dispersed, as the psychological and social phenomena in question are very poorly defined under the sole term of 'influence'.

In this case, Aldo Naouri is perfectly aware of the scope and limits of his mathematization, but a more scientific approach might possibly be able to use it as the point of departure for a theory, invoking for example the derivatives of the curves in the area of adolescence to explain certain phenomena. Essentially, this is the positivist approach taken by the sociology of Auguste Comte – there are *laws*, and the points in the cloud are due to the particularities of experimental circumstances. Supporting such a schematization is in itself a complex psychological phenomenon; the apparent innocuousness of the design contributes towards not feeling the need to reject it. In a way, the existence of such hidden laws also reassures us, as we feel that are not in completely unknown territory.

In the 19th century, the neo-classical economists took the same approach, but went further in their calculations.¹²²

Let us take the case of Jules Dupuit (1804-1865), the inventor of what is today known as *marginal utility*. In France, as the Bourbon Restoration was ending and the Second Empire beginning, the notion of utility was under debate. Dupuit saw it as a quantity, a property of the object exchanged and its price, divided up according to the advantages held by the seller-manufacturer or those of the consumer. "*Political economics*", he writes (as opposed to social economics), "*must take as a measure of an object's utility the maximum sacrifice each consumer is willing to make to obtain it*". He uses the now famous example of a toll bridge: "[the utility of a toll bridge] *is always divided into two main parts: 1) the lost utility corresponding to the crossings which would have taken place were the toll abolished and which have not with the current price; 2) the utility produced corresponding to crossings carried out. This utility is itself divided into two main parts: a) utility for the producer, or the product of the toll; b) utility for the consumer, or the difference in value between service rendered and price it costs*"¹²³

¹²² Léon Walras is explicit on the matter: "Mathematical facts must be distinguished, separated into two categories. Some are exterior... we call them physical facts, and they are the concern of the physico-mathematical sciences. Others are intimate; they happen within us, the theatre of their actions is deep inside us. Hence, as a result, they do not appear to others as they do to us, and if each of us can compare them to each other in terms of size or intensity, judging some to be bigger or more intense than others, this estimation will be subjective and individual. We call these Psychic facts; they will be the concern of the psychico-mathematical sciences. Mechanics and astronomy belong to the first category; Economics belongs to the second, and assuming it to be the first of its kind, it will probably not be the last". L. Walras "Economie et mécanique" *Bull. Soc. Vaudoise des Sc. Naturelles*, Vol 45, 313-325, 1909.

¹²³ J. Dupuit *Annales des Ponts et Chaussées* 1849

Since then, Dupuit, to recuperate the largest section of utility possible (cf. 'b)' above), advocated the setting of tariffs according to categories of users: "*There is the fine, the very fine, the extremely fine, and the super fine, all of which, despite being cut from the same cloth and showing no other difference than that of a superlative in the label, are sold for very different prices*".¹²⁴ "*So when the bridge is completed and the state establishes a tariff, it no longer has any regard for production costs, and charges less for a heavy cart which causes more wear and tear than a suspension cart. Why two different prices for the same service? Because the poor man does not attach the same price to the advantage of crossing as the rich man does, and raising the tariff would only prevent him from crossing*".

"*The aim is always the same*", he explains. "*It is to cause the service rendered to pay out not what it is worth, but what the buyer estimates its worth to be*" [ibid]. Dupuit invented market segmentation in 1840.

Moreover, Dupuit realized that, through the thought experiments which defined it, his notion of utility was difficult to measure. He recognized that it was abstract. "*It will perhaps be objected that the calculation for which we have given the formula depends on data which no statistic can provide, that we will thus never be able to express with a precise figure the utility provided by a machine, a road, by whatever type of work...*"

If we were to obtain measurements by varying the pricing of the toll, to evaluate how much traffic would remain and how much would disappear, we would not obtain a curve but a *scatter plot*. This is due to the fact that social reality is much more complicated than Dupuit had thought. Implicitly, he had made various assumptions of independence for the construction of his utility-function:

- independence from the opinion of other buyers: buyers do not consult each other.
- independence of buyer behaviour from details of daily historical reality. The cloud of "traffic relative to the toll" depends on the weather, the time, the season, and on a thousand other factors,¹²⁵
- independence from other ways of crossing the river, other toll bridges, ferries, and their tariffs
- independence from general trends. Dupuit's user is a consumer. He did not foresee that the buyer could also resell his toll ticket, like when one purchases a work of art (or even a common object nowadays, on e.g. Ebay or Pricemaster). This is obviously the case in the financial markets.

Let us emphasize an important feature of his method, which was to mark all economic thought until the present day: *Dupuit's reasoning was local*.

- *geographically local*: other river crossings, and other rivers, are not taken into consideration. What would happen if the State were to apply his reasoning to all bridges?

- *economically local*: Dupuit reasons as if all things were equal. If another provider in the transport service modifies their prices in relation to Dupuit's toll-bridge, the problem becomes more complicated, even instable (as was the case for Hotelling's ice-cream sellers).

- *above all, mathematically local*: the reasoning is a differential calculus (developed on page 375 of *Ann. des Ponts*, 1849), which was to open the way to the *marginal analysis* at the heart of *neo-classical theory*. Boundaries and limit conditions are absent. We will see below that the neo-classicists were heavily influenced by the laws of mechanics formulated, by Euler and Lagrange, as the result of an optimization: typically we examine the derivative of a functional to see where it vanishes, in order to find its maximum point. Or, equally, we might

¹²⁴ *Ann. des P. et Ch.* 1944

¹²⁵ Many of the curves economists trivially assume to be differentiable or convex can in fact be shown to be scatter plots. Obviously, price dependencies over time are real applications, never passing twice through the same abscissa, but then regularity is uncommon.

calculate the relative derivatives (elasticities) to see if they are equal, or we might translate a curve to see how the intersection shifts.

If we keep in mind that we are in fact talking about scatter plots, do these little variations of marginal analysis have a concrete meaning? Let us not forget that in the economy everything happens *within time*, and that here time is absent.

In fact, several years prior, Augustin Cournot had already asked similar questions about the *demand function* $D=F(p)$, which gives the quantity of the good resulting on the market from a certain price level p . “As so many moral causes, impossible to enumerate or measure, influence the law of demand”, he writes, “it is clear that we must not expect this law to be expressible by an algebraic formulation, no more than with the law of mortality or any of those laws determined within the domain of statistics, also known as social arithmetic. It would then be up to observation to provide means of drawing up, between appropriate boundaries, a table of corresponding values of D and p ; [...] and we could stretch the solution of problems to numerical applications.”¹²⁶

A fine philosopher, however, he realized the difficulties we described above, and he adds: “But even if we never reach this goal (because of the difficulty in procuring observations both numerous and exact enough, and also because of the progressive variations in the law of demand in a country which has not reached an appreciably stationary state), it would still not be unreasonable to introduce...”, and he continues by pleading for the interest mathematical analysis holds for general functions, allowing the relations between functions to be shown, thereby reducing the number of them needing to be empirically determined in order to deduce all the others. Dupuit and Cournot knew that utility and demand were difficult to measure, and even seem to admit it as impossible, but both trust in mathematics for their considerations to contribute to a lasting scientific knowledge. Dupuit, because the idea that the integral of a curve is different to a subjacent rectangle seemed to him robust in itself – not model-dependent, we would say today. And Cournot, because he believed that, even if the functions themselves were not known, it was still possible to find the laws linking them, such as there being a demonstrable relation between the mortality curve and the age curve in a country with a stationary regime, even if neither is explicitly known.

Economic models, begun in the neo-classical period, are of a very particular type. They propose a simplified vision of the world, as with all models,¹²⁷ but this simplified vision is *calculative*; in the language of simple “calculus” mathematics, functions are regular, indefinitely differentiable, with simple analytic expressions. Nicholas Georgescu-Roegen makes the following distinctions: “In physics a model is also 'a *calculating* device, from which we may compute the answer to any question regarding the physical behavior of the corresponding physical *system*'.¹²⁸ The same is true for the models of engineering economics. The specific role of a physical model is better described by remarking that such a model represents an *accurate blueprint* of a particular sector of physical reality. But the point, which I made in “Economic Theory and Agrarian Economics” and which I intend to explain in greater detail now, is that an economic model is not an accurate blueprint but an *analytical simile*.”¹²⁹ Georgescu-Roegen insists on the fact that the economic model is a concept so far removed from reality as to be insufficient for directing our actions: “To illustrate now the difference between blueprint and simile, let me observe that one does not need to know

¹²⁶ *Recherches sur les principes mathématiques de la théorie des richesses*, (1838).

¹²⁷ Cf N. Bouleau, *Philosophies des mathématiques et de la modélisation, du chercheur à l'ingénieur*, L'Harmattan, 1999.

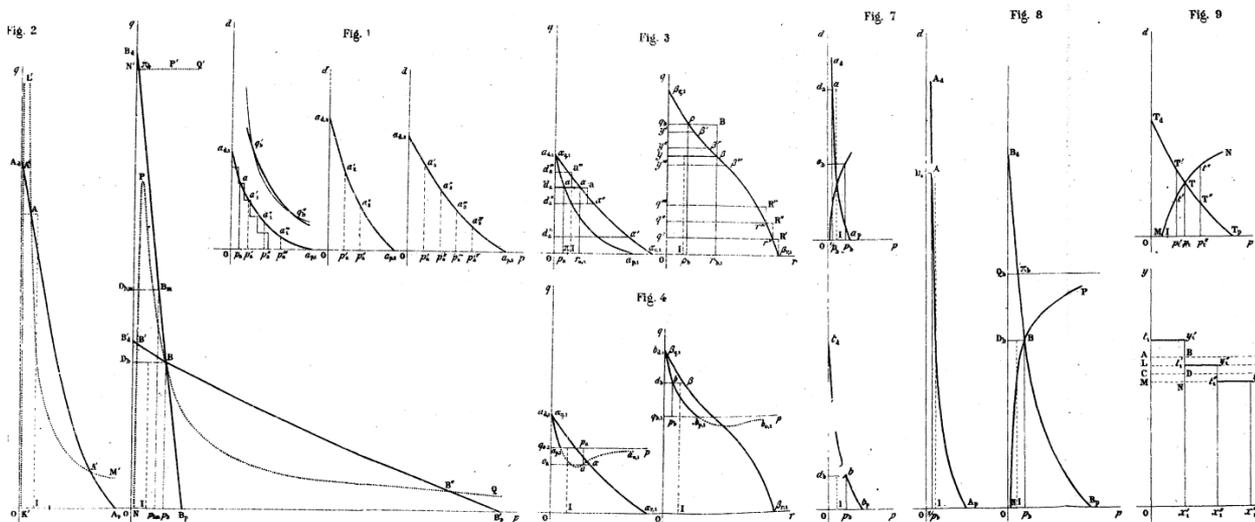
¹²⁸ P. W. Brigrman *The Nature of Physical Theory* Princeton 1936, emphasis from GR

¹²⁹ *The Entropy Law and the Economic Process*, Harvard Univ Press 1971.

electronics in order to assemble a radio apparatus he has purchased in kit form. All he needs to do is follow automatically the accompanying blueprint, which constitutes an *operational* representation by symbols of the corresponding mechanism [...] Many graduate students too feel greatly frustrated to discover that, in spite of all they have heard, economics cannot supply them with a handbook for banking, planning, taxation, and so forth. An economic model, being only a simile, can be a guide only for the initiated who has acquired an analytical insight through some laborious training. Economic excellence cannot dispense with 'delicacy and sensitivity of touch' — call it art, if you want.”

In fact, if we accept that economic models are abstract, conceptual models, such as that of Aldo Naouri, then we cannot reproach them for seeking simplicity. When Georgescu-Roegen wrote “why should economic laws, or any other laws for that matter, be expressed by analytical functions?” he was thinking of the most accurate representation possible of the *scatter plot*, but this was not the intent of the neo-classicists, who wanting to create an *outline* for running a business or developing public policy. The accomplished philosopher and economist Augustin Cournot had already realized this distinction, and informs the reader of his plan to ensure that “the solution to the general questions arising from the theory of wealth should depend mainly [...] upon this branch of analysis whose object is arbitrary functions, obliged only to satisfy certain conditions”.¹³⁰ The points forming the cloud are forgotten, and can even be replaced by theoretical individual behaviours conforming to the model.

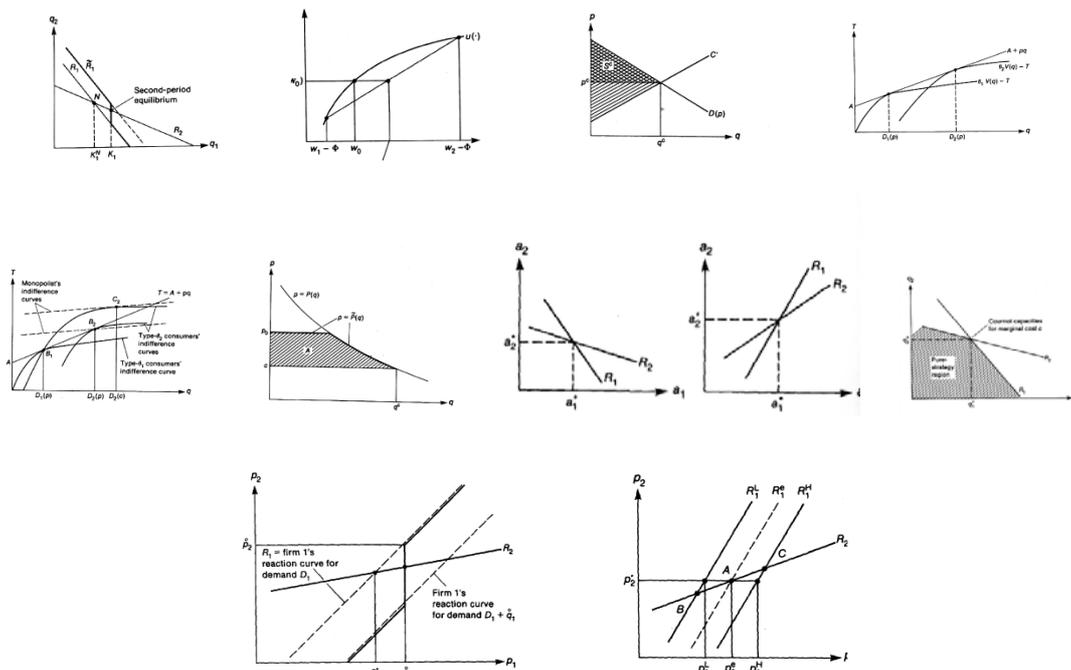
Let us see how economists reason. The curves of supply and demand in the main work of Léon Walras look like this:



Below now are some diagrams taken from Jean Tirole’s work, *The Theory of Industrial Organization*,¹³¹ and we see that the functions do not need to be very sophisticated, and in fact are even simpler than in Walras. The various arguments are explained with straight lines or with convex or concave curves – that is, symbolically using first and second derivatives. Note also that the arguments are local, and that limit conditions – highly important in real mathematical problems, and in practical economics, of course – are not mentioned.

¹³⁰ A. Cournot *Recherches sur les principes mathématiques de la théorie des richesses* (1838).

¹³¹ MIT 1988.



Neo-classical language consists of an immense simplification, aiming to increase understanding of trends which are not immediately observable and of the ways a system reacts when certain parameters are changed. The simplification is reminiscent – curiously – of that carried out by the Meadows team of the Club of Rome. In both cases, we have smooth curves, and in both cases, the equations governing the system are determinist and not especially complicated.

In this respect, the criticism William Nordhaus made of the works of the Club of Rome shortly after their publication is a blatant case of the pot calling the kettle black. Having reproached the Club of Rome’s works for being purely theoretical, his response took the form of a modelling in the exact same ilk, based, as is normal in neo-classical language, on a few determinist equations ‘à la Hotelling’ which give a more optimistic prediction of long-term trends by assuming that technology will improve: “Over the next century or so, many low-cost energy resources will be largely depleted, leaving more abundant but also more expensive resources. Ultimately, if and when the transition is completed to an economy based on plentiful nuclear resources (either through breeder or fusion reactors), the economic importance of scarcity of resources will disappear, and capital and labor costs alone will determine prices”.¹³² Without going into topics we shall explain in more detail later, let us note for now that Nordhaus makes the serious error of trusting completely in the regulatory effect of prices, even though in his opinion term markets (of options, futures) are not sufficiently developed on resource markets: “The absence of futures and insurance markets rules out the theorems usually drawn from general equilibrium theory.” We will see that, on the contrary, the presence of a term market does not stabilize prices at all, but, instead, *completely prevents all stabilization*.

The reality of markets providing quoted prices and interest rates, which are the data agents use to make decisions, is very different from the images given by neo-classical thought; it is stochastic, and cannot be understood without its chaotic temporal dimension.

¹³² W. Nordhaus, “Resources as a Constraint on Growth” *Amer Economic Revue* 64(2), 1974, et “The allocation of energy resources” in W. Nordhaus, H. Houthakker and R. Solow *Brookings Papers on Economic Activity* Vol. 1973, No. 3 (1973), pp. 529-576.

The amazing principle of least action

What made the neo-classical economists of the 19th century believe it possible to cleave to a purely local line of argument based in stylized cloud-functions, using neither measurements nor border conditions? The answer is the equations of mechanics and the example of light.

Science as envisaged by Dupuit resembled the optics of Euler-Maupertuis, and their principle of least action: it is resolved in the search for an optimum.

Maupertuis and Euler's *principle of least action* strongly impressed upon 18th century minds, like a splendid discovery bringing proof of the harmony of God's creation. It has remained at the centre of scholarly debates since the formal improvements to mechanics made by Lagrange, because it gives to understand that natural laws can be obtained as an application of the *calculus of variations*. It exercised a *religious fascination* on the minds of the 18th and early 19th centuries: "It is not then in the small details, in these areas of the universe whose relations remain too unknown to us, that we must seek the Supreme Being: it is in the phenomena whose universality suffers no exception and which their simplicity exposes to our view [as with the laws of light]. This is the principle of least action: a wise principle, so worthy of the Supreme Being and to which nature seems so constantly attached [...] What satisfaction for the human mind, in contemplating these laws which are the principle of movement and rest for all bodies of the universe, to find in them the proof of the existence of He who governs it!" (Maupertuis, 1748)

That the differential calculus used in mechanics was the explicit inspiration of the neo-classicist economists is attested to by Léon Walras: "Open the analytic mechanics of Lagrange, and you will see there that P and Q being two *forces* or *powers* applied to two points of a system, dp and dq being the virtual speeds of these forces measured by the infinitely small spaces susceptible to being crossed in a same instant by their points of application and depending on their directions, and Pdq and Qdp being the moments of the forces P and Q , following the definitions laid down by Galileo, then the equation $Pdp+Qdq=0$ expresses the equilibrium of the two forces. Well then, let us change the terms. Instead of force, put *scarcities* or intensities of the last needs fulfilled; instead of 'virtual speeds', put *virtually exchangeable quantities*, or infinitely small quantities susceptible to being added, via purchase, to quantities already possessed or to be cut off from them by sale in a trade. Then, the same equation will express the *maximum* satisfaction of an individual's needs or of economic equilibrium. In this way, if economics is not mechanics itself as applied to the balance and movement of cash, then it is at the very least a science analogous to mechanics".¹³³

Obviously, in this analogy, Walras is omitting the crucial role played by boundary conditions in resolving the problems of continuum mechanics. Just as with the principle of least action, we know today that the property of light waves which leads them to take the shortest optical path when crossing an interface gives the appearance of a purely local concern, thanks to the shortness of the wavelengths. Maxwell's equations on electromagnetic waves assume, as with all problems in physics, that the boundary conditions are known.

These salient features – independence of agents presented as an approximation, approaching prices and quantities as concepts, then over the 19th century as a function of production, the resolution of problems by local differentiation – were to become the framework for neo-classical theory. Stanley Jevons, Carl Menger, Léon Walras (general equilibrium), von Böhm-Bawerk, Vilfredo Pareto (theory of optimality), Irving Fisher, etc. created an evocative language of great flexibility, used to this day.

¹³³ Léon Walras, *Esquisse d'une doctrine économique et sociale* (1898) *Economica* 1992, p405-406, cited by F. Vatin, in "L'esprit d'ingénieur : pensée calculatrice et éthique économique", *Revue Française de Socio-économie*, n°1, 2008/1 131-152.

It is interesting to compare this epistemological approach to that which Condorcet had proposed, at the end of the preceding century, for another kind of mathematization of the social which can be seen as a still fledgling form of the theory of information or of survey techniques.

Condorcet, a highly capable mathematician, believed that the truth of uncertain assertions was delicate, and that “*calculus becomes necessary whenever the truth or falsehood of opinions depends on a certain precision in values*”. His plan was to apply probability calculus to the social, in order to understand how the “reason to believe” spread and was propagated – a notion somewhat similar to that of utility, but relative to the veracity or falseness of judgements. He pushed this idea, leading to his mathematically beautiful discovery of the “voting paradox”,¹³⁴ but did not think it could be extended to calculating behaviours.

“The universal quantity of merchandise or that of a particular merchandise can be approached via numbers; but the desire to buy and to sell is not susceptible to any calculation, and yet variation in price depends on this moral quantity, which itself depends on opinion and passions. Attempting to submit everything to calculation is a beautiful idea, but look at the greatest geometers of Europe, the D’Alemberts and the Lagranges. They examine the movement of three bodies mutually attracting each other: they suppose that these bodies are masses without extension, or bodies very similar to spheres, and this question, as limited as it is by a hundred facilitating conditions, has occupied them for over twenty years, and continues to do so. The effect of the forces acting in the head of a stubborn salesman are even more difficult to calculate”. (Letter to P. Verri, 1773)

Condorcet’s reasoning moves away from the concept, the reason to believe, and towards a mathematization through probabilities. *His epistemology is an extension of that of Laplace*: we cannot determine everything, principles, laws of forces and the way in which they act, etc. – all that is relevant is calculus of probabilities. The approach is an *a priori* limitation of science. Condorcet needs to make explicit all his assumptions, independence or correlation of opinions, etc., before carrying out calculations, as the results he obtains are highly sensitive to the laws of probabilities chosen, while for Dupuit and the neoclassicists these hypotheses can remain implicit.

How can we “reduce” cloud-functions?

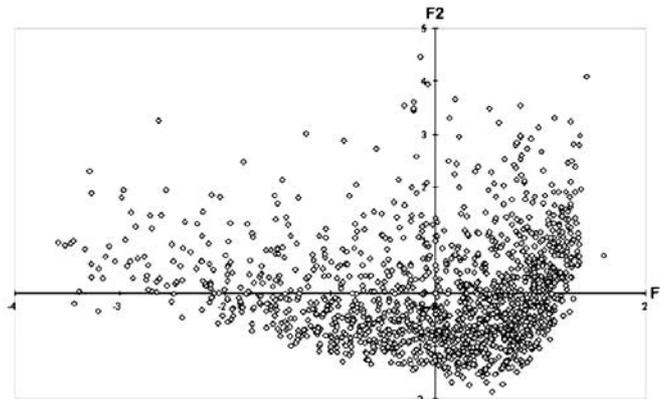
A natural question, which comes to mind upon seeing Jean Tirole’s diagrams, is whether these little lines and curves should not be epistemologically thought of as the result of statistical analyses of observed data. They would express correlations, and be lines of regression or curves of non-linear regression from the clouds measured. The laws of neo-classical economics could be shown as the result of principal component analyses or as estimates of conditional probability laws.

On a more fundamental level, it is the precise function of *econometrics* which finds itself under debate here. Edmond Malinvaud’s famous manual,¹³⁵ for example, is intellectually situated *between* neo-classical theory and reality. In fact, the work is entirely dedicated to statistics, with economics a mere pretext; it could equally well be a work on medicine and barely any changes would need to be made. The features of economic activity it does mention are given a very cursory examination. Econometrics finds itself in an ambiguous position. On

¹³⁴ Given three possibilities, A, B, C, there can be a majority who prefer A to B, a majority who prefer B to C and a majority who prefer C to A.

¹³⁵ E. Malinvaud, *Statistical Methods of Econometrics*, North-Holland 1970.

the one hand, it moves away from the real and towards a conceptualization, following an interpretative approach typical of statistics; on the other hand, it gives to understand that the neo-classical laws can be extracted from reality by use of inferential procedures. Econometricians will maintain that they do not postulate neo-classical economic hypotheses, markets are incomplete, competition is imperfect, the world is “second tier”, etc. The fact remains that neo-classical language is the main interpretative tool used, in addition to normal statistical tools. Econometric studies, in order to make sense, draw their resources from both sides, using circumstances and translation of observed conditions in economic situations, and taking from theory the tools to discuss these observations.



Scatter plot as provided by statistical studies applied to the social. Extract from a survey on “personality indicators”, in M. Loriaux and D. Remy, *La retraite au quotidien*, De Boeck 2005.

If we admit that neo-classical theory is a mechanistic model of certain social facts, then econometrics is a means of assigning these mechanisms to precise, dated social situations. However, as with the curves of maternal and paternal influence on the child in Aldo Naouri’s model, the law as realized in the context of real facts has great difficulty relying on what is observed, because the breadth of social reality represented has little in common with its small curves. This is where statistics come in.

Econometrics based on statistics return to the basic assumption that *the world is a neo-classical model disrupted by chance, which statistics allow us to correct. This idea is completely false.*

a) Firstly, it is not chance which distances the real world from mechanical models and their laws. Chance is only ever a bit-part player, neutral and mathematized, standardized in its meanings and its risks. The world is not ruled by chance, because there is no chance to be found in that which makes sense and motivates people. These are vitally important philosophical questions, which I discuss in my earlier work *Risk and Meaning*. The probabilistic world is a kind of standardization that is *incompatible* with meaningful understandings of the world. This leads to the issue of the “tails” of probability laws, which are never known and yet which concern the rare events which matter most to us. It also affects sample size in statistics and the epistemological place of qualitative surveys and case studies such as those used by sociologists, which are the only tools able to unearth notions not already present in the investigator’s model.¹³⁶ Think of what we call the labour market, and how it is a world infinitely more complex than that posited by chance and laws relying on regression curves.

¹³⁶ Cf B. Flyvbjerg, “Five Misunderstandings About Case-Study Research” *Qualitative Inquiry* Vol 12 Nr 2 April 2006, 219-245.

b) Above all, however, *chance is on the side of economics because of finance*. The shocking lie of econometrics is that it acts as if financial hazard did not exist, despite it being the main cause of disruption in the world, and as if it could be simply forgotten that neo-classical economics is composed of regular curves which are nowhere to be seen in reality, especially not in the speculative markets making up the heart of the economy – i.e. those upon which futures positions can be taken. *We must accept the revolutionary idea that finance is one of the predominant factors in the complete distancing of the real world from neo-classical models and the ideas of the classicists*. Econometrics is absolutely incapable – thanks to all the statistics that would be required – of giving the underlying trend of a quoted quantity in such a market. It is logically impossible. We will examine the reasons for this more closely in the final section of this chapter. Still, these immeasurable tendencies are those which would inform economic actors on the direction they should take for the “wealth of nations”, taking into account global constraints and limits on resources.

Two types of market

This discussion leads us to introduce a distinction: there are markets and there are markets.

When Marx and Say talk about the market and discuss the notions of value and surplus value, the markets they speak of are not the same as those markets about which Black, Scholes and Merton reasoned in terms of Brownian motion. Contrasting the categories, we can give the name *type 1* or *socially distributed markets* to trade situations where each buyer is recognized as separate, as is each seller, and the sale and article exchanged are strongly established both geographically and socially. The description of the article and the sale necessarily includes within itself elements pertaining to context. “I call ‘market’ that place”, wrote Auguste Walras in 1831, “where buyers and sellers, i.e. traders, meet, that is to say the place where we find on the one hand men with needs and, on the other, rare utilities suited to meeting these needs. Property, the fruit of limitation, and monopoly, which follows from property, are the reason why these rare utilities can only fall into the possession of those who need them through an exchange, containing at once a sale and a purchase”.¹³⁷ For example, the idea of the labour market is an aggregate, to help understand the role of savings, investment, unemployment levels, salaries, production, etc. Each real element is a candidate, with his or her own idiosyncrasies, for a particular job in a given business in a certain region at a particular date. The transaction will be subject to a contract, and the salary paid out over a period of time during which the worker hired cannot ‘resell’ his employment contract and hire a sub-employee to fulfil his role. “But rare utilities and the needs requiring them are not floating in mid-air, nor lost in space”, continues Auguste Walras. “Men cover the earth, and rare utilities propagate around them. One always finds, in a particular place, a particular quantity of people and a particular quantity of limited commodities. In this way, scarcity is created, determined and applied. It is always in a given place that we see the emergence of this highly remarkable disproportion, indicated above and long hinted at by common sense, between the totality of certain goods and the totality of needs which would possess them”. Similarly, the real estate market is a type 1 social-repartition market. It concerns buildings identical to each other only in that they might share a location; the procedure takes time, and the possible speculative behaviour of the buyer must necessarily take into account the individual characteristics of the building and urban change in the area, in addition to other general indicators contributing to spot price.

On the other hand, the financial markets are *type 2*, or *speculo-valued, markets*. The marketed item is standardized to allow the definition of a standard unit, as with continuous quantities in physics, and the exchanges are made more fluid, meaning that one can buy and

¹³⁷ Auguste Walras *On the Nature of Wealth* (1831), chap XIX.

resell whatever quantity one wants, whenever one wants. This then concerns *currencies*, which fluctuate in relation to one another whilst always retaining the property of transitivity in rates, *shares* in important companies, representing dozens of thousands of businesses, and *bonds and rates*, which are the tender of the loans given out by states or banks. However, it also concerns *standardized raw materials*: oil, gas, and various other petroleum products; metals both precious (gold, platinum, silver) and base (iron, zinc, aluminium), plus rare metals used in electronics, notably listed on the *London Metal Exchange*; agricultural products (wheat, soya, wool, cotton, rapeseed oil, palm oil, cocoa, rice, coffee, etc.), notably listed on the *Coffee, Sugar and Cocoa Exchange* (New York). These markets form the basis of the world economy, in the sense that any small business sees its supplies of basic commodities conditioned by these prices, and any agricultural enterprise sees its opportunities restricted by the same, via wholesalers. Financial markets provide a certain competition for the listing of these standardized products by remaining historically specialized; these markets are of course accompanied by derivative markets, trading in the classical derivatives and allowing the buying and selling of futures and options. Obviously, speculation plays a part not only as regards the function of rarities satisfying needs, but also plays a fundamental structural role. The rigorous logic of arbitrage theory shapes everything that happens in these markets.

Recent sociological studies often seem to blur the distinction between type 1 and type 2 markets, thanks to concepts relative to the social constitution of markets (economization, socio-technical arrangements, agencies, networks, performativity, etc.). The specific features of the quoted financial markets are that agents are at once buyers and sellers, and that mathematization is pursued to the creation of *formulae*, inducing a structuring of calculation agencies and of complex socio-technical agreements for the estimation of product prices.¹³⁸ These sociological analyses thus contribute to a better understanding of the historical emergence of contemporary finance and of some of its new institutions, but on the other hand they leave aside the essential characteristic of these markets – namely, that fixed prices are created by speculation itself, following a process which no-one understands in detail unless it produces an extremely convulsive result and said result conforms to theory. This characteristic is, in my opinion, the reason behind a completely new relationship between these markets, the problem of the entrepreneur in decision-making, and externalities.

Dyed-in-the-wool fans of “free trade” think it an excellent idea to try to convert all type 1 markets into one or more type 2 markets. They call this process fluidification, or giving more *flexibility* to the market. European officials in the directorates-general dedicate huge amounts of time and energy to this absurd, ideological cause, which aims to standardize listable units by rendering goods *fungible* and lifting all bans which might be the cause of black markets. From the resale of valid but unused railway tickets – which exists on the Internet, and is harmless in itself – to the market in organs and passports, etc., the limits to unacceptable transgression are being forever pushed back.¹³⁹ And this political error is accompanied by a theoretical one: type 2 or *speculo-valued* markets, have nothing to do with those conceptualized by Walras junior, and the neo-classical theorists.

The distinction between markets of type 1 (socio-repartition) and type 2 (speculo-valued) naturally leads us to ask whether it would not be possible to completely separate both kinds of market and take measures designed to diminish, even suppress, the influence of type

¹³⁸ Cf. MacKenzie D., *An engine, not a camera: How financial models shape markets*. MIT Press, Blackwell 2006; M. Callon “Elaborating the notion of performativity” halshs.archives-ouvertes.fr 2009; K. Çalıskan, M. Callon “Economization, part 2: a research programme for the study of markets” *Economy and Society* vol 39 n1 2010, 1-32.

¹³⁹ Cf Testart J., Godin Ch., *Au Bazar du vivant, biologie, médecine et bioéthique sous la coupe libérale*, Seuil 2001.

2 markets on the economy, and thus obtain an economy without the problems caused by speculation.

The reality is not so simple. In fact, while the two types represent two extreme positions, in practice we find all sorts of intermediary situations. When someone buys a painting, a beautiful old book or a country house, is this merely a social purchase, or is there not also an idea of being able to resell the object? An entrepreneur who optimizes the costs of his raw materials is, after a certain fashion, speculating on his stocks. More philosophically, use value seems to be influenced, even contaminated, by exchange value, as we are social beings and our tastes linked to those of others. It is hard to separate production and usage from commercial activity. However, if we cannot make this separation, then criticism of type 2 speculo-valued markets has a more fundamental impact on market economy as a whole.

Inside or outside the model?

We find ourselves now in the presence of two ideologies: the financial and the neo-classical. What then is the epistemological role today of neo-classical terminology, with its analytical utility function models and its production functions with exponents α and $1-\alpha$? These conceptual representations, while very simply mathematized, are shrewd and even amusing. It is quite enthralling to watch how putting pressure on savings causes investment to rise and unemployment to fall, etc. However, as with Aldo Naouri's model discussed earlier, this is all "in the air". A *utility function is exactly the same thing as the curve of paternal influence on the child*, being extremely far removed from reality. And this becomes dangerous, just as a psychological model would, when used as a reference for good conduct, being both ideological and without limits.

Using a little mathematical system to recognize "laws" between notions relating to "wealth" by quantifying them goes far beyond a theoretical exercise – a job for philosophers – when this model becomes the primary reference for most actors.

The model remains a *mechanistic* image of an abstract human being, far removed from reality on both the individual level (think of the immensity of the fields of psychology and psychoanalysis) and the collective (think of the variety of usages and cultural values, and of the epistemological complexity of sociology).

Let us take an example external to neo-classical theory itself but a product of its aftermath: the Nash equilibrium, in game theory. In a game with multiple players, a Nash equilibrium is present if each player's strategy is optimal when the strategies of the other players are fixed. We can, on reflection, show under certain hypotheses that if time passes or parties succeed each other, a stable situation will be a Nash equilibrium, because if this were not the case, at least one player would not be playing as well as he could. The game dynamic is a more complicated matter, and can be strange in some cases. To remain within a Nash equilibrium, each participant seeking to optimize their position, it is also necessary that even if one player makes a slight adjustment, the other players are not obliged to alter their strategies. (We see mathematically that there is a need for a *contractive* dependence condition between the various strategies in a suitable normed space).

If we apply these ideas to the case of the market in credit derivatives as it was organized before the subprime crisis (which will be examined in further detail in the sixth section of chapter III), we must consider that the trading of securitized portfolios between financial institutions, the risks of which were safely assessed by coherent risk measures themselves calibrated by the market in credit derivatives, was not far from a Nash equilibrium. In fact, the prices indicated on the market allowed any establishment to mathematically optimize the prices of their own contingent assets. Moreover, it was the very idea of the Nash equilibrium which strengthened securitization and credit derivative procedures during their introduction at the turn of the 21st century.

But what lesson are we to take from the historical reality of the subprime crisis, now so widely known? It shows us that agents – and modellers – can believe they are in a Nash equilibrium whilst actually being on the verge of a major crisis. This is simply because the notion of the Nash equilibrium is extremely model-dependent, and models require *interpretation*. Our interpretative faculties allow us to understand the world according to a new and different reading (here, understanding that the contraction in US household savings and the rise in property prices could not continue indefinitely).

It was precisely these interpretative faculties which Charles Peirce and John Dewey thought they could reduce to the possibilities of action, this being the fundamental reductionism of pragmatism.¹⁴⁰

In the real world, players are not in game theory; the game they play is not fixed, the same for everyone and drawn from a common rulebook, but depends upon their own ability to interpret the economic world.

If we replace the *optimizing individual* (representing Cournot's ideal economic actor) with the *interpretative individual* (coming under a more creative conception of the social subject), neo-classical theory as a whole collapses, as does game theory, which had supported it. The interpretative individual has a permanent interest in what causes a certain mathematization of the world to be partial, incomplete, unworkable. It manufactures counter-expertise and counter-modelling. It sees things differently.

We are all interpretative, and only allow ourselves to remain within the rational of a particular model if we are made to by political force.

In fact, that is not exactly what happens. In reality, economists consider themselves interpretative beings, eschewing some models and constructing others, etc., and believe ordinary humans (and market agents who fail to predict crises) to be the prisoners of reductive models.

Why is there no economic kinetics?

The neo-classical economists were inspired by mechanics, but not enough as to take time into account. A very large number of economists, feeling constrained by this mindset which is still taught to students today, noted this deficiency and worked to better understand the reality of an economics in which time played a role. The first stage in progressing from a static formalism which tried to perfect the theory of general equilibrium would have been the study of *kinetics* – that is, economic phenomena involving the actual speeds of changes in quantities. In mechanics, this opens the door to the phenomena of viscosity, vortices, turbulence, etc., which are all very current and well represented mathematically. In a science like chemistry an analogous issue arises, that of moving beyond simple descriptions of equilibria wherein the concentrations of the constituents are stabilized and on to the role played by speed of reaction – thus leading to an understanding of catalysis and the discovery of a vast, surprising phenomenology.¹⁴¹ Kinetics has a clear importance in life sciences. It is therefore only natural to ask: if economics is susceptible to arguments similar to those of equilibrium in heavy bodies, why is there no corresponding body of reciprocal arguments incorporating speed in relation to time – that is, trends?

¹⁴⁰ Cf N. Bouleau “On Excessive Mathematization, Symptoms, Diagnosis and Philosophical bases for Real World Knowledge” *Real World Economics*. n 57, 6 September 2011, 90-105.

¹⁴¹ Cf. for example Vidal C., Lemarchand H., *La réaction créatrice*, Hermann 1988.

One way to answer is to say that real economics, in fact, does take place in time and finds there all the complexity and creativity of life itself. It is therefore out of the reach of formalisms.

A highly popular critique in this vein was developed towards the end of the eighties. Epistemological thought on physics and biology had been a turning point for systems sensitive to initial conditions, open systems, and chaotic systems. Similarly, environmental philosophy had alerted public opinion to the unexpected advance of technology and the links between pollution and entropy.¹⁴² It seemed essential to mark the intellectual paucity of reference to neo-classical schemas compared to the finesse and fertility of these new ideas. The rallying point of this renewal was the study of the consequences arising from the fact that economics à la Walras had not taken into account the *irreversibility* which seemed the keystone of both the dialectic tradition (Hegel, Marx), which insisted on the driving role of creativity in human efforts for the evolution of societies, and of the new discoveries and possibilities appearing in the natural sciences.

The 'tâtonnements'¹⁴³ of the market unfold in real time, and the first observation to be made is that the order of players is not unimportant. In the labour market, when it comes to discussions between the head of a business and trade unions on the issue of pay rises, having the initiative and “going second” are not equivalent, as the action taken by the first to move then alters the conditions determining the choice of the second.

Another aspect in the interplay of supply and demand with relation to price is that the responses of the “players” take a certain time to be played out. They are then consequential to what is taking place but with a certain delay, which easily produces cycles and prevents the reaching of a fixed point. To this must be added the fact that the magnitude of the response can be excessive. Sensitivity to changes is often governed by threshold phenomena, meaning nothing happens until a certain level is reached, and then a sudden, abrupt reaction takes place. Even in the case of gradual responses, large levels of elasticity can cause the process to diverge. We thus come to what M. Ezekiel described in the 1930s as a cobweb response.¹⁴⁴

Moreover, asymmetries are common between increases and decreases. A temporary reduction in production, leaving part of the productive capital unused, is an easier decision for a manufacturer than increasing production for a brief period of time. In more complex situations, or when thinking on a macroeconomic scale, a path effect often appears. For example, it has been demonstrated that purchasing power parity was not the elastic restoring force governing exchange rates between currencies, but that these last actually depend on the historical path of public policy.¹⁴⁵

These works launched a highly interesting field of research on what can be called *real economics*, this being defined as an economics which takes into account the *temporality* of decisions; meanwhile, neo-liberalism was established and deepened misunderstanding, thanks to its heterodox academic circles.¹⁴⁶

In this, however, we have not really answered the question of the absence of economic kinetics, but rather that of the pertinence of the theory of general equilibrium à la Walras – an equally fundamental question, but a different one. There remains a real historical enigma in

¹⁴² Cf. Georgescu-Roegen N., *The Entropy Law and the Economic Process*, Harvard Univ. Press 1971.

¹⁴³ term due to L. Walras, used by economists, denoting the trial-and-error process.

¹⁴⁴ Ezekiel M., “The Cobweb Theorem” *Quarterly J. of Economics*, vol VII n1, 1937-38, p279-280.

¹⁴⁵ Cf. Aglietta M. “Stabilité dynamique et transformation des régimes monétaires internationaux” in *Les figures de l'irréversibilité en économie*, Boyer R., Chavance B., Godard O., eds, Ecole Hautes Etudes en Sciences Sociales 1991.

¹⁴⁶ Cf. for example Sapir J., *Les trous noirs de la science économique*, Albin Michel 2000.

the fact that we start theorizing but stop at the very beginning. The analogy between neo-classical theory and mechanics is not a simple formal similarity between certain equations, as often happens between various theories.¹⁴⁷ It has an important *historical* role in reinforcing the legitimacy of mathematized economics, thanks to the immense prestige mechanics has acquired, as we saw earlier. W. Stanley Jevons and Léon Walras argued extensively on this subject, the legitimacy of bringing mathematics into the human sciences being no more automatically accepted in that time than it is now.

This is the main theme of the preface to *Elements of Pure Economics*, and Walras developed it still further towards the end of his life, in the article, “Economics and Mechanics”.¹⁴⁸ He stresses the formal similarity between static equations in mechanics and those involved in economic equilibrium by taking as examples the moments of forces acting on a steelyard balance and the proportionality of scarcities and prices. In *The Theory of Political Economy* (1871), Jevons expresses a similar state of mind: “the theory here given may be described as *the mechanics of utility and selfinterest*”. He refers to the *virtual velocities* – i.e., to the mechanical approach of carrying out infinitesimal changes in the position of the application points in order to easily discover equations (the method used by d’Alembert as the principle of virtual work) – which re-establish the lexicon we established above. Jevons devotes a whole section, called “Analogy to the Theory of the Lever”, to this correspondence between economic balance and that of the lever.

If we take an epistemological step back, we cannot avoid being struck by the partial and incomplete nature of this analogy. Neo-classical theory is a theoretical construction which provides a model of the commercial trade of a society but *in a static manner*. We know that this model is simple and mathematical, far removed from what happens in reality, but what is much more surprising is that it is a model in which everything moves – supply, prices, demand, etc. – yet which does not involve time. How can quantities evolve and change without time being present in the equations? From the analogy with mechanics, we immediately call to mind those strategies of actors governed by functions dependent *on variables and the trends of these variables*. Fundamentally, mechanical equations provide a material system with a relation between parameters of position and their first and second derivatives in relation to time. Nothing of the sort is to be seen here, as the neo-classicists did not study systems governed by equations of the type:

$$p_i = F_i(p_1, \dots, p_n, q_1, \dots, q_n, \dot{p}_1, \dots, \dot{p}_n, \dot{q}_1, \dots, \dot{q}_n) \quad q_j = G_j(p_1, \dots, p_n, q_1, \dots, q_n, \dot{p}_1, \dots, \dot{p}_n, \dot{q}_1, \dots, \dot{q}_n)$$

where the points designate derivatives with respect to time. There exists no economic kinetics in the way that there is a chemical kinetics which allows us to posit and calculate reaction speeds and is behind the discoveries of the behaviour of certain self-structuring dynamic systems.¹⁴⁹ For Walras, the effect of price signals on demand, or of demand signals on price, is a process – ‘tâtonnement’ – not amenable to an explicit mathematical representation. The curiosities of what would be provided by chemical kinetics do not seem to him worth the effort of an investigation, as it would only confirm the tendency towards equilibrium. Only the *signs* (+ or -) of responses to increases can interest him in considerations of ‘tâtonnement’, as when one attempts to weigh an object by adding and removing ever smaller weights to the other side of a balance.

The *price signal* of goods – that is, the amplitude of price trends – is what provokes changes in the behaviour of economic agents, and hence has repercussions on the price itself of products fabricated or services provided. This loop can give rise to regular or irregular

¹⁴⁷ For example, the theories of electrostatics, gravitation and heat, which all interpret the formulae of classical potential theory, cf. N. Bouleau *Philosophies des mathématiques, op. cit.* p 224 *et seq.*

¹⁴⁸ *Bull. Soc. Vaudoise de Sc. Naturelles*, Vol 45, 313-325, (1909).

¹⁴⁹ Bénard convection, the chemical reactions of Belusov-Zhabotinsky, etc.

cycles, such as the relations governed by Volterra equations. Prices and quantities are both functions of descriptive parameters belonging to the economies studied, which can themselves vary for exogenous reasons and require the presence of tendencies. Economic kinetics would be likely to cause the appearance of phenomena analogous to those found in fluid mechanics in dampers or whirlpools, such as stable yet non-optimal trajectories on indifference curves between two goods, price signals with delayed interpretation creating dynamic predator-prey type systems, and so on and so forth.

Subsequently, in the 20th century, academic studies on economics filled this gap by studying temporal systems in their improvements upon neo-classical theory¹⁵⁰ and within the framework of game theory.¹⁵¹ Two main routes of investigation were followed: firstly, the research on intertemporal equilibria which in the 1950s basically studied the stability of a constant, hence exponential, growth regime; secondly, the study of problems of intertemporal optimization under constraints, using either classical mathematical tools (Lagrange multipliers), or more recent ones (the theorems of Kuhn-Tucker or Hamilton-Bellman-Jacobi), and notably the works of Arrow-Hurwicz, around the 1960s. In these studies,¹⁵² the corrective mechanisms for agent behaviour according to price were modelled following various hypotheses. These investigations then branched out into numerous sophistications under the frameworks of game theory, learning theory, and the theory of dynamic optimization.

Given the fact that market price agitation was admitted into theory from the end of the 1960s,¹⁵³ what is striking in all these works is the lack of importance accorded to the fact that price trends from competitive markets are not visible, meaning that calculations of intertemporal optimization remain abstract commentary-models with no clear connection to real economics. An important part of these works remains within discrete-time, and the sophistications of neo-classical terminology rest even more today on a theoretical structure which is essentially static, and only marginally modified. For example, to represent the production capacities of a business in relation to disposable capital K and mobilized labour L , the production function most commonly used is still of the type $Y=F(K,L)$, like that attributed to Cobb-Douglas, with a possible property of homogeneity (constant elasticity of substitution) expressing yield on a constant scale – an equation in which trends do not feature at all. Economists are still in the habit of creating intertemporal models and theories limited to two periods – or three periods, in order to be able to transcribe a recursion taking into account observed growth – as if this implicitly contained the general case, with increments providing derivatives when the time interval tends to zero. Also, until recently, econometrists did not concern themselves with tendencies. Edmond Malinvaud dedicated one page in 750 to this issue, and proposes a statistical test without describing the assumptions made either of its validity or in estimating its convergence speed as the time interval tends to zero.¹⁵⁴

An original historical development in economic knowledge thus emerges. On the one hand, we state that economic kinetics is non-existent, or at least a belated and secondary issue

¹⁵⁰ Thus, Ramsay's model (Ramsey F. P. "A Mathematical Theory of Saving", *Economic Journal*, 38, pp. 543-559, 1928), Hotelling's model (Hotelling H. "The economics of exhaustible resources" *J. of Political Economy*, vol 39, n2, 1931) and Solow's model (Solow R.M. "A contribution to the Theory of Economic Growth" *Quarterly J. of Economics* 70, 65-94, 1956), all comprise derivatives with respect to time. Other models make similar use of variational equations where the unknown is a function of time. It remains nonetheless true that the immense variety of phenomena which would be induced by an economic kinetics has not been thoroughly investigated.

¹⁵¹ Cf. Gaël Giraud *La théorie des jeux*, Flammarion 2009.

¹⁵² Cf. the summary by Leonid Hurwicz "The design of Mechanisms for Resource allocation" Richard T. Ely Lecture *The Amer. Economic Review*, Vol 63, 2, 1-60, 1973.

¹⁵³ Cf the articles by P. Samuelson (1965) and R. C. Merton (1973).

¹⁵⁴ Malinvaud E., *Statistical Methods of Econometrics*, Noth Holland 1970.

in the structure of this discipline. On the other hand, we can see that since the creation of the stock exchange, though with a notable recent resurgence, a large number of variables essential to economic operation have become subject to listing on financial markets – markets of the speculo-valued type 2 *where trends are not visible*.

Let us summarize. 1) The core of the neo-liberal mindset is static, and does not incorporate tendencies. 2) The financial markets developed, with the importance we know, over the neo-liberal period covering the last thirty years, do not provide trends nor prices for raw materials, nor for currencies between themselves, nor for the actions taken by businesses. We could then believe that there is a consistency between these two phenomena and that the development of the modern economy does not need trends to function, that the workings of financial markets confirms the ideas of people like Jevons and Walras. A new harmony or a *new alliance*?

Not at all. The two logics are absolutely contradictory. If the contractors for materials and the devices required for their production, and if consumers of goods with a certain durability – goods not immediately destroyed by their use – were instead of reasoning in static terms to take into account the trends attached to these prices in order to optimize their choices, the result would be the beginnings of speculation. Trends above the rate of interest (a riskless rate) would induce purchases and this speculation would cause prices to rise. Similarly, downward trends would induce sales. Progressively, a term market would arise for these commodities or services in which... we would no longer see trends. The reasons for this will be given in section 4 of this chapter.

Economic kinetics is a contradictory notion: if agents realize the existence of trends and develop type 2 markets around them, the trends disappear. We can no longer see them, as they are completely hidden by volatility. This is for incontrovertible reasons¹⁵⁵.

Let us consider a business producing fuel for domestic boilers consisting of granules composed of residue from sugar beet, rapeseed and leftover wood. Its unit cost p is determined by the equation:

$$dp/dt = F(p_1, dp_1/dt, p_2, dp_2/dt, p_3, dp_3/dt)$$

If p_1 , p_2 , and p_3 follow regular curves in relation to time, the company succeeds in optimizing its price to increase business. If one of the three products is put on the market as a standardized, globally traded raw material, nothing can be seen any longer.

We can express this in another way. In an economy where all commodities are the object of type 2 markets, objective information on tendencies can only be obtained from sources external to the markets, such as watchdogs for economic behaviour, specialized agencies, announcements from the State, etc.

Inversely, in order for price trends to be visible and induce specific, quantified behaviour, it is necessary for the market in question to be hampered by rules preventing the

¹⁵⁵ The idea is not new. Paul Samuelson began his well-known article “Proof That Properly Anticipated Prices Fluctuate Randomly” (1965) with the quip that “in competitive markets there is a buyer for every seller. If one could be sure that a price will rise, it would have already risen”. Then he attempts to clarify the issue using rational expectation and by appeal to its mathematical formulation of conditional expectation. He thus obtains a model for spot prices that is a martingale. Two remarks are appropriate: The question addressed in the introduction and in the title of the article concerns the *volatility* of the rate, thus it is not the property of the martingale *itself* that answers to this observation. For there are some martingales that do not fluctuate much. A compensated Poisson process is quite calm; its derivative is deterministic at every instant of time. Yet observations show that the spot price does fluctuate. As we see it, the importance of this phenomenon is a question of order of magnitude. What I insist on is that this volatility is not simply an amusing curiosity and a secondary epiphenomenon. On the contrary, this volatility causes the global economic machine to slip and to stick: it no longer shows the price signal that entrepreneurs value and which Hayek saw as the most intelligent aspect of the market economy.

So the idea is not new, but its consequences have not been understood at their full extent.

application of the principle of arbitrage, causing time-series to provide trends that cannot be immediately benefitted from.

Interpretation-models and commentary-models

Given the lack of economic kinetics, the economists who want to follow in the epistemological wake of neo-classical language make models in *discrete time*. Students are told that it is “customary” in economics, that it allows them to concentrate on truly important questions, that it does not affect anything... We will see that, on the contrary, it rather deeply affects the epistemological significance of the model.

In order to clarify our ideas, let us take one such economic model, related to climate change. The IMACLIM-R model, admirably produced and developed by the CIRED team in France, functions using successive equilibria. At each date, a division of the world into regions and parameters qualifies economic variables so that production, consumption, savings, various energy costs, the different types of investment and commercial exchange are calculated in such a way as to satisfy an equilibrium, which is then translated by prices. This is done through a numerical fixed-point method, using as a starting point equations of slightly improved production functions.

Then, we move on to the next time-step, where a similar method will be applied. The passage from an instant, n , to the instant $n+1$ is the object of a *transition* where certain variables are modified, be it by recognition of a climate policy or by studying a particular scenario. These modifications done, the equilibrium must be rechecked and the fixed-point algorithm reapplied, this time to the stage $n+1$, before continuing.

The model is constructed in this way in order to be able to say that each stage has a representation, static (as in neo-classical economics) and pertinent to a “possible” economy.

Nevertheless, the main point, which we must keep in sight at all times, is that *if the model reflected reality and if this model was scientifically known and recognized, the fluctuation in price between time n and time $n+1$ would be used for profit by agents (not merely speculators, but all agents), meaning that the prices would not remain those of the model*. The model is impossible to realize. It cannot be “true”. It is not enough that at each stage the economic likelihood should be safeguarded for the model to be able to claim to represent what will happen.

Purely descriptive models such as those of the Club of Rome do not have this flaw. On the other hand, it is incontrovertible for all models aiming to forecast, to anticipate prices. Suddenly, it must be asked: what is the value of such models from a scientific point of view? The answer is subtle. Epistemologically, these models cannot claim to represent an interpretation of reality, cannot compete amongst other models which propose “a possible world under these or these hypotheses” – in other words, amongst what are usually referred to in science as “theoretical models”. They can only situate themselves “beside” reality; they are commentary-models, just as one comments upon a theatrical play without the actors themselves noticing anything.

We now have a better understanding as to why Léon Walras confined himself to static models. *They*, at least, can claim to be interpretation-models, social laws like those Auguste Comte wanted to discover.

Moreover, I do not think that these “commentaries” are without interest. In the case cited, the manipulation of such a model can allow the detection of poorly identified or poorly understood phenomena. However, they obviously tend to cut researchers and academics off from the world of economic actors and decision-makers. These commentaries, if limited to specialized and discrete scholars, have their value. But it is not with such models that we will change the behaviour of business-owners, nor that of consumers as a whole.

3. There can be no speculative market without price fluctuation

Before the 19th century, economists did not believe that fluctuations in market prices could be caused by the market itself. All observers, including Marx, knew well that prices shifted, but they attributed these movements to various economic causes, such as changes in the structure of production, political disturbances, vagaries in agriculture or the time necessary to return to a state of equilibrium following an accident.

Today, things are different and markets are intrinsically turbulent for profound reasons upon which we shall expound. But many decision-makers and economists – who often believe themselves to be at the cutting edge of liberal ideas – still maintain a mental picture of the calm and harmonious markets in which the neo-classicists believed.

The error of Léon Walras

The neo-classicists, Jevons, Cournot, Whewell, Gossen, Thünen, Mangoldt, etc., did not provide us with a detailed study on how the effects of the law of supply and demand relate to and depend on time. Like many others, Walras carried out incremental arguments on a timescale of sometimes a day, sometimes a year.

There is an easily understood historical reason for this: the calculus of probabilities was not sufficiently advanced. Until the end of the 19th century, what we call *continuous probabilities*, i.e. calculations based not on enumeration but on differential and integral calculus, whilst taught by Laplace, Gauss, Poisson, Cauchy, Tchebychev, Cournot, Bertrand, etc., and known by physicists such as Boltzmann, Maxwell, etc., were still not especially well known among economists as a whole. And, above all, the very notion of *stochastic process* had not even been dreamt up, let alone mathematically mastered. It was necessarily an advance of the 20th century as, being technically very delicate, it could only be truly developed with the tools of measure theory and functional analysis in normed spaces. One precursor was Louis Bachelier, who at the very beginning of the 20th century proposed a theory of “probability diffusion”, applying the approaches of game playing to infinitesimal stakes and over infinitely small lengths of time in order to construct a “mathematical theory of speculation” (1900). However, following the mathematical tools created by Emile Borel and Henri Lebesgue, it is to Kolmogorov, at the start of the 1930s, whom we owe the first solid foundations for the theory of stochastic processes in continuous time, and he in fact cites Bachelier as an instigator.

A second reason is the idea that market formation is something akin to the carrying out of a regularization, a mechanism close to an average through the interplay of competition. Other phenomena are transitory: “We always assume”, writes Walras, “the fundamental data of the economic problem, that is, the quantities of capital possessed, the uses of consumable products and services, and net income supplement, to be invariable, so as to have an economic basis analogous to what is in mechanical terms known as a *steady state*. We assume, moreover, the phase of preliminary trial and error to be over, i.e. the equilibrium to be established in *principle*, and the phase of static equilibrium to be inaugurated, i.e. the equilibrium establishing itself in *fact*”.¹⁵⁶

A highly revelatory aspect of Walras’s philosophy is his manner of describing what would turn out to be a description of a market in continuous time, and he does in fact raise the issue: “we still have to move from the hypothesis of a periodic, annual market to that of a permanent market, that is, from the static state to the dynamic state”. For this, Walras posits a production and consumption “both extending across all moments of the entire year, and the fundamental data of problems are changing from moment to moment”. Without carrying out

¹⁵⁶ Léon Walras, *Eléments d'économie politique pure*, 4th edition, 1902.

calculations, he arrives at a description based in what would today be called a stationary stochastic process, suggesting this idea to the reader without ever using the term ‘probability’ nor that of ‘risk’: “Such is the permanent market, always tending towards equilibrium without ever arriving there, for the reason that it only advances by trial and error, and before this trial and error process is even completed, it is restarted with new costs”. We get the impression that Walras is seeking a concept which would allow him to express a vibration around an equilibrium maintained by irregular impulses. *He has the idea that these oscillations are weak*: “The market is then in this regard like a lake disturbed by the wind, the water always seeking its equilibrium but never finding it”. This is an error on a theoretical level, as we shall see, for the stochastic processes representing markets are highly turbulent, more a tempest than a breeze. But in Walras’s time, there was no stock market seething in this manner. He thought, like Cournot, that these variations were weak and without repercussion for the behaviour of most savers.¹⁵⁷ It had developed considerably since the time of Cournot, but the examples used by Walras are relative to real production and services: “There are, however, days when the lake surface is almost horizontal”, he continues, “but there are no days when the actual supply of services and products is equal to their actual demand, when the selling price of products is equal to their cost prices in production.” Adjustments are slow and *for Walras instabilities are exogenous to the market*: “just as the lake is sometimes violently disturbed by a storm, so is the market sometimes violently shaken by crises, which are sudden and general disturbances of its equilibrium. And we could better repress or prevent these crises if we had a better idea of the ideal conditions of equilibrium”.¹⁵⁸

As for Bachelier, he was to go even further, seeing the trial and error process as truly random. As his proof, he took the correlation between his theory and the movements of the stock exchange: “its utility [of the theory of speculation] cannot be doubted, as the results provided by examining quotations are in perfect agreement with those provided by calculation. This correlation between theory and observation is equally interesting from a philosophical point of view; it effectively proves that the annuity market obeys the laws of chance”.¹⁵⁹ But Bachelier was not yet in possession of the line of argument which was to come from gambling theory after the Second World War, today known as the theory of arbitrage, in order to show that – for reasons arising from the market itself – prices are forced to fluctuate considerably.

The difference between the market as implicitly seen by neo-classicists to act on goods and services themselves and contemporary markets is the possibility of speculation on the future value of the market. Neither Walras nor Jevons based their calculations on the assumption that buyers buy with the sole intent of reselling at a better price. They did not set out to develop a theory of speculation. After the First World War, with early signs appearing of the impending crisis of 1929, the importance of what was happening on stock markets was realized. Keynes, in the famous twelfth chapter of his general theory would denounce the irresponsibility of speculators and the potential of the real economic risks, those taken by entrepreneurs.

As a collective game of buying and selling, it has been apparent to many scientific minds, for some time now, that the market process is inherently unstable. I would like to quote here a passage written in 1947 by the great mathematician Norbert Wiener who has thought deeply about the issue of stable and unstable systems. “There is a belief, current in

¹⁵⁷ Cournot in fact wrote in 1838 “Thus the stock-market thermometer shows, through tiny alterations in its course, the most fleeting variations in the probability assessments to which public funds are subject, variations which are not sufficient reason to sell nor buy for most of those who have invested in public funds”. *Recherches sur les principes mathématiques*, op. cit.

¹⁵⁸ *ibid.*.

¹⁵⁹ Louis Bachelier *Calcul des probabilités*, chapter XII (1912).

many countries, which has been elevated to the rank of an official article of faith in the United States, that free competition is itself a homeostatic process: that in a free market, the individual selfishness of the bargainers, each searching to sell as high and buy as low as possible, will result in the end in a stable dynamics of prices, and with redound to the greatest common good. This is associated with the very comforting view that the individual entrepreneur, in seeking to forward his own interest, is in some manner a public benefactor, and has thus earned the great rewards with which society has showered him. Unfortunately, the evidence, such as it is, is against this simple-mind theory [...] in the overwhelming majority of cases, when the number of players is large, the result is one of extreme indeterminacy and instability.”¹⁶⁰

The teeth of the market have been underestimated by the Marxists

For a while now, and especially during the period of financial globalization that occurred from 1970 to 1990, it has been realized that capital moved more than one would reasonably expect. This fuelled a long and expansive rhetoric from the Left on the theme of *speculation*. The markets *attacked* currencies one after another. The crisis in Mexico and then that in South-East Asia were experienced by local businesses and managers as artificial instabilities due solely to the desire for differential profits.

In accordance with the idea that a sufficient mass of capital allows the influencing of prices, these phenomena were linked to the scheme of provoking massive selloffs in order to cause a currency to plummet, and following up with advantageous purchases, as seen in the archetypal example of speculation George Soros’s speculation against the Pound in 1992. Other similar schemes were stigmatized as emanating from the greed of the ruling classes, together with a sheep-like mimicry in behaviour regarding stocks. Inspiration was drawn from the famous analyses realized by Keynes and his distinction between fundamentals and the proper allocation of resources on the one hand (a concern to which he attributes the term ‘enterprise’) and, on the other, casino-like gambling, similar to those portrait competitions where the key is not to look for the best portrait, but that which will be most successful (behaviour which he labels as ‘speculation’ [*General Theory*, chapter 12 §VI]).

Two factors have reinforced an interpretation of market attacks in terms of a class warfare issue or an implicit reference to Marx’s *Das Kapital* or some other great social narrative of the 19th century.

Firstly, the constant fact that all market fluctuations elicit explanations. Some involve certain evolutions or trends, provided by commentators in the economic pages of the media. We are inundated with such commentary. A fluctuation is attributed to loss of confidence in some business owner, or some movement of unspent funds towards other opportunities, etc. Always emerging *after the fact*, these explanations feed into long theses and economic policies debated by elected officials and party leaders. Consequently, the landscape looking like a battlefield, one cannot help but attribute all “moods” of the market to the deliberate will of certain actors, adversaries motivated by private interests linked to the wealthy classes. This is not a false view but simply too hasty, as the privileged classes would clearly have preferred securer income, both less risky and more systematic, over this bedlam which can severely affect even them. Moreover, it is of these risks that they will then boast in order to justify themselves politically.

It must also be added that these numerous interpretations which spontaneously blossom around stock information are multiple, and this constitutes the second factor. They are largely subjective, as has long been understood. It has also been recognized that economic actors can have personal “views” on the expertise of a given manager, or the chances of

¹⁶⁰ Norbert Wiener *Cybernetics* (1947), Hermann 1958, p185.

success of a given technique, and that each one of them projects this reading onto the future, thus building a particular, personal law of probability on what will happen. They can make these specific, random forecasts whilst conserving a coherent logic, as has been brilliantly theorized by the school of subjective probabilities of Finetti, Ramsey and Savage. Each can apply probability calculus to their own judgements whilst preserving for their “reasons to believe” all the rationality attached to gambles in the presence of competitors who could profit from any possible inconsistencies.

However, as long there is interpretation, we are distancing ourselves from reality. The proliferation of interpretations does not constitute a stable, clear doctrine, and it is impossible to follow this directionless pandemonium. If speculators respect only their personal interest, there is no reason why the economy – meaning the real process of production, the division of skills in the social contract, the creation of facilities, investments for the future, collective costs of training, etc. – should be correctly orientated as a result of this ‘anything goes’ attitude. And as for reality, the Marxists have an accurate conception of it, based in the historically placed situation of means of production and the capacity of men to transform them in accordance with a dialectic that is concrete and material, rather than abstract like that of Hegel. Infrastructures and class consciousness are key to a broad vision which has been abundantly reworked, improved and extended upon by socialist intellectuals. These bases, even in their current watered-down forms, are marked by an unconditionally productivist scientism. It cannot strictly speaking be referred to as ‘positivism’, since for communists the great veil of knowledge is not raised by the scientific community alone but also by the party that understands and makes the historical choices which will affect the workers and hence production. Keynes, meanwhile, was an independent spirit who distanced himself from doctrinal ideologies, but even he could not resist believing in the existence of a real economy whose markets are uncaring, driven by *short-sighted* interests. The long-term is the basis for solid reference, whilst markets completely neglect to prepare for the future.

This is very true, and even a fundamental remark. “Selfish” interest, as advocated by Adam Smith, sacrifices common property in a *Tragedy of the commons*... The issue is central, and Keynes is perfectly correct in making it the core of his argument. However, this problem is in fact so huge that it goes beyond mere criticism of the financial markets to affect the economy as a whole and the competitive race for growth. The future is at stake in these struggles, and no-one can agree upon what is desirable. The future is also a policy, and Keynes, by claiming that there is a superior way of thinking, of organizing the economy for the long-term, is taking a political side. In this case, the role he gives to public stimulus has been favourably welcomed by those who could be called social productivists.

The teeth of the market have been underestimated by socialist thought. They are not directed against the workers, but in fact destroy everything: the variables following the path carved out by their environment (the smooth-curved diagrams of the Meadows team), but also the pretty little models created in neo-classicism. They raise up a universe of prices based on lotteries. We will see this in more detail in the next section.

Criticism of the financial markets on the theme of speculation is insufficient

Starting in this direction leads us to fall immediately into the rut of productivism. This is because, today, the generous motives of solidarity, reducing inequalities and supporting the dignity of the poorest among us, this humanist philosophy (as it is called), are expressed as politically left-wing – that is, in reference to the historical struggles conducted during the period of industrialization. Saying “they amuse themselves while we work” is not a criticism that matches the level of the stakes at play with this problem. It is insufficient for many reasons.

Firstly, it is not the taste for risk that is the *motive* of speculators; otherwise, they would play at Monte Carlo.

They take risks because, following a simple argument, the current theory of portfolio balance in an investment market concludes that fluctuating investments produce higher yields on average and safer investments lower yields, as the employees of commercial banks explain to their customers. Another reason is that the geographical locations and types of activity where volatility is higher, such as emerging financial markets, are more complex and the information work carried out by specialists, more serious than the typical ‘me-too’ behaviour currently followed, will be rewarded with higher profits. But *they try to avoid risks as much as is possible*. Elementary economic theory believes that investments in markets give yields which are generally positive on average but random, and that the higher the average yield, the more uncertain the investment: *variance grows with expectation*. In this balancing of expectation and risk, theory assumes that the behaviour of economic agents is governed by a utility function allowing us to mathematically calculate the level of their aversion to risk. These ideas are helpful for training students in economic calculations, but in practice traders do not view gains and losses symmetrically at all.

Given the vast range of instruments now available to them (notably options, interest rate derivatives and credit derivatives), each of them *configures* as much as possible the law of probability governing their position: better to be 99% sure of winning a small amount than 1% sure of winning a large amount. Obviously, there are traders who play “long-shots”, but that is not the usual way of doing things. Why prefer the 99% chance of a small profit? For a mathematical reason, and for a strategic one. Firstly, pure chance has no memory, and even if yesterday fell within the 99%, today’s odds are still 99%. Even if unlucky, the “return period” is very long, and can be decades for a well-optimized portfolio. And there is another reason: if indeed unlucky, the trader will have plenty of ways to demonstrate that the circumstances were truly unpredictable.¹⁶¹

Secondly, economic theory fully justifies the role of speculators as agents who often take uncertain positions on the future in order to protect others from risk. It is normal then that the market should remunerate them for this service. The textbook example is the case of the historical appearance, in the 19th century, of options on the cereal market, of a farmer selling his crop in the spring before the harvest to a rising speculator.

Finally, this suggests that it would be enough to reform the financial markets. What exactly would this involve?

Calming the markets?

The sociologist Robert King Merton, known mainly for introducing the notion of “middle-range sociological theory” and for his analysis of “self-fulfilling prophecies”,¹⁶² makes a sociological distinction between retreatism and the rebellious act of rejecting existing cultural methods and objectives for new goals and new means. If we take the damage done to the planet and the inertia of the economic supertanker seriously, we are part of this rebellion. However, faced with the power of capitalism, the rebellion becomes illusory and its acts double-edged. This has been well understood by the *indignant* who try to act on the level of ideas. Obviously, this is also what I am doing with this work.

Calming the markets is an extremely difficult operation, and one which has not yet succeeded. A tax on financial transactions *proportional to their volatility* is a promising idea,

¹⁶¹ For the consequences of this behaviour, cf J.-M. Béacco and N. Bouleau *Il faut bien que le hasard y trouve son compte*, *La Tribune* 14-10-2010, January 2004.

¹⁶² R. K. Merton, *On Social Structure and Science*, 1996. R. K. Merton is also the father of the R. Merton who won the 1997 Nobel Prize with M. Scholes for contributing to the so-called “Black-Scholes” revolution in options hedging (cf N. Bouleau, *Financial Markets and martingales*, Springer 1998).

but would need to be imposed by a global public power, and this certainly will not be the UN or the World Trade Organization as they are currently structured. We will nevertheless analyse this idea further in chapter III-6.

In the face of the infringements made upon the most obvious rules of probity by a given actor or financial institution, as so regularly punctuate our newspapers – the most recent being the Barclays Libor manipulation affair – the reaction has been to introduce deontological rules and accounting procedures. To this, the liberals invariably responded that immorality is everywhere, that it is part of human nature, and that we should punish the people involved, rather than the financial system which is innocent in itself. An issue, then, of education and social pressure. Moralizing the markets necessarily means rethinking society with a more modest and more controlled role given to finance. But the logic of the markets is a logic of liberty.

What we call regulations (Basel II and Basel III, December 2010) are in fact recommendations of “good management” from the point of view of international law, because the collective interest they defend believes it necessary to have as little regulation as possible.

The philosophy of this soft law, which governs the most powerful machinery in the world, began to be taken up by the European Commission in 2006, hence before the subprime crisis and before the 2006/46/CE directive on companies listed in the stock market. The conviction behind these legal practices is exactly the opposite of what the average person thinks. Namely, it believes that rules of constraint not only often fail to achieve their aim but also have the effect of distorting free competition and hence the healthy functioning of listing, purchases and sales. Essentially, the market operates healthily when all actors are able to express their interest freely – meaning their interest as they see it themselves.

It is here that we find a principle as brilliant as it is subtle: “comply or explain”. The banks and businesses concerned are annually demanded to either comply with an explicit prudential or deontological rule (of the kind that business clubs or professional associations develop) or, if this has not been the case for part of the year, to explain why they have not complied and what they have done instead.¹⁶³ We cannot help but think of overly lax parents who let a child get away with anything provided he is capable of defending his actions when asked to!

In fact, behind this principle lies a demand for transparency, obviously *a posteriori*, which is at least something when one considers the excess of extant fiscal paradises, off-shore investments and banking secrecy abuse. We note especially that the judiciary no longer has the job of sanctioning content, only form, leaving the actors to essentially police one another, in harmony with basic axioms.

The logic of markets and liberal finance is a logic of freedom: capping rules or conditional authorization on certain operations can allow arbitrations which destroy fluidity. It will not come as a surprise that the fund manager George Soros, who made his fortune in speculation, extols Popper’s philosophy of “open society”, i.e. total liberty in the interplay of economic and scientific competition.

Finally, in current political discourse, moralizing the markets most often means ensuring that they move less and better indicate the underlying trends which make up the true foundations of economics. This is how economists of reform generally think. *However, markets cannot spell out trends. It is absolutely impossible on an ontological level, prevented by their very structure.*

¹⁶³ Cf. J.-B. Poulle *Réflexions sur le droit souple et le gouvernement d'entreprise, Le principe “se conformer ou expliquer” en droit boursier*. L'Harmattan 2011.

And, on this subject, let us note that today there are no financial markets allowing term operations and speculations where this idea actually applies. It would be naive to think so. We live in the era of the Internet, of “eBay” and “Pricemaster”, and the practice of purely speculative purchasing and selling is very easy. As we have already noted many times in this work, beyond the financial markets lies the actual idea of market, whose consequences have not been sufficiently thought through. The belief that organization of the economic landscape and creation of guidelines for the actions of households under market mechanisms is a good way of controlling their behaviour, this hypothesis, false on the level of financial markets and businesses, is also false for consumers, for the simple reason that it prevents them from seeing the effect of their individual action on the collective result. In any interplay of divergent interests, this leads to collapse.

4. Price fluctuations will consume all of nature

In this section, which constitutes the heart of our argument, we will examine how probabilistic thought as developed during the 20th century, from the discoveries of the pioneers (Henri Lebesgue, Emile Borel) to the sophisticated and plentiful works in modern financial mathematics, modifies forecasting based on hypotheses and models. However, I do not wish to use Ito calculus, nor differential stochastic equations, nor write even a single formula. The aim is to extract from the study of stochastic processes those qualitative traits that have significant philosophical implications for the political decision-making process.

Indeed, we need to acknowledge that the impact of the economy on the environment is not a result of temperance or mitigation of natural variations but rather that the economy itself – in addition to the underlying trends due to growth – is a major source of perturbations arising from the random fluctuations in prices or values that are caused by the anticipations made by the agents. Consequently we need to understand the additional effects that randomness superimposes on arguments based on the finiteness of the world and its flows of energy.

I intend to conduct this discussion without technicalities since they only obscure the issues. However, while I have tried to limit the mathematical background required from the reader, I cannot avoid assuming a certain level of knowledge, since the concepts arise from that subject.

The term *nature* in the title above needs to be better qualified, as it can conceal various different meanings, and we shall indeed do so in chapter IV-2. For now, we will in this section be using it in the very common sense of the simple ‘natural/artificial’ opposition. We do not assume that this opposition has an absolute, timeless character, and we readily admit that a thorough historical, biological and anthropological analysis could well reach an original critical point where this duality fades, but in our time the general idea of *prosthesis* and *prosthetic* substitution retains all its meaning as a non-spontaneous approach, the result of a technical-scientific process.

We begin by reviewing the analysis of the Club of Rome to provide the context for our main discussion.

Back on the Rome report: simple models and their refinements

The issue of perfecting models is a classic trap. On the one hand, simple models have the disadvantage of being far from the laws of physics, biology and economics, but the advantage of being easy to calibrate. On the other hand, complex models seem to better reflect our knowledge of the phenomena being studied, but they have so many parameters that it becomes impossible to fine-tune them properly. Furthermore, their perfectionism gives an illusion of completeness: one can never be sure that they have taken everything into account. Ultimately, the most appropriate choice of model depends on the social use to which the model is being put, the sort of knowledge available, and the possible actions that can be taken¹⁶⁴. The case of the Club of Rome is here typically a global reference, something for “everyone”.

What is the philosophical value of the work of the Club of Rome? After the appearance of the first version of the report¹⁶⁵ numerous critics highlighted various weaknesses in the style of reasoning it used. Firstly, it was too simplistic: how could the reality of the world be captured in an algorithm whose equations comprise merely a few hundred lines of code? Next, and above all, it was closed: it could not take into account

¹⁶⁴ Cf. Bouleau N., *Philosophies des mathématiques et de la modélisation*, L'Harmattan 1999, Partie III.

¹⁶⁵ Meadows D. H., D. L. Meadows, J. Randers and W. Behrens III, *The Limits to Growth*, Universe Books, 1972

innovation, progress arising from science or technology or, more generally, human creativity. All of this may change *completely*, even the meaning of the words used in the model, yet the projections are based only on current knowledge. For example, concerning nuclear power, it only takes into account the nuclear fuel resources, the difficulty of storing waste and the problem of areas rendered uninhabitable by accidents. It does not consider the success of fusion technology whose advantages and disadvantages are still not well understood¹⁶⁶.

The new version of the report, published 30 years later¹⁶⁷ argued that the first version had not been contradicted by subsequent facts¹⁶⁸, and maintained, in the new model World3-03, the same methodological principles. Balance sheets drawn up by the Meadows team are relatively independent of subjective economic interpretations because they are based on measurements of quantities: energy received from the sun, quantity of arable land, population etc, which allows the authors to express themselves in terms of specific indicators: “human welfare” and “ecological footprint”. Several scenarios are studied under different assumptions of economic policies. The general conclusion is well known: unless politicians are very vigilant, we will always get an “overshoot-collapse” situation, i.e., excessive growth followed by collapse.

The truth value of this report does not lie in the details but in the thesis – which offends most philosophies and many religious beliefs – that one may take seriously and scientifically the fact that the finiteness of the world and its resources means radical changes are required to prevent collapse. This is a change of scene from that in which economics and politics usually take place, and can be seen as a turning point for civilization. It allows us to see that many old ideas about progress are based only on a desire for instant power without taking into account the limits, which is then turned into a rational theory. At this level, obviously only a simple line of argument can persuade.

The power of simplicity applies to all models where there are conflicting interests. Let us now consider climate change and the IPCC with its three groups studying the physical phenomenon, the impact and politics of reduction and adaptation, and economic models for mitigation. Although the work of the third group is *a priori* the most delicate and the furthest from the objectivity of the natural sciences, it is the conclusions of the first group about human responsibility for climate change that have been attacked by climate skeptics. There remains an on-going conflict between the wider scientific community and protestors who claim to be adhering to scientific principles in challenging the hypothesis that the increase in greenhouse gases is due to human activity.

Human responsibility cannot be proven with absolute certainty because one cannot state with mathematical precision what would have happened without human intervention. Yet, even without absolute proof, reason affirms the human responsibility claimed by the IPCC, even though this clashes with and opposes economic logic. Why? Is it because of the seriousness of the work by various teams around the world, based on different models? Is it because of the fact that among those who have contributed to the work there are many researchers based in rich countries whose interests are not well served by raising these issues and that many leading climate skeptics are linked to powerful economic interests? It certainly is not an argument of authority (the number of renowned scientists or the prestige that some of them have) or a return to a positivist view of truth. But the relativism of knowledge – which relates to the issues discussed – seems too subtle a concern, a second-order effect. Ultimately, what is most important is the simplicity of the argument: On the one

¹⁶⁶ Cf. the discussions about the ITER (*International Thermonuclear Experimental Reactor*) project.

¹⁶⁷ Meadows D. H., J. Randers and D. L. Meadows, *The Limits to Growth, the 30-year Update*, Earthscan 2008.

¹⁶⁸ Turner G. M., “A Comparison of *The Limits to Growth* with 30 years of Reality” *Global Environmental Change* 18 (2008) 397-411.

hand, the graph of CO₂ emissions as a function of time, on a historic scale, with its clear sign of the post-industrial period, combined with the physical fact of the effect of CO₂ on the absorption of different wavelengths and, on the other hand, the graph of lower-atmosphere temperatures, with its step-change in order of magnitude just after the industrial age.

It is a mistake to complicate prospective models of the environment. Excess mathematization is a natural path in the academic world, as a result of numerous institutional factors¹⁶⁹. It is the most convenient way, in the academic world, of avoiding any *commitment*. One speaks of self-organization, of complex systems that are sensitive to initial conditions and, by talking of multi-agent models and other possible thesis topics¹⁷⁰... the ethical conclusion gradually, without anyone noticing, evolves into the belief that it is only scientific research that needs to be perfected. The productivism and selfishness of the privileged classes are forgotten. The economy is hit hard by this tendency.

We therefore take this precise position: we admit the simplicity of the Club of Rome's discourse as a methodological choice, but we analyse the issues from a probabilistic point of view.

In the most recent version, the Meadows team considered several different scenarios (11 scenarios are discussed). In some ways this already represents the start of a probabilistic line of reasoning, but without considering the consequences of stochastics on current dynamics.

In these scenarios we find the general idea of an evolution first in exponential growth (30 pages in Chapter 2) which, after a certain time, becomes tempered by constraints arising from limits in material and energy in the planet (80 pages in Chapter 3). What happens after the peak is only sketched, the authors emphasizing that this time of decline causes social changes so great that they cannot be modeled sensibly. Simplifying to dimension 1, one could say that there is a logistic equation, more or less refined, that leads to certain horizontal asymptotes for the combined balance sheets of minerals and fossils, and certain bell curves, with a peak and then a decline, for the marginal trends and quantities, i.e., for the derivatives.

Our plan will naturally be the following: first we describe the new features of stochastic processes with regard to deterministic trends, and then we review the consequences of uncertainty for the vulnerability of the environment subject to economic rationale and we conclude this section by highlighting the most important points.

Qualitative aspects of stochastic processes

While a deterministic quantity is completely described by the evolution of a number as a function of time, a stochastic process is, in some way, a piece of music for multiple voices.

Probabilistic "reasoning".

For all evolutions (growth, decline, convergence) we should specify whether we are arguing in distribution, in mean or path-by-path.

Arguments "in distribution" or "in the mean" (quadratic mean, or in spaces of summable p-th power), also arguments "in probability" introduce compensations that

¹⁶⁹ I've gone into this in more detail elsewhere: on the philosophical level cf "On Excessive Mathematization, Symptoms, Diagnosis and Philosophical bases for Real World Knowledge" *Real World Economics* 57, 6 September 2011, 90-105 (<http://www.paecon.net/PAEReview/>) and on the financial level "Mathématiques et autoréférence des marchés" (<http://cermics.enpc.fr/~bouleau/publications.htm>).

¹⁷⁰ In this way one talks of "complex adaptative systems", "critically self-organized" systems, the "agent-based" or "self-generated" complexity, or of "highly optimized tolerance" etc. cf for example [Harris, 2007], Rosser J. B. Jr., "On the Complexities of Complex Economic Dynamics" *J. of Economic Perspectives* Vol.13, Nr 4, 169-192, 1999.

probabilistic calculus allows between the events where there is an increase and those where there is decrease. The evolutions thus described are in general fairly regular because the causes that attribute certain probabilities to certain phenomena usually have some degree of permanence.

But we are also interested in what happens for each trajectory that chance produces, because it is one of these trajectories that describes what actually occurs, or at least what the model suggests will occur. And the most fundamental information that the study of stochastic processes has given is that the behavior of trajectories can be very different from that which dynamics depicts from distributions or mean.

Trajectories in stochastic processes are erratic, often very erratic. There are stochastic processes that are smooth, but only where chance applies to only the derivatives or higher derivatives of the quantity. In general stochastic processes are very irregular. A good image is given by share prices, or the silhouette of a mountain crag.

What happens in financial markets – forgetting for the moment the economic role of these institutions – is interesting because it shows how uncertainty, and the imperfect knowledge that agents have of the future, result in the frantic movement of the quantity on which they act. Where the evolution of a currency or an action is not certain – and thus financiers do not agree on the likely outcome – the quantity will not take a medial path that would represent some sort of averaging of the opinions. Instead it will become erratic, and much more erratic when the uncertainty is large. This wildness, which financiers call volatility, is considered to be the most objective measure of the uncertainty affecting the economic quantities being studied [Bouleau, 2004].

In other words, in general, a stochastic process doesn't possess any clear trend (no speed or derivative in the mathematical sense); from one moment to the next it will increase or decrease.

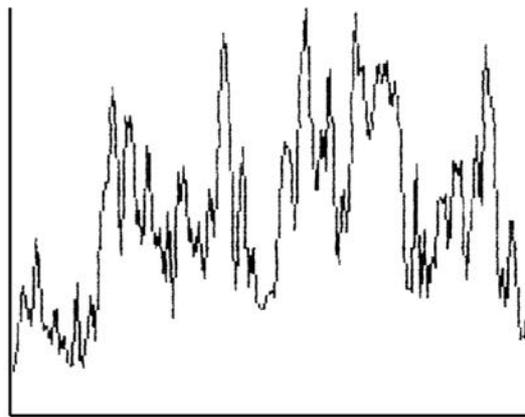


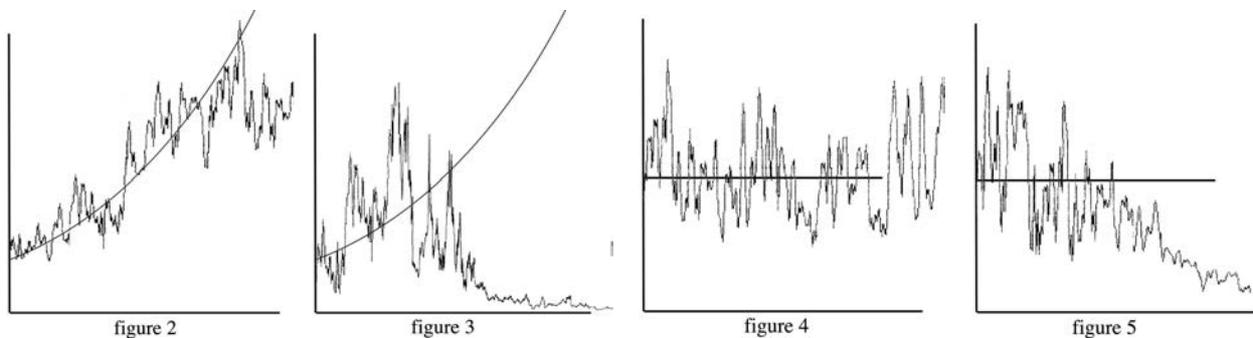
figure 1

Phenomenology of the exponential family.

The heart of the argument of the Club of Rome is to consider phenomena with constant relative growth rates and to show that, sooner or later, they “go to the wall”. These are quantities whose rate of change is proportional to their actual value, with a positive coefficient. In the case of many variables these can be put in a matrix calculus and the signs of the eigenvalues indicate which linear combinations of variables will vanish and which will increase explosively. This exponential growth cannot last and will necessarily be interrupted by some phenomenon whose role as a brake will increase progressively. Hence the appearance of an additional term in the equation which leads, in the simplest case, to a logistic equation or similar, and results in a saturation and, for the Club of Rome models, to a collapse.

One fundamental phenomenological point is that this is completely different in the case where the quantity has a random element to it. If a quantity showing an exponential character is subject to some randomness that is constant proportionally to the quantity's size, then one of two things will happen. If the randomness is small, the general path of the trajectory will be as one would expect: an exponential curve with fluctuations, above and below, that gradually become larger; this case is illustrated by figure 2. But if the randomness exceeds a certain threshold (as often occurs in financial markets, for example) the behavior of the paths will be completely different from what our intuition suggests: they all end, after some oscillations, by tending to zero; this case is illustrated by figure 3.

This phenomenon is well known in the case of martingales, which are processes in which the mathematical expectation is constant¹⁷¹. There exist positive martingales for which all trajectories tend to zero (figure 5). In this case the study of phenomena “in distribution” or “in the mean” do not at all match what happens in reality. And this is not just some sort of mathematical pathology; such cases are extremely common, particularly in economics.



For example, if you put your money in a fund that pays 4.5% and you reinvest your dividends constantly, you will achieve exponential growth. If, however, there is some uncertainty which increases the volatility, and this volatility exceeds 3%, the oscillations are such that one will frequently approach very small values, and in the long run you are certain to be ruined.

As another example, if you put your money in at 10% and each year you gamble half your money, the cumulative effect of the gain and the uncertainty will lead you inevitably to ruin. The positive martingales which tend towards zero are typical in fair games and have major significance in terms of collapse.

The same remarks obviously also apply if we consider situations where there is some limit on the exponential dynamic which causes some braking, leading to an equation of the logistic type, with a bell curve instead of something that increases indefinitely.

The most important philosophical point of this phenomenology is that in the case where there is randomness, and it exceeds the threshold we discussed, *it is impossible to tell from the trajectory what would have happened without that randomness*¹⁷². In other words, *exponential behavior cannot be detected in what is objectively observable*. Thus an observation such as figure 1 does not allow us to infer an underlying exponential dynamic.

¹⁷¹ Figure 4 is how one intuitively expects a martingale to behave. It's the special case of a “uniformly integrable” martingale.

¹⁷² The general question of knowing if one can understand the deterministic trends underlying a stochastic process has been written about at length. The negative response is a consequence of the theorem attributed to Girsanov, cf. [Bouleau, 2004] p37., and for a precise mathematical formulation cf. [Lamberton et al., 2008].

Stationarity does not mean “always the same”.

A somewhat similar remark needs to be made about stationary processes. In most cases, and especially in the normal (Gaussian) case, they exceed, after a certain period of time, all levels given in advance¹⁷³. Thus a situation which appears to be “sustainable” when considered “in distribution” may turn out not to be so for every trajectory. This is because the size is unbounded (its marginal distribution has no compact support) and that chance makes it “walk” everywhere.

One would think, then, that this phenomenon cannot occur in a finite world. However, we will see later that economic logic requires us to consider that prices are unbounded. (see below and next section III-5)

In an uncertain world there are rare events, and their probability is generally unknown. We now turn to issues that are less descriptive, and more semantic in nature.

If knowledge comes from statistics obtained from experiments, then distribution tails are poorly known; this is obvious and frequently noted. If the quantity represents a level (of water, or of temperature, etc.) then extreme events are badly probabalized.

But we must go further than this. We must consider the role played by *meaning* in the concept of rarity; this is linked to the unprobabilizable uncertainty that was so dear to Keynes. What does it mean to talk of a “rare event”? An event is simply a (Borel) subset of the real numbers. Events whose description is complicated generally have a poorly understood probability, for the same reasons as those related to extreme events. And the central philosophical point is that our interest (in the most general sense of that which attracts our attention) is governed by the *meaning* of the event, i.e., by the impact of this event on the rest of the world. This impact is not in the model studied but in, precisely, that which is not modeled. Translating this concern into the probabilistic language of models is a difficult operation that usually we do not know how to achieve.

To precisely describe the mathematical form of events that we fear is particularly difficult for a stochastic process. An event is a region in path-space. Why talk of this one or that one? One speaks of those which are interesting, those that mean something in terms of consequences for what matters to us, on the economy or on the environment. But the interest that we bring to such and such phenomenon is not at all objective and is usually highly subjective. That is why the *forms* of families of temporal trajectories that have some meaning, that can be interpreted, generally have poorly understood probabilities, because the rarity ascribed to them is usually subjective, at least in part. It is linked to the fact that the event matters to us, or to others.

Let's clarify this tricky but important point. How does an event, which is perceived as rare by some people but not by others, come to have a poorly understood probability? The model is a summary and we extrapolate from it by different interpretations. The model's output is accurate about the things that are common to all these various interpretations, because the model only “speaks” clearly about this common ground. Except for some purely physical phenomena (emission of alpha particles, Brownian motion, etc.), for most of the interesting situations that we are concerned with (in the environment, in economics, etc.) the element of chance in probabilistic models is a way of representing our ignorance, some sort of convention that we stop at a set of facts and interpretations, and we do not go beyond this point, because that is where opinions start to diverge¹⁷⁴.

¹⁷³ This is true even for processes that are *strictly* stationary, i.e. when their marginal distributions of order n are invariant under translation of time.

¹⁷⁴ One can read more about this in my book *Risk and Meaning, Adversaries in Art, Science and Philosophy*, (Springer 2011), especially chapters II (Cournot's “Philosophical Probabilities”) and XI (Jacques Monod's Roulette).

Vulnerability of the environment when subject to economic “rationality”

Does this collection of striking features of the phenomenology of random processes have any consequences for our understanding of the work of the Club of Rome and, more generally, the question of the limits to growth?

The first issue is to determine whether or not there is randomness and, if there is, what creates it.

It is the economy that adds randomness. All rated quantities – raw materials and prized materials, sources of energy, lands and real estate – all fluctuate in our liberal economy. We will go deeper into the reasons for this in a moment. But let’s note already that to reason as the Meadows team did, without using monetary value, is to build a model that is disconnected from the forces that represent the interests of agents (or at least from those forces that the agents believe represent their interests). The key fact that *the economy exists* – particularly in the globalized neoliberal period we find ourselves in – means that the link between an economic interpretation of the world, which is very random, and the deterministic curves of the Meadows report, is not made.

The mechanism for finding a market price necessarily involves randomness. We can first ask whether price formation in markets is truly stochastic in nature, or whether it is governed by some complex, chaotic mechanism. The question might be interesting to the *quants* on the trading floors, but for our purposes it is not very important. Both representations are simply models. What matters is that it moves and that one cannot tell in advance how it will evolve.

In organized markets, for a price to be established, market makers or an exchange systems must work constantly to produce the current spot price. Indeed, if the dealers are split into two groups: the bulls who think it will rise and that the current price is too low, and the bears who think the opposite, what will happen to the price if the bulls buy? The price will rise. And if we let the bears sell, then the price will fall. The organization providing the spot price will therefore sometimes let one group speak, and sometimes the other, so that both camps always have some members. Technically it will seek to maintain *good liquidity*, i.e., to minimize the bid-ask discrepancy (for details of how markets function, cf. for example [Cont et al., 2010]).

Thus we understand that when we say that volatility is the uncertainty in the evolution of the price of the quantity, we may as well say that this irregularity reflects the difficulty that the trading organization has in achieving the balance between buyers and sellers needed to maintain the permanence of the pricing.

A difficult point to understand: how can the spot prices of markets reach such exorbitant values compared to the value which common sense would attribute to the underlying product, or even compared to the disposable funds of economic agents?

It is hard to understand how in financial markets the *amplitude of oscillations* can far exceed the price anyone would be willing to pay for a unit of the underlying quantity. It seems impossible and paradoxical, but is in fact far from either. *Prices are not bounded by any limit.*

This is due to the fact that speculation works like a lottery. How does one sell a Van Gogh painting worth €100 million in a country where no-one has the money for such a purchase? Auctioning it is not an option, as that adjusts the price based on the highest bidder. It is then the lottery that allows this kind of sleight-of-hand. If one manages to sell 10 million tickets at €10 each, the case is closed. And there you have the reason for this phenomenon which is so typical in speculation.

The price of a scarce commodity does not follow the logistic curve of the Club of Rome; it follows a “punk hairstyle” instead. We’ll now look at things in more detail. If we take the price of copper, or the price of teak, the primary characteristic of the trajectory over time is that it is jagged, and that no-one can say with any certainty whether it is about to go up or to go down, let alone predict its value in a year’s time.

The best example is the price of fossil-fuel energy resources. Neo-classical economists in the nineteenth century proposed deterministic models. The best-known examples of this type of thinking are the Hotelling model and its improvements. Without going into detail about the equations, a model that takes account of randomness will give a price graph similar to figure 3. We note that the prospect of depleted resources, combined with the fact that dealers use their arsenal of futures products on the derivatives markets to anticipate future prices, render these models meaningless unless they incorporate a *significant* random component. Without that, expectations would make the price explode. For this not to happen, it is essential that the agents believe that there is a positive probability that the price may go down again. And this can only happen if the prices are randomly excited. This is what happens in financial markets for most quantities, for similar reasons. We can even understand that this is not just a little bit of randomness – a light breeze that gently shakes things – but rather *it is a massive disturbance that will completely obliterate the underlying deterministic curve*. This reinforces the need to reason as if we do not have any idea at all when the “peak oil” will occur¹⁷⁵.

The “price signal” of exhaustible resources works very poorly. The consequence of this is that the “wise response” to the depletion of resources, that of raising prices so as to encourage agents to develop alternative energy sources and substitutes for the missing minerals, will not occur spontaneously, purely as a result of the price, because there is too much variation in the price signal¹⁷⁶. The fall in the price of an energy resource, from a very high price to a low price, will kill the long-term investment in new technologies.

Indeed, it is clear that the magnitude of the financial uncertainties that we face prevents us from taking new directions. Using the IPCC estimates, for a stabilization target of 550ppm¹⁷⁷ CO₂ equivalent, the marginal cost reduction in 2030 would be between \$5 and \$80 per ton, i.e., a spread of 1 to 16. In these conditions, a businessman interested in the carbon emissions of his enterprise must evaluate investments whose profitability, even with some subsidies, is extremely uncertain, when compared with the long-term interest rate that the financial markets can provide today. Instead of stepping out and being the first among its competitors to begin this adventure, the business is almost obliged to wait until that spread is reduced.

This also explains why a system of tradable rights, as in Europe, or a tax on petroleum products, can only be effective at creating decarbonization and energy-efficiency technologies if it leads to the publication of a quasi-deterministic forecast of how the price will vary over a sufficiently long period¹⁷⁸.

¹⁷⁵ Helm D., “Peak oil and energy policy—a critique” *Oxford R. of Economic Policy*, V27, Nr 1, 2011, pp. 68-91.

¹⁷⁶ A study of J. B. Boyce about petrol, carbon, and 78 minerals, showed no correlation between the variation in the price and the variation in the quantity extracted (“It Happened Too Early!: Prediction and Inference in the Hubbert-Deffeyes Peak Oil Model” Dec. 2011 (online). The impact of the variation in the price of petrol on the economy is also complex and variable, cf Lescaroux F. and Mignon V., “La transmission de la variation du prix du pétrole à l’économie” in *Les effets d’un prix du pétrole élevé et volatil*, P. Artus, A. d’Autume, Ph. Chalmin, J.-M. Chevalier, eds, Rapport du CAE 2010.

¹⁷⁷ ppm signifie parts per million, CO₂ equivalent signifie le équivalent amount of carbon dioxide.

¹⁷⁸ The graphs shows that neither the TIPP in France, nor the Italian tax that has significantly increased pump prices, satisfy this criterion.

Local agricultural methods are disrupted and driven to destructive practices. In agriculture and livestock, in addition to meteorological variations, globalization has added significant randomness to prices which, since the winner takes all, ends up destroying traditional, sustainable practices and encouraging methods that are destructive and short-sighted. These survival techniques may also draw on ancient agricultural and farming customs but these are then carried out using the available mechanized technologies (burning of forests, fishing and hunting endangered species)¹⁷⁹.

The economic valuation of non-marketable common goods will relentlessly erode them. We can now better understand why the cost-benefit analysis evoked in chapter III-1, in addition to having the weaknesses we already pointed out, sees its logic collapse completely where the environment is concerned, due to the random nature of economic prices.

The refrain is always the same:

To preserve the environment, economists usually say we must give a value to its preservation, i.e., put a price on it. This presents various kinds of difficulties, technical, political or legal. On a purely technical level, cost-benefit analysis (CBA) gives a price to non-marketable goods in such a way as to be comparable with marketable goods¹⁸⁰. CBA methods are usually explained in textbooks¹⁸¹, so we will not go into detail here. However it is done, cost-benefit analysis can only determine a price *based on information from the past and the present*. Yet prices fluctuate. There will necessarily come a time when randomness in the evolution of prices will mean that the service provided by the collective good will be valued lower than the substitute marketable goods that it could be replaced by. Certainly we can see that preserving the environment is of growing importance in public opinion and in this regard, a proper CBA needs to be updated to take this into account. But this concerns non-marketable goods – by definition, there is nothing to sell. The price estimate of the ecological service is inevitably calm and quasi-deterministic. It can only follow a smooth curve (a convolution) and thus a time will come, sooner or later, when the service provided by artificial means will be cheaper.

This is particularly serious for biodiversity. In chapter III-1, we discussed the approach of dividing species into two categories.¹⁸² On the one hand we have *remarkable biodiversity*, which we take care of, and on the other we have *ordinary biodiversity*, whose *ecological service* provided is calculated by methods of cost-benefit analysis. We can then carry out calculations of least cost in order to work out whether the goods already appraised by the economy are preferable to the advantage of species variety.

It is clear that on each specific question, on the way to preserve such and such species in its current condition, the fluctuations in cost legitimize artificial substitutions and the irreversible destruction of habitats. Consider a specific marshy wetland area that is in destructive competition with a deposit of fossil fuels. The two rarities do not evolve in the same way. On the one side there are real and random fluctuations in the price of fossil energy (due to speculation) and on the other there are gradual adjustments in the calculation of

¹⁷⁹ On globalization and randomness of prices cf. Daviron B., Dembele N. N., Murphy S. and Rashid S., “Report on Price Volatility” Draft report by the HLPE Project Team, 2011. On the complex interplay of interactions cf. Warren R., “The role of interactions in a world implementing adaptation and mitigation solutions to climate change” *Phil. Trans. Royal Soc. A* (2011) 369, 217–241 doi:10.1098/rsta.2010.0271. Furthermore, being unable to occupy space with sustainable activities, poor regions are also led to accept poorly-recycled waste from countries that are more technologically advanced.

¹⁸⁰ Serious shortcomings in this method, when applied to the environment, have already been identified, cf. (Hanley 1992) and (Ackerman et al. 2002). But the point made here is, in our opinion, even more serious.

¹⁸¹ For these methods, without any critical discussion, see (Pearce et al. 2006).

¹⁸² Cf for example in France “Approche économique de la biodiversité et des services liés aux écosystèmes, Contribution à la décision publique”, *Centre d'Analyse Stratégique* April 2009.

“ecological services”. The fuel deposit will, some day, end up priced above the carefully calculated estimates for the marsh. We now see why this method has been called *the bulldozer of substitutability*.

What we have just said about the non-marketable aspects of the environment applies equally well to externalities as a whole.

To consider the economic value of the market a moral reference is to turn the environment into a gambler at the casino: sooner or later, it will inevitably be ruined.

Market value is still considered, not only by mainstream economists but also by policy makers, as a reflection of what people are willing to concede for the use of goods, after taking account of personal criteria and the collective game of social exchange. In the background is a picture of a harmonious world, in an equilibrium that slowly evolves with improvements in business performance and changes in consumer tastes. This image is a legacy of the neoclassical thinking of Léon Walras and others of the 19th century, who saw the economy in terms inspired by the minimal action principle in mechanics, and who described equilibrium states by mathematical methods of optimization. It is completely superseded by current practices which, while still relying on that philosophy, have great difficulty in thinking of economics without growth [Jackson, 2009], particularly in the case of the credit and securities market and because of the “debt-based monetary system”¹⁸³.

But in addition to this, prices fluctuate. In these conditions the competition between a non-marketable good and a commercial commodity is not equal. Under the blows of the waves, even large fragments of a cliff can fall into the sea, but they do not rise again when the sea is calm¹⁸⁴. The key point here is that in the long term the present economic organization, with its financial markets that govern the most important prices, is incapable of setting limits to prices that fluctuate. *In other words, the whole world is finite and bounded, except for prices.*

From quoted prices in financial markets to prices in everyday life. We first make a remark that complements the arguments above. Stock prices, currency rates and commodity prices fluctuate in financial markets, as we have said. But the way the economy works in society in reality means there are certain “valves” which ensure that certain quantities stay stable or grow randomly, but never go down. This is generally true of real estate prices in city centers in Europe, and of salary levels for certain professions, etc. Without going into the mathematical details, the reader will understand that the existence of steps and rises creates a situation that is random and unpredictable, whose consequences are similar to those of a process which rises and falls, in so far as we never know how much it will increase in a given time period.

It thus appears that the primary source of turbulence that spreads through the economy comes from the financial markets¹⁸⁵. The fluctuation in prices of raw materials is transmitted to manufactured products, that of currencies is added in by international commerce, and that of credit ratings by the balance sheets of businesses. In the end, the economy as a whole is built on a seismic zone. This leads us to the conclusion that this turbulence, which has such

¹⁸³ Cf Sorrel St., “Energy, Growth and Sustainability : Five Propositions” *SPRU Electronic Working Paper* n185 (2010).

¹⁸⁴ Recent examples include the exploitation of oil sands in Canada, coal in Australia, and the Belo Monte dam which has just been signed off by the president of Brazil, and which will flood 400,000 hectares of forest, and displace 40,000 inhabitants.

¹⁸⁵ Specifically, the turbulence comes from the fact that if a market shows a clear trend that sets it apart from a risk-free investment, then it is unstable, since buying and selling will, respectively, cause the price to increase or decrease.

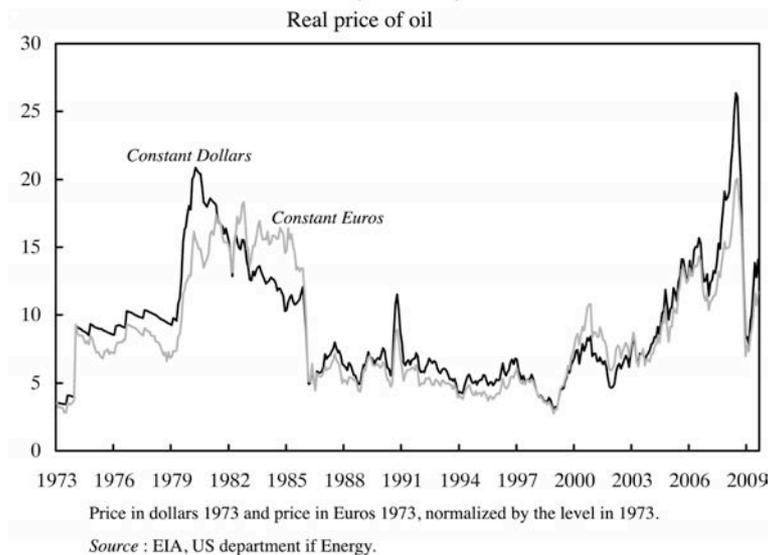
devastating effects where the economy and the environment meet, is there to allow financial markets to exist. Given that, should we conclude that we should get rid of them? Yes, so long as we measure how much this idea necessarily disrupts free trade from top to bottom. Because even if capital markets are the principal source of randomness, they are not the only ones (there is also randomness in business, in transport, in economic policy decisions, etc.). Until we know how to think, globally and in the details, about a sustainable economics that does not unduly restrict our customary freedom, in which the evolution of prices over time is smooth, it is essential to regulate and vigilantly resist the attacks of randomness that come from economic logic.

An implacable logic

It is precisely for this reason that there is randomness in financial markets. For if the trends were clear, they would be immediately exploited, and their clarity would disappear. In hiding these trends, randomness weakens the arguments that one can derive from the finiteness of the world and its limits. This is one reason why the warnings given by the Club of Rome were not acted upon: *bell curves – quasi-exponential growth, overshoot, peak, decay and collapse – we do not see these in prices*. We genuinely feel, when watching commodity and share prices, that the economy is still broadly in the same situation. So long as agents' behavior is governed by the economic climate rather than by moral considerations, *business as usual* will continue.

For the ancient Greeks, chance was on the side of nature; they feared the wrath of Poseidon so much that they were ready to sacrifice a young girl. Until the 18th century it was the “elements” that were random; humans actually occupied only a tiny part of the planet. Now the situation has changed: a great disaster, such as the Tōhoku tsunami, may kill 20,000, i.e., three millionths of the world population, yet this is far lower than the number who die in car accidents each year. Humans occupy the majority of the planet and it is they, by economic reasoning and free-market logic, that is the main source of randomness. *The economy is now the environment that the environment finds itself in. Neoliberalism has become the storm*, against which the world needs protection. That clearly means that it is not enough to relay information about the current and future physical states of the world; this will not convince an economic agent who sees prices fluctuate. It is essential to attack the problem at its root, which is the way that the market economy “speaks” by imposing a screen of volatility over the determinism of the collapse.

We choose some graphs from among the many possible, to serve as a visual aid to complement this section.



Regarding the graph of crude oil prices, let us emphasize that the ordinate axis is starting from zero. This shows clearly the *enormous* variations experienced by market prices. The effect of fluctuations in crude oil is recognized as a serious problem for the world economy.¹⁸⁶

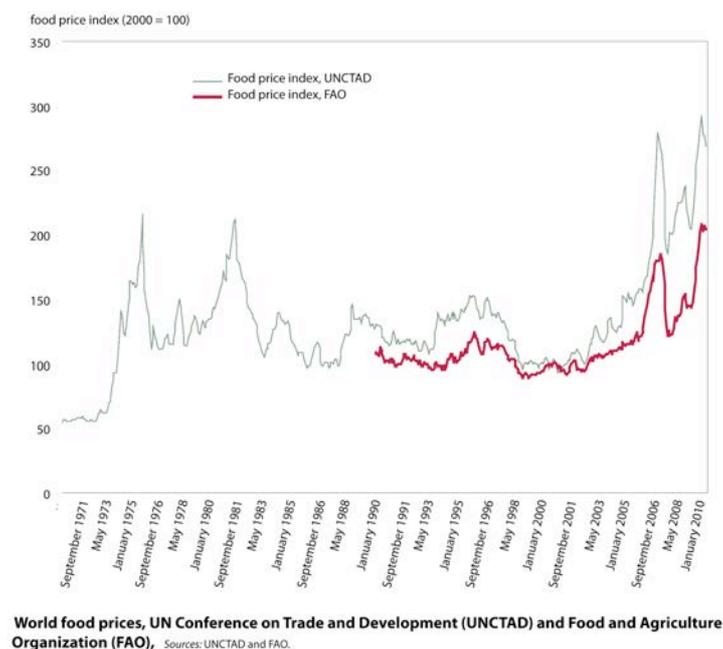
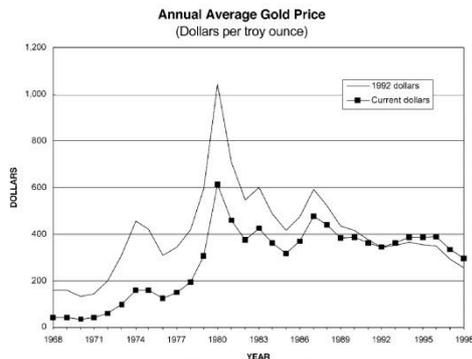


figure 7

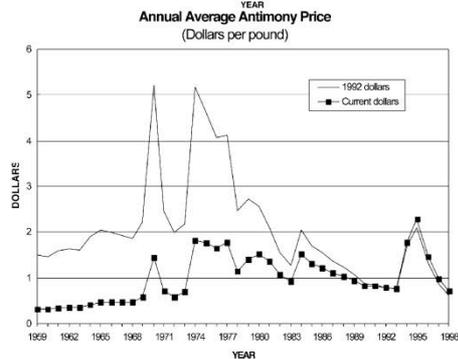
On this graph, we can see that even an *index*, a weighting of several food quantities, fluctuates considerably and is the cause of major uncertainties in agricultural organization.

¹⁸⁶ Cifarelli G., Paladino G., "Oil Price Dynamics and Speculation, A Multivariate Financial Approach" *Energy Economics* Vol 32, 363-372, 2010.

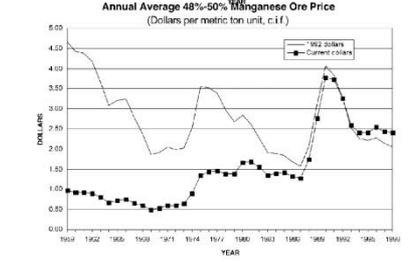
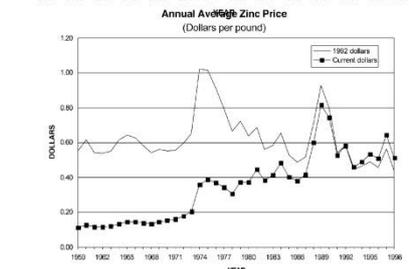
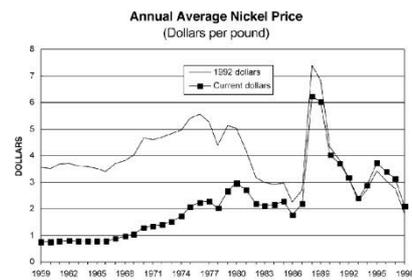
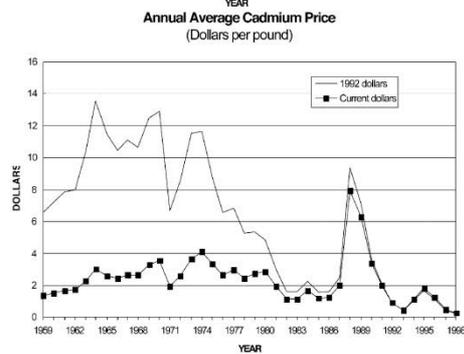


Prices in current \$

Real prices in current \$



of metals
gold
antimony
cadmium
nickel
palladium
zinc



On the subject of exhaustible resources, typically an intertemporal issue, economists, and especially those most lauded by liberals, continue to attempt to reason using neoclassical machinery, by improving Hotelling's mathematical approaches,¹⁸⁷ the conclusions of which are described as a "fundamental principle of the economics of exhaustible resources" by Robert Solow. The latter, in his works, refines these arguments by clarifying and diversifying hypotheses. It is interesting to note that even completely immersed in this mindset he still comes to write, "it is legitimate to ask whether observed resource prices are to be interpreted as approximations to equilibrium prices, or whether the equilibrium is so unstable that momentary prices are not only a bad indicator of equilibrium relationships, but also a bad guide to resource allocation".¹⁸⁸ And this remark is made without taking into account that interest rates are practically given by the financial markets and hence fluctuate randomly according to time and due date, nor that the current price of ore, via the game of speculation, has no visible tendency, as in any type 2 market.

The contradictory nature of any economic kinetics is demonstrated in these works. It is to the great credit of Robert Solow that he sensed this without ever saying so in such terms. Moreover, he arrives at the following conclusion, which is completely in line with

¹⁸⁷ H. Hotelling, "The Economics of Exhaustible Resources," *J. Polit. Econ.*, April 1931, 39, 137-175.

¹⁸⁸ Solow R. "The Economics of Resources or the Resources of Economics" Ely Lecture, *The American Economic Review*, Vol. 64, No. 2, (1974), 1-14.

what I argue in this work: “The same considerations suggest that the market for exhaustible resources might be one of the areas in the economy where some sort of organized indicative planning could play a constructive role. This is not an endorsement of centralized decisionmaking, which would likely have imperfections and externalities of its own. Indeed, it might be enough to have the government engaged in a continuous program of information-gathering and dissemination, covering trends in technology, reserves and demand [...] In the case of exhaustible resources, it could have the additional purpose of generating a set of consistent expectations about the distant future.”

5. Frequently asked questions.

For the benefit of the reader in a hurry, and to facilitate a rapid introduction to the theses of this book and to some technical details, I present this section in the useful form of a dialogue.

Its pedigree is ancient, and its effectiveness recognized ever since Socrates, all the way up to the 18th century philosophers, via the *Dialogue Concerning the Two Chief World Systems*, in which, thanks to his open exchange between the three characters of Salviati, Simplicio and Sagredo, all interested in the subject but with varying levels of knowledge on it, Galileo managed to explain a particularly non-conventional worldview for the time. Here, I will not state who the characters involved are. The reader might consider the dialogue to be between Lester Brown and George Soros – an environmental economist engaged with contemporary issues and a financial expert in international markets – or between Nicholas Georgescu-Roegen and Louis Bachelier, representing the physicist concerned with problems of the planet and the theorist of market behaviour, though the dates involved render the discussion imaginary. It could even be between the professor of political economics Susan Strange and the professor of financial mathematics Nicole El Karoui. I leave it entirely up to the reader's imagination...

– *What is the origin of price volatility in markets?*

Robert J. Schiller (Yale University) begins his 450-page book *Market Volatility* [Schiller, 1989] with the phrase “The origin of price movements are poorly known in all speculative markets for corporate stocks, bonds, homes, land, commercial structures, commodities, collectibles and foreign exchange”.

In its simplest version, finance theory says that an asset cannot have a foreseeable evolution unless it is deterministic and varies as the core investment, without any risk: the “bond”. It also says that under certain hypotheses, often framed in terms of perfect information – although the notion of information is simple to express mathematically, but not at all simple in what it represents – the uncertain assets are martingales, i.e., processes which have the “centre of gravity property” [Bouleau, 2004]. We know mathematically that these processes are very irregular. Thus we have a theory that explains the irregularities we see in stock prices. But this is not the real explanation of the behavior, of course, because markets usually function with only incomplete, partial information.

All studies conclude that there are two types of reason. On the one hand, the effect of real shocks that change the landscape of the activity: technological innovation, consumer tastes, social or political change, fundamental changes in currency rates, etc. On the other hand, there are psychological factors arising from differing opinions, changes in confidence, differing levels of risk-aversion, etc.

We have outlined above a simplified form of the non-arbitrage principle: the value of an asset cannot be predicted if its evolution is different from a bond, because if not, then it would enable risk-free profits and this would change its value. This argument does not explain the more complex phenomenon that the variation in the price of an asset (its volatility) is even larger when the evolution of the asset is more uncertain.

To discuss this latter phenomenon would require a definition of uncertainty different from that given by volatility. This is a genuine research program with a high risk of subjective interpretations. We are therefore reduced to recording that volatility is, often (for instance for currencies), lower in the more highly diversified and highly structured economies of advanced countries, and greater concerning the assets of developing countries where there is more uncertainty about the future.

– How is it possible that the phenomenon of hiding fundamental trends in the evolution of resources by the markets, i.e. the “teeth of the market”, has not yet been singled out as a major problem? Are economists not aware of it?

The market has become sacred. The randomness it generates is what the Ancients took to be ‘destiny’. This has gone so far that ‘market’ is widely used as a synonym for ‘society’.

We live in a world where, to validate a hypothesis, we readily give credit to the collection of a large number of opinions. This is made easier by ever more widely used means of modern network communication and the proliferation of websites, blogs, wiki-style encyclopaedias, Delphi-like forecasting methods, etc. It is somewhat similar to the method of evaluating researchers in the academic world by counting citations. From a logical point of view this consensus method is curious, as the veracity or falseness of judgements, as classically expressed by Kant, comes either from experience or analytical deduction, and opinion has no place in either case. Even if we consider uncertain phenomena, surveys give no information on the state of the world, only on the actual beliefs expressed.

The idea that truth and shared beliefs are one and the same is the central thesis of utilitarianism, particularly well expressed by John Stuart Mill. This is the philosophical audacity of the complete socialization of truth. We do not know everything, but have sufficient knowledge to act in practical terms if we take into account opinions in a society allowing their free expression. In the Anglo-Saxon form of positivism, thanks to Mill, we find the idea that the validity of a judgement is based in its resistance to all attempts at refutation. This kind of external logic appeals to the “biodiversity” of ideas and to their confrontation.

At the turn of the 20th century, this current became an actual doctrine with the *pragmatism* of Peirce, Dewey and William James, in which the strength of reference to possibilities of action in the real world will be pushed to the extreme, made to absorb all of existence. It is an a-ontological theory in which Kant’s thing-in-itself is seen as to be purely and simply replaced by the possibilities of action of people in society. Obviously, this philosophy is in perfect agreement with liberal economics, as it regards ‘value’ in the economic sense of appeal, interest, propensity to own, as being synonymous with ‘value’ in the philosophical sense of ‘moral value’, or even, following Mill, ‘truth value’.

The serious problem with this highly efficient, highly operational conception is its inertia, giving undue weight to conformity of opinion. Continental positivism has the same issue, for somewhat similar reasons. The key point is that utilitarians and pragmatists confuse beliefs and interpretations,¹⁸⁹ which causes them to miss the fundamental role dissident readings of the world play in the construction of knowledge and in today’s apprehension of tomorrow’s possibilities.

From the point of view of the neoliberal economists, only prices have importance. They reflect values and thus, according to pragmatist philosophy, *they are reality*; everything else *does not exist*, and the curves of the Meadows team diagrams are like unicorns, werewolves, or chimera. *We don’t need them.*

For over two centuries, economic language has become more and more sophisticated by adapting to changes in daily life and managing to give individuals a framework relevant to their personal business in a context of growth and technical innovation, and thanks to the fact that this economic language, now globalized at all levels, from the managerial aristocracy to small traders in developing countries, has become the most trusted reasoning of today. We can thus take the measure of our society’s inertia on its subjects.

¹⁸⁹ In the same way that using citation-counts to assess an article reduces to the same level both the very profound and original work which requires some effort from the reader, and the utterly mediocre work. Both will have few citations.

Finally, it must be added that uncertainty does not handicap everyone equally, and is even an advantage for some economic actors. The existence of uncertainty as to price trends requires us to seek out information external to the markets, via a documented analysis of the physical, geographical and socio-historical factors which influence prices. Such a gathering of information, in order to be of high quality and capable of evaluating its own relevance, must be carried out by specialized teams, and is therefore expensive. If we look at the extremes, this kind of collection of information is easy for Monsanto but completely inaccessible to a poor Indian farmer.

— *Are there not, among economists, some who believe that trends are visible? We hear phrases everywhere in stock market news such as “the dollar is rising”, “the euro is falling”, etc.*

This means nothing more than the fact that the dollar has risen, or the euro fallen. Explanations are easier to find for the past than for the future. That said, it is true that numerous economists imagine that financial markets are simply sophistications, or complexifications, of markets as perceived by Léon Walras.

What is heard most often is criticism of the sophistication of the financial markets: that new derivative products facilitate speculation, that the self-referential nature of markets distances them from the real economy, that their mathematics are bloated and use up intelligence which could be better applied elsewhere, that term markets are myopic and do not take future generations into account, and so on...

These pertinent criticisms are however, all too often, thought of as excesses correctable with healthy regulation, helping the financial markets to rediscover the adjustment mechanism functions so useful for the economy. Textbooks often state, like Roger Guesnerie, that “the market is a powerful calculation tool, at once computer, program and algorithm, with unrivalled performance levels, able to bring about a system of signals which creates order and produces effectiveness in the individual decisions of economic agents”.¹⁹⁰ This eminent scholar, like many economists, thinks that financial markets reduce uncertainties: “the sophistication of the financial markets is in part a response to the need to limit uncertainty on future transactions: for example, a term market where one today buys or sells a real or financial product negates, if not all uncertainty, at least uncertainty on future prices”.¹⁹¹

This is an error, or at least a highly ambiguous statement. Certainly, he who buys today to receive in three months has purchased, and for him the price is no longer random. But has he bought at a good price? *Futures* and term products *do not reflect* the historical evolution of prices as it appears in reality, always for the same reason: if it were clear today that a future price would be higher (or lower), this would have repercussions on its current spot price, which would climb (or sink). In fact, the current price fluctuates, and term prices even more so.

Beyond this, there is always a belief in the existence of an instantaneous, measurable *trend*: “it [the market] provides unambiguous signals only in the short-term”. That someone as competent as Roger Guesnerie should still be able to believe that such non-ambiguous signals are given by markets in the short-term can be blamed on a favourable over-interpretation of neo-classical ideas, considered, in essence, to be a desirable world.

¹⁹⁰ R. Guesnerie, *L'économie de marché*, Le Pommier 2006.

¹⁹¹ *ibid.*

– *If I drive my car along a bumpy road, even if I have a good suspension system, I will still be able to feel whether the road is ascending or descending!*

Shock absorbers use the viscosity of liquids in order to provide a stronger resistance if the speed of the pressure applied is higher, and weaker if it is slower. On a signal, it carries out what is called a moving average, or convolution. The signals fall then into two categories. For those where this regularization allows the discovery of a trend, as is the case for a low-quality or paved road, the irregularity – the noise – is not so great that one cannot redraw the line that would have been followed were the signal not disturbed, i.e. the road in a good state. On the other hand, for highly random signals such as those provided by fluid markets, or the silhouette of a steep mountain range, we are no longer in the first category, and the moving average does not allow any precise forecast. Casinos are helpful for understanding the phenomenon. Calculate moving averages on the results for all games over a day or a week, and you will still deduce nothing about the next game.

The point is delicate, but of such importance that it merits further explanation. Let us imagine a poorly-balanced roulette wheel, in which the numbers from 19-36 occur slightly more regularly than those from 1-18. We will say that market prices are rising if the result is between 19 and 36, and sinking if it is between 1 and 18. Under these conditions, if you observe results for ten or twenty games, and have no other information available, you will be unable to say whether the roulette is biased towards higher or lower numbers. If you observe results over a much longer period, the law of large numbers and the central limit theorem will give you an approximate distribution of the drift of this biased roulette wheel, the range tightening more and more as you go further into the past. But what is the point of delving into the past in order to predict an instantaneous tendency? Is the wheel's bias constant? We do not know.

Neo-classical thought is so attractive that many economists see near-equilibria, like that of your car with its amazing suspension, all around. For example, two scholars recently wrote on petrol prices that “the more the price deviates from its long-run equilibrium value, the more fundamentalists will become active. Their orders then drive prices back to more fundamentally justified values. However, if the price is close to its fundamental value, the market impact of fundamentalists is relatively low. In such a situation, the presence of destabilizing chartists and/or random shocks may cause a new (temporary) bull or bear market”.¹⁹² They omit the fact that behaviour could easily be of the type we examined in chapter II-4, figure 3.

– *But what about derivative products? Do they not allow us to discern market trends? They allow speculation through taking advantage of specific changes and thus, since they are listed on derivative markets, this listing gives information on probable future market evolution. For example, if we look at the price of an at-the-money call option and it is higher than its theoretical value, the market assumes that the underlying price will rise.*

Trends are all subjective. The market says nothing clear. In your example, let us not forget that there is a lot of fluctuation; the expression “at-the-money” means that the exercise price of the *call* is the current value of the spot price, but the spot price moves... Also, the market value of the *call* itself fluctuates.

Arbitrage theory, which is nothing more than the coherent application of logical reasoning to speculation situations, states that it is not possible to realize a guaranteed profit.

¹⁹² Reitz S., U. Slopek, “Non-Linear Oil Price Dynamics: A Tale of Heterogeneous Speculators?”, *German Economic Review*, Vol. 10, No. 3, pp. 270-283 (2009).

It does not prevent possible profits, but gives an important rule on the subject: if you place yourself within a law of probability where the current has a certain trend (your conviction), and you use this law to manage derivative products, you are taking an additional risk. By taking such risks, you may profit, but you may also lose.

— *In any event, derivative products allow speculation. Isn't this where the problem lies?*

Not exactly, or rather, not only. There is a dysfunction running deeper within the market itself. If derivative markets were not institutionalized, they would still exist under the counter, and banning them would lead to the same problems as those of the Prohibition period, when alcohol flowed freely. Derivative products allow speculation in this one precise sense: thanks to derivative products, one can *take a position* vis-à-vis the market. In other words, one can build a portfolio which will be beneficial if a certain evolution does indeed occur. This can even be done in a highly precise and detailed manner. With combinations of vanilla options (the most standard) at differing maturities, one can take a position that, for example, a price will be higher in three months, lower in six, and then higher again in twelve.

To take a position is to interrogate the market on its evolution; it will only reply later. And its response will just be one draw from the deck of a law of probability. To buy the underlying asset in order to resell it, or to buy derivative products, is to take a position – in other words, to speculate. This means taking risks.

— *Returning to derivatives, is the value attributed by theory to a call, a term contract, or another contingency product, correct? Is it the market value?*

Theory is only expressed via models, and these models can always be contested and improved upon by other models. Theory says exactly this: “if the model is good, we can affirm that if you base your decisions on a value of this contingent product different to that indicated, you are taking risks it is possible to avoid”. The end argument is very strong: to not follow arbitrage theory is to take unnecessary risks. But this argument depends on the relevance of the model. You tell me that speculators want to take risks! Risks they select themselves, yes, but not risks imposed on them from the outside, which they could avoid.

— *Does hedging one's bets mean that one is no longer taking risks?*

Arbitrage theory provides – in the case of the most commonly used models – prices for options (theoretical prices calculated based on volatility), and also provides methods of hedging, that is, how to construct a portfolio which will behave identically to the term product in question. Thanks to such a portfolio, one negates the risk of the term product.

In fact, one only *more or less* negates the risk. This ‘only more or less’ is because the model is not quite the same as reality...

— *So you are saying that, using the evolution of the price of an asset up to today, one can deduce nothing of its trend.*

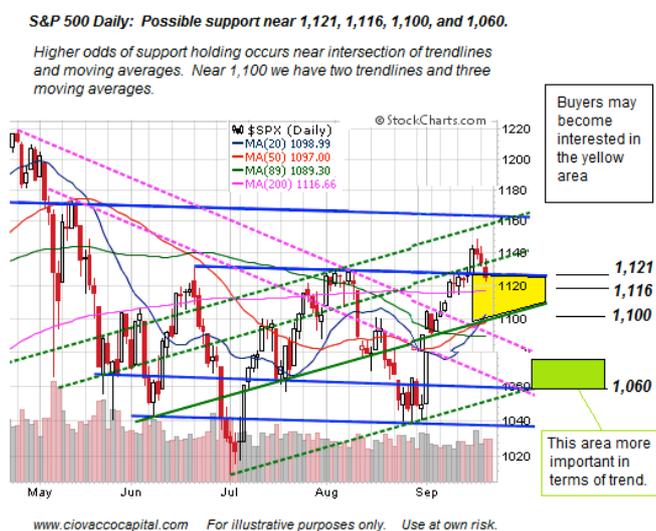
Nothing that allows a risk-free profit. You can use all the moving averages and convolutions you like, but you cannot draw any precise indication from the past as to the average or central value with which the law of probability will furnish a price in a week or month's time.

The only thing one can objectively draw from such observation is the instantaneous fluctuation of a price, known as its historical *volatility*. It is enough to observe the spot over a

recent period, and a quadratic variation algorithm provides this information with high precision.

— *And yet, on all the websites of financial markets, we see diagrams of “technical analysis” or “charts” with bands and all sorts of information – this is what people are interested in!*

For the evolution of a price, everyone bases his ideas on his own understanding. If it is the price of a share in a company, one can assume that its directors are competent, that its products will gain a wider market, etc. This creates a “worldview” for each market actor, a sort of “personal law of probability” regarding future events. Chartists’ graphs contribute by bringing an element of interpretation to observed evolutions. This is more superficial than an analysis of the geographical, institutional and technical data that govern the activity of the enterprise. In reality, the details of chartist methods have no theoretical relevance, being to finance what horoscopes are to medicine, but globally and socially speaking, the markets need people who believe in them – small-time investors contribute to fluidity.



— *For arbitrage theory to be applied as it is set out in textbooks of financial mathematics, in the language of stochastic calculus, the trajectories of prices have to be stochastic processes, of which the most used are semi-martingales, which have strong immediate unpredictability. Why would these trajectories not follow other rules? How is it that markets perfectly realize a stochastic process which has these properties of dissimulating trends? By what interplay of buyers and sellers, of those who have ‘long’ and those who have ‘short’ positions, as the terminology goes, does the spot price fluctuate perfectly according to theory?*

Quite simply, because there are teams who dedicate their time to scrutinizing all the flaws of the market from which profit could be drawn. With all the powerful means of statistical analysis provided by contemporary information technology, they track the behaviour – often unconscious – of traders in order to profit from it. Many are those who work at this, meaning that the organism which manages the market can count on a whole international army of “assessors”, whose speculations help give spot prices the appearance they should have under arbitrage theory.

Let us be more precise. The mathematical framework of arbitrage theory – the stochastic analysis of random processes – is not *validated*. It cannot be. We have only one

trajectory available to us. But its logical structure and its reasoning on games of chance are so well applied by these teams that this logic imposes itself.

— *Then you believe, like most theorists, that technical analysis and all its interpretative principles of returning to the average, of convergence, etc. are the astrology to arbitrage theory's astronomy, in the celestial mechanics of finance?*

The question is of knowing whether, in the end, the market behaves as if it were a sample of a model of stochastic calculus, or, more precisely: is the model of financial markets based on the framework of stochastic calculus a good model? (one sense of the term efficiency). Without completely answering this question, we can note that many concrete facts are well rendered by this model, as are many arguments and much reasoning. In particular, a simple fact explained here by Burton Malkiel: “whatever patterns or irrationalities in the pricing of individual stocks that have been discovered in a search of historical experience are unlikely to persist and will not provide investors with a method to obtain extraordinary returns. If any \$100 bills are lying around the stock exchanges of the world, they will not be there for long.”¹⁹³

The very existence of these purely speculative teams of which I have just spoken, who carry out psychological and mathematical speculation in the very short term,¹⁹⁴ proves that the market *is not efficient* in this sense¹⁹⁵ – but also that it is not far from being so, as in order to capitalize upon it, one must be better than these teams.

— *This very efficiency, which is not realized in practice. Does it not validate technical analysis?*

Not at all. The term *efficiency* has in economics almost as many different meanings as there are economists. This confusion becomes a vast empty rhetoric in which the ignorant, the man on the street, and politicians all get bogged down.

Eugene Fama is behind the most widely taught manner of tackling the notion of efficiency nowadays. Following this author, we try to connect economic properties of markets to mathematical properties (Markov processes, martingales, etc.) by means of the concept of *measurability*, on the mathematical side, and that of *information* on the economic side. “A market in which prices always ‘fully reflect’ available information is called ‘efficient’”, says Fama.¹⁹⁶

Here is what is usually said: there are three levels of efficiency.

Weak efficiency means that the current price incorporates all information on the past prices of the asset involved. If it is satisfied, statistical analysis on the temporal series of the price's trajectory cannot lead to any kind of profit.

In semi-strong efficiency, the price contains all information publically available. The evolution of other assets cannot, through correlations with the asset studied, provide possibilities of gain.

¹⁹³ Malkiel B. G., “The Efficient Market Hypothesis and Its Critics” Princeton University CEPS Working Paper No. 91, April 2003.

¹⁹⁴ Which thus arises from economic speculation, cf N. Bouleau, *Financial Markets and martingales*, Springer 1998, p65 ff.

¹⁹⁵ Here efficiency does not refer to economic relevance, nor to the information “contained” in the price, but only to the properties of the processes that describe the price.

¹⁹⁶ Fama E., “Efficient Capital Markets : A Review of Theory and Empirical Work” *J. of Finance*, Vol. 25, No. 2, May 1970, pp. 383-417.

In the case of strong efficiency, the price contains all economic information both public and private; in such a case, no-one can, on average, beat the market.

Using these definitions, one tries to construct statistical tests to rule on whether a given market is or is not strongly or weakly efficient. This has led to an abundance of publications.

It can be seen that this approach is an attempt to link *the economic notion of efficiency*, which can mean nothing other than competent allocation of resources (capital, investments) in such a way as to avoid waste, to *mathematical formalizations* concerning stochastic processes (martingales or semi-martingales for discounted prices, Markov processes, filtrations). But this intellectual trajectory, the mathematization of the idea of sensible allocation thanks to this association, is highly contestable.

The notion of information, taken from the theory of communication of signals in channels of transmission, is of no use for describing the knowledge and interpretations of economic actors; it is far too poor. Economics will never let itself be led to say that agents have “more or less information”, as this would be extremely naive. Agents, like you and I, interpret the world, which is what they call ‘understanding’ it. As Hayek says, “the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess”.¹⁹⁷

As for the notion of “measurability in relation to a sigma-algebra”, as this is the issue in question, it is abstract in the extreme, impossible to grasp in any operational sense. Fama uses the term ‘information’ for what probabilists call a σ -algebra, and notes as Φ_t that which is now usually noted as \mathcal{F}_t . When t varies, the growing family of σ -algebras (\mathcal{F}_t) is a *filtration*, a theoretical notion used in the development of stochastic analysis, the mathematical framework of arbitrage theory. But let us not forget that the only reality we have at our disposal is of a single trajectory. The σ -algebra \mathcal{F}_t is relative to the random process in question, or even to multiple random processes, but we do not know on an operational level these objects which cause the probability law of a trajectory or group of trajectories to intervene. Experience does not provide the stochastic process for the course of a listed quantity, only a trajectory – which is a completely different notion – interrupted at the present instant. We do not have the notion of measurability used at our concrete disposal.

At both ends, the idea of efficiency is a *forced one*: on the side of real, experienced economics, the notion of information is simplistic in the extreme, while on the side of observed spot prices, we do not see the σ -algebras used.

It is vital to distinguish two methodological objectives:

- a) description of trajectories of prices on financial markets, construction of the best models for describing them,
- b) analysis of the economic functions filled by the various markets.

In type 2 markets, where speculation is possible for the permanent buying and selling of any quantities, a) finds itself with an obvious partial answer: if the trend were clear, it would instantly modify the value of the spot price. Therefore, the trend cannot be clear. This argument can be improved upon if we adopt a more precise mathematical description for a).

As for b), it comes under the particular situation studied. It is sure that “markets react” to what is happening on the ground. However, the issue of knowing whether this reaction reflects a good understanding of what is happening is not so certain. There is a large amount of gregariousness. Insofar as traders mostly remain seated in front of their screens, the financial markets are extremely self-referential (we will return to this idea in relation to a tax on financial transactions in Chapter III-6).

¹⁹⁷ Hayek F., “The Use of Knowledge in Society” The Amer. Economic Review, XXXV, n4, 519-530, 1945.

To conclude my response to the question, I will say that no mathematical hypothesis is necessary in order to understand that on speculo-valued markets trends cannot be seen. I repeat, this is due to the fact that opportunities for speculation, via all means available (including statistical studies on the spontaneous reactions of most traders), are pushed to the limit by specialized teams.

— *So the trajectories of listed quantities fluctuate, but why do they fluctuate more for some assets than for others?*

The most fluid markets, those which are closest to theory, do not prevent an asset from having a very low volatility, or that its course should barely deviate from the yield curve of a risk-free investment. However, let us reflect further: can this be the case for the trajectory of a natural resource which is running out? All are convinced that the scarcity of non-renewable resources will have an ever stronger influence on their prices. A gentle curve bordering on a risk-free rate is unrealistic, and would provoke purchases today for term sales, causing the trajectory to rise. And in a game of opposing forces like that between scarcity and the discovery of new resources (shale gas, etc. for petroleum), the trajectory of spot prices will align itself so that it is impossible to say whether it will rise or fall. But then can the trajectory of this resource remain calm at a high level? There can be no calmness in this matter. Reduction in use of the resource due to its elevated cost will in itself act fitfully in an end dynamic which is ever more sensitive and instable.

— *And are price peaks limited by theory?*

No. The machinery of derivative markets means that the price of a barrel of oil, for example, can reach a value far higher than the amount each actor in the market is willing to dedicate towards this quantity of the product. This is due to the fact that the market and its derivative contain lotteries. We saw this in chapter III-4. How can one sell a Picasso worth a million Euros to buyers with no more than €1000 of disposable funds? By selling 1000 lottery tickets with the painting as a prize. Similarly, the market is capable of offering the object “a 1/1000 chance of an oil-barrel”.

For example, a *call* can be seen as a set of lottery tickets. If I buy a call which is very far “out of the money”, it is worth almost nothing, and if I buy a lot of them, I then have a portfolio which resembles a ticket for the national lottery... Derivative markets allow the easy creation of lottery tickets on the more varied configurations of the evolution of a price.

They also allow the inverse – the creation of a portfolio which has a small chance of enormous losses but generally leads to small winnings. One technique consists of buying derivatives to cover almost all eventualities, leaving just a slender gap... Usually, to build such a portfolio one must tie up a significant sum corresponding to the price of all these options which cover almost all eventualities. It is somewhat like buying 90% of the tickets for a lottery. But it is possible to borrow or take out conditioned loans, i.e. to only pay for these options on maturation. This adds costs, but can allow one to pay out nothing, or almost nothing. This is the effect of *leverage*. Good traders will always try to *configure* their portfolio so that these losses have only a slight probability of occurring.

Portfolio *configuration*, that is, the preference for certain portfolios vis-à-vis others with the same average and variance, is the subject of behavioural portfolio theory.¹⁹⁸

¹⁹⁸ Cf N. Bouleau *op. cit.* 56 ff. Since all the traders arrange their position to win a little with high probability, the natural game of change means that here or there, like a flicker on a global scale, some huge losses occur. Cf J.-M. Béacco et N. Bouleau “Attention, un Kerviel peut en cacher une autre” *Les Echos* 8 Oct. 2010.

– You say that the trajectories of financial markets fluctuate by necessity, following the probabilistic laws of speculation. By what process does this fluctuation appear in practice, in the interplay of supply and demand in markets?

On this subject, neoclassical thought is again highly pervasive. Walras believed that in market economics, individuals “tended” to carry out the solution to the equations of general equilibrium which he had formulated. His idea was of a process of trial and error which, starting from an initial price “called out at random”, led the interplay of supply and demand to converge upon the solution. It was a fixed-point process, as we would say today, which assumed certain mathematical conditions of contraction which have since been clarified. Moreover, Walras judged that, during the “trial-and-error process”, changing circumstances would intervene and force continual re-adjustments.

However, the oscillations of financial markets are not due to trial and error *à la* Walras. We must not blend everything together.

This is because, in the timescale in which they are produced (on the more fluid markets present today, hundreds and even thousands of transactions per second can take place) the economic circumstances have not changed. There is no new information coming in from outside. The only thing which changes is the price trajectory itself, as a kind of microscopic instability which then amplifies itself up to a certain level. Also, without contextual modification, the trial and error proposed by Walras would converge and give a curve which was relatively regular in relation to time, being deflected only upon receiving knowledge of changes to data.

The inner mechanism which creates this fluctuation is delicate. Propositions of buying and selling according to the intentions of agents (order books) in an organized market provide the list price, and this is what we call the *microstructure* of the market. The proposing of models for prices beginning with a model of the microstructure is today still an area of investigation for researchers. Many approaches have been suggested. It is not clear that there is a single mechanism, as the financial markets have been organized in various ways since the 1970s, at auction or electronically.

One of the ways to represent agents’ behaviour in financial markets is to consider a mean field dynamic – that is, to simplify interactions and mutual influences of agents among themselves by supposing that each agent interacts only with the mean of all agents and with the exterior, or in other words, with a stochastic process of exogenous economic data. The number of equations is thus equal to the number of unknowns and allows a resolution. Each agent thinks that the evolution will occur in line with a trend (a drift coefficient) which represents his opinion.¹⁹⁹

Another approach consists of considering the order books of buyers and sellers and the two lines which interact to represent the best bid and the best ask²⁰⁰. In both cases, we proceed to the limit for a large number of transactions.

Some consider it simpler to admit that each trader acting on a market is convinced of a probabilistic law relating to the development of the price trajectory, so for example, for one

¹⁹⁹ Cf for example M. R. Remita and K.-T. Eisele “Stock Market Dynamics Created by Interacting Agents” *Jour. of Appl. Math. and Stoch. Analysis* 2005.

²⁰⁰ Cf R. Cont and A. de Larrard “Price dynamics in a Markovian limit order market” arXiv:1104.4596v1 and the references cited there; D. Easley, M O’Hara “Microstructure and Asset Pricing” in *Handbook of the Economics of Finance*, G. Constantinides and al. eds Vol.1B Financial Markets and Asset Pricing; Lyons, R, 2001, *The Microstructure Approach to Exchange Rates*, MIT Press.

trader the correct value might be 5 with a probability of 1/3 and 7 with a probability of 2/3. Hence, if the value remains for a long time near 5, he will judge that it will soon move towards 7, and will take this into account. In this representation, each trader tries to act in such a way that the market realizes – simulates – the stochastic process he has in his head. The results are all the more spread out when the *a priori* images are different.

The best understanding of the microscopic structure of the market, however, remains that, outlined above, of being aware that all imperfections – in relation to arbitrage theory – are constantly being exploited by specialized teams. This shapes the course of the price trajectory so that the making of any risk-free profit is incredibly difficult.

Let us emphasize the fact that there is a profound dysfunction within the market, intrinsic to the temporal structure of prices, creating a situation which is nothing like what the neo-classical economists expected in markets, nor what most leaders and politicians in favour of the “market economy” believe today. Price fluctuation, by preventing risk-free profits, also prevents a reading of how sensitive market price is to variation in such and such a parameter. In economic terms, *the elasticities are invisible*, which – in an era where important decisions must be taken regarding reorientation of choices on energy sources, on minerals, on urban issues, on agriculture, etc. – can only freeze behaviour and predictions, trapping them within traditional, conservative criteria.

6. The market is inconsistent with the price signal

We have seen that, for a standard article, the realization of an organized market like the financial markets, in which the price is managed in a sufficiently mobile fashion to maintain good fluidity, by this same functioning of expectations, blurs the underlying trends which become subjective. The trends can be used to take a position but this position will be risky. Moreover, and this is a crucial point, this phenomenon prevents us from seeing the beginnings of a scenario such as the Club of Rome considered, and that with the best will in the world, the economic players will not see anything on the dials of their cars that will make them ease off on the gas pedal.

Is this blurring restricted to environmental phenomena? Obviously not. There is no question of externality here. It fundamentally concerns the fact that the *temporal dimension* of price, in a fluid market where exchange term assets quotas are possible, is not as the neo-classicists thought²⁰¹, the price signal is no longer seen.

Today critics consider very diverse aspects of contemporary capitalism. Many denounce the excursions of markets outside the real economy, the speculative bubbles, without pointing to the erasing of the price signal. These bubbles were tamed by economists because one can easily deal with them without upsetting the theoretical bases of the neo-classicist corpus: they are solutions of equations with different boundary conditions. It is now recognized that neo-classicists had forgotten that partial differentiation problems should have specified boundary conditions.

But it is a mistake to think that without speculators the price would be the intersection of a smooth curves of supply and demand, both curves being stable over time, and that one would thus see the real economy. There is a double-error there: firstly the curves don't actually exist – there are only clouds of points – and secondly it is neither simple nor obvious in financial capitalism how to separate speculators from entrepreneurs as Keynes advised.

In fact, business leaders and government officials have integrated rules of supply and demand into their decisions as if one could see and measure them. They use direct measurements – out of the markets – to take account, for example, of the increase in the cost of synthetic latex as compared with natural rubber latex or vice versa. Behavioural responses are assimilated in the spirit of actors thanks to the management courses and training. The neo-classical theory remains the only logical structure of the micro-economic and educational content of the MBA. By asking directly, outside the market, about likely supply and demand, they also meet the same worries as the speculators, leading to the growing frequentation of sites of specialized information.

The fundamental problem of the economy, according to Hayek

In a remarkable, and rightly celebrated, article, Friedrich Hayek posed the question of establishing what is the problem we aim to solve by constructing a rational economic order. What is interesting is that his answer is not that it is trying to implement a model like Walras's general equilibrium. His idea is much more functional and sociological, political even, in the sense of the search for a desirable organization of the city. "The peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form, but solely as the dispersed bits of incomplete and frequently contradictory

²⁰¹ According to the economic philosophy most commonly taught, which is very near to the neo-classical, the market economy offers stimuli allowing the agent to profit from the quality of his decisions (price incentives) and also to progress if he commits errors (learning opportunities), cf. Bonner S. E., Sprinkle G. B., "The Effects of Monetary Incentives on Effort and Task Performance: Theories, Evidence, and a Framework for Research", *Accounting, Organizations and Society*, 27, p303-345, (2002).

knowledge which all the separate individuals possess. The economic problem of society is thus not merely a problem of how to allocate 'given' resources—if 'given' is taken to mean given to a single mind which deliberately solves the problem set by these 'data.' It is rather a problem of how to secure the best use of resources known to any of the members of society, for ends whose relative importance only these individuals know. Or, to put it briefly, it is a problem of the utilization of knowledge not given to anyone in its totality.²⁰²

When Hayek speaks here of resources, the rest of the article makes clear that he means all types of resources: natural resources, but also resources of knowledge, awareness, know-how, everything that can be used by human intelligence. If one thinks of the sequence of epistemological ideas in the 20th century, it is remarkable that Hayek had seen, in 1945, things that would only properly be appreciated by sociologists of science in the last quarter of the century, namely that objective and universal facts are only a part of knowledge and that “the knowledge of the particular circumstances of time and space” is an important driving force for modern society which is not a matter for big science.²⁰³ “Today it is almost heresy to suggest that scientific knowledge is not the sum of all knowledge. But a little reflection will show that there is beyond question a body of very important but unorganized knowledge which cannot possibly be called scientific in the sense of knowledge of general rules: the knowledge of the particular circumstances of time and place.”

Hayek then emphasizes that economic decisions arise when managing change: “It is, perhaps, worth stressing that economic problems arise always and only in consequence of change” and he insists that business talent consists in knowing how to behave in the face of such changes. “In a competitive industry at any rate — and such an industry alone can serve as a test— the task of keeping cost from rising requires constant struggle, absorbing a great part of the energy of the manager [...] The very strength of the desire, constantly voiced by producers and engineers, to be able to proceed untrammelled by considerations of money costs, is eloquent testimony to the extent to which these factors enter into their daily work” and the local circumstances and special factors that constitute this local knowledge cannot be summarized by statistics (p524).

Thus the relevance of an economic order is primarily to allow the players in a situation to react quickly when a decision is needed: “If we can agree that the economic problem of society is mainly one of rapid adaptation to changes in the particular circumstances of time and place, it would seem to follow that the ultimate decisions must be left to the people who are familiar with these circumstances, who know directly of the relevant changes and of the resources immediately available to meet them.” For this, the manager needs, in addition to his own local knowledge, to align his decisions with the context; he needs a connection with the outside world, and that is what the *price system* provides.

Hayek then argues, in this brilliant article, that the market, or rather the system of management by price system, fulfils the work of coordinating the knowledge resources of the diverse actors, and this system “economizes knowledge” by providing only those indicators that the manager needs, and ignoring everything that the manager does not need, be they causes near or far, ethical or otherwise.

While this plea for the market economy is dated, between state planning and coordination decentralized by prices, Hayek does not truly consider intermediary situations — those which interest us for managing the planet — where knowledge beyond prices is added to the system, complementing local knowledge with global developments.

But that is not the point I want to address here. What Hayek said, essentially, was that for economic organization to be effective, in the sense of being able to use all resources of

²⁰² Hayek F., “The Use of Knowledge in Society” *The Amer. Economic Review*, XXXV, n4, 519-530, 1945.

²⁰³ Cf on this subject Bouleau N., “On Excessive Mathematization, Symptoms, Diagnosis and Philosophical bases for Real World Knowledge” *Real World Economics*. No. 57, 6 September 2011, 90-105.

knowledge, it must be based on a price system. More precisely, if we analyse his argument, it is the price changes that are the most highly prized signals in this organization. “Assume that somewhere in the world a new opportunity for the use of some raw material, say tin, has arisen, or that one of the sources of supply of tin has been eliminated. It does not matter for our purpose—and it is very significant that it does not matter— which of these two causes has made tin more scarce. All that the users of tin need to know is that some of the tin they used to consume is now more profitably employed elsewhere, and that in consequence they must economize tin.” The *change* in the price of tin propagates through all users and even to those of tin substitutes. “It is more than a metaphor to describe the price system as a kind of machinery for registering change, or a system of telecommunications which enables individual producers to watch merely the movement of a few pointers, as an engineer might watch the hands of a few dials, in order to adjust their activities to changes of which they may never know more than is reflected in the price movement.”

Price movement! The reader will have understood my point: Hayek is certainly right in his analysis that the price system game is essential for the proper expression of economic know-how, but the problem is that with markets as they currently function internally, *we can no longer actually see* the change in the price of tin.

Note also that for Hayek the price system is enough to propagate all the exterior constraints that affect the entrepreneur who is managing his business with a certain production function. It is this decentralized mechanism that he sees as a remarkably efficient and economic means of knowledge. The remaining point is that the whole argument would apply just as well even if the price system were distorted by cartel agreements, corruption etc. It is the propagation of information that Hayek finds marvellous in this system. Conversely, if the state or other agents intervene, these constraints are added to the system, but its “marvellous” propagation still works.

The real issue is that it needs to be possible to make price trends visible.

Importance of the price signal: the case of carbon

As it currently operates, as we will see, the signals provided by prices are crucial for the whole economy. Households sort and optimize for the cost of food, clothing, transport and housing costs on a daily basis, taking account of prices whose evolution is considered as a fundamental political indicator. Their statistics are used as reference in indexed contracts.

The variation today of price with respect to time, dp/dt , is the object of permanent attention of consumers but is also an absolutely indispensable piece of information for the entrepreneur. Organization of production takes time, such a process started today will not yield new products until subsequent years, and the marginal costs are evaluated today thanks to the observed trend in prices of materials and tools, labour costs and financial charges. The precious information for setting up projects and thus for the dynamics of the economy, is to be able to identify the causes of changes in price. In other words, for each factor that contributes to the price of an object or service, by watching how the observed price changes with the price of this factor one can establish this factor’s role and evolution.

This becomes of paramount importance if it is a question of changing behaviours. If one considers the finiteness of resources, pollution, the fragility of ecosystems in the face of technical risks are not drawbacks that can be protected against by a simple insurance policy. The central issue is to modify the ways of life by that, in the first place, affect them and influence them, namely prices.

For example, if one wishes to move gradually to the so-called “functional economy” in which one does not buy objects but leases them, the manufacturer is responsible for providing the service permanently, for maintaining and recycling all materials involved. It is

absolutely necessary to pass to such a system quickly to prevent the final dispersion of metals and other products to the ocean depths. The system obliges industry to a detailed account in the medium term, it cannot embark on this adventure now, the prices of raw materials and energy are too volatile to see clearly.

Since the United Nations conference in 1997 where the Tokyo Protocol was signed, the relevant national and international bodies concerned themselves – more or less – with changing behaviours on emissions of greenhouse gases. For this, the idea is to make emissions of CO₂ more costly, using the price signal²⁰⁴.

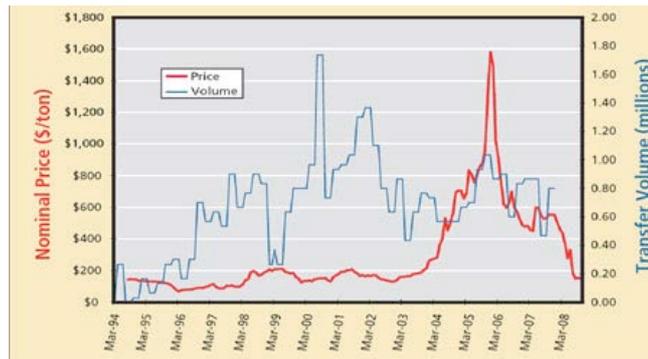
The European Union put in place a system of trading for quotas of emissions of greenhouse gases, the ETS (Emission Trading Scheme), detailed in the directive 2002/87/CE which states that the quantity of allowances given each year for all of the EU would decrease linearly from 2013. For 2013 the total allowance for the EU is calculated from national plans accepted by the Commission. Member states shall auction allowances and at least 50% of the profits of these auctions must be used on measures for reducing emissions. This system harmonized with the mechanisms called “projects” in the Kyoto Protocol (Clean Development Mechanism, CDM, and Joint Implementation, JI) by directive 2004/101/CE. In line with IPCC recommendations, the European Council in 2009 supported the goal of reducing emissions by 80 to 95% by 2050 compared with 1990 levels. According to the liberal principal that flexibility is synonymous with cost reduction, during the period 2013-2019 the member states may deduct the following year an amount up to 5% of their annual quota issue (banking or carry-over). They may also transfer to other states up to 3% of these quotas. The European system covers more than 10,000 industrial facilities that account for more than half of the remaining emissions resulting from more diffuse sources (domestic heating, transport, agriculture, etc.). It is currently the largest market for emission rights in the world, but it is far from unique; similar systems exist in some states of the US, and in Asia (Korea, China and Japan), New Zealand and Australia.

The gradual extension of tradable quota systems does not preclude the use of tax-measures as well. By the 1990s the Scandinavian countries and Finland had introduced a carbon tax in their tax systems and they did not abandon it when the European ETS was implemented. Switzerland and Ireland have also adopted a carbon tax in 2008 and 2010 respectively. France failed to agree to such a tax in 2010, but only by a small margin.

Discussion of the merits of a tax or a system of tradable rights is entirely focussed on the development of an effective price signal and the means by which one could extend this price signal, in one case as in the other, to all emissions, including diffuse emissions. The theoretical economics literature is abundant on this topic. We learn that governance by quantity (tradable rights) or by prices (taxes) do not react the same way to uncertainty²⁰⁵. We must also distinguish the shape of the proposed tax, if it is a percentage of the price, like VAT, or if its base is the amount of material, like an excise duty. Unfortunately the debate on tax remains virtual at the European level, since any tax requires unanimity and can be imposed practically only for each member state.

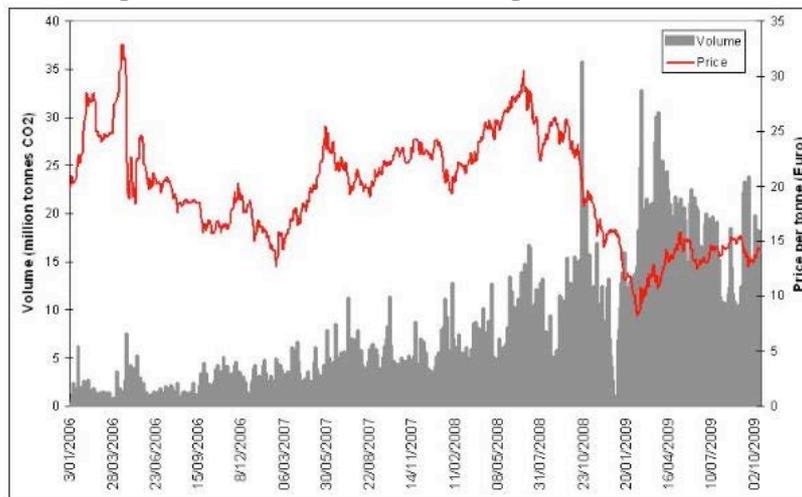
²⁰⁴ On the importance of the signal-price for emissions, see: Godard, O., “L’organisation internationale de la lutte contre l’effet de serre. Une revue critique des thèses du rapport de Jean Tirole”, *L’Economie politique*, 46(2):82-106, 2010 ; Jaffe, A.B., R.G. Newell, R.N. Stavins, “A tale of two market failures: Technology and environmental policy”, *Ecological Economics*, 54(2-3):164-174, 2005; Fischer, C., R.G. Newell, “Environmental and technology policies for climate mitigation”, *J. of Environmental Economics and Management*, 55(2):142-162, 2008; Quirion, P., “Distributional impacts of energy-efficiency certificates vs. taxes and standards”, *FEEEM working paper*, 18, 2006.

²⁰⁵ Cf. Quirion, P., “Does Uncertainty Justify Intensity Emission Caps”, *Resource and Energy Economics*, 27: 343–353 (2005).



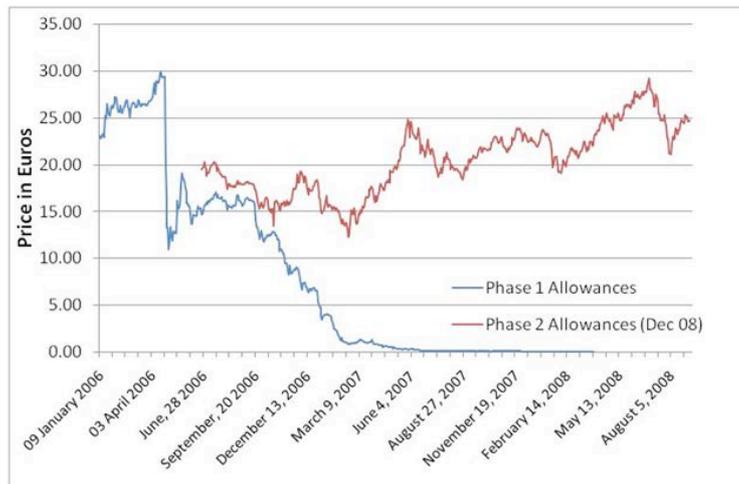
Price of the right to emit one tonne of SO₂ and volume of transactions in the market organized by the Environmental Protection Agency which markets both options and future contracts on these allowances.

The system of tradable rights was initiated in the United States by the Environmental Protection Agency about acid rains for emissions of SO₂ and NO_x. The marketed rights have a rate and their derivative products are also marketed. Various financial markets allow trading in pollution rights: the European Union Allowances (EUA) are rights relating to the Kyoto protocol, Certified Emissions Reductions (CER) are related to the European ETS scheme. Beyond the EUA and CER there are also derivatives marketed in particular options and futures (Nymex, European Climate Exchange, GreenX, etc.). These markets also offer futures products on the CDM (Clean Development Mechanism) and California Emissions Trading Scheme – a system of cap and trade similar to the European ETS scheme.



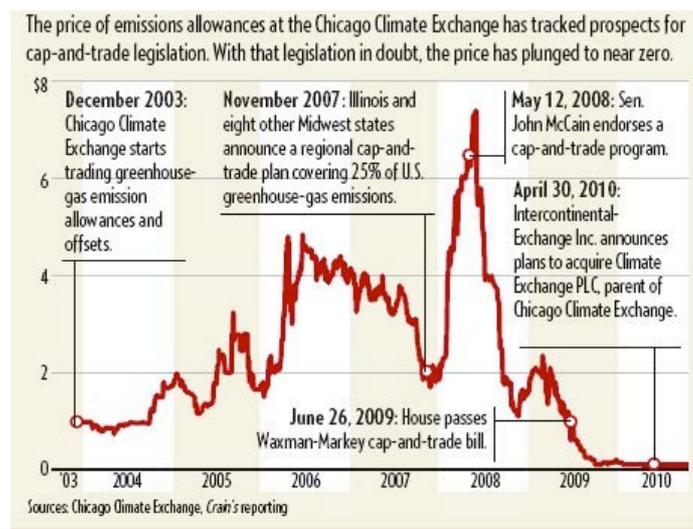
Price and volume of transactions of EUA (European Union Allowances).

If we take a closer look at these markets and their derivatives, we see the same phenomena as elsewhere. The price of the underlying (here the price of emitting a tonne of CO₂ equivalent) is very volatile, and that of the derivatives similarly. Always the same ideas are applied here, everybody is happy that – in theory – the very existence of these markets resolves the excess of pollution at minimal cost. Yet it goes unremarked that the underlying signal is barely visible because of the volatility.



Price of European emission rights.

The case of the Chicago Climate Exchange is unique because it was a private venture set up to trade emissions rights in the United States on a voluntary basis for companies that committed to an annual 6% reduction in their emissions without there being any binding regulation in the whole of the US. After a fairly successful period based, more or less, on the idea that the exchange was anticipating legislation that the Obama administration would vote in, the level of transactions plummeted and the market closed.



The short life of the Chicago Climate Exchange

Beyond these unique circumstances, it should be noted that here also the negotiated price of these emissions rights was very volatile.

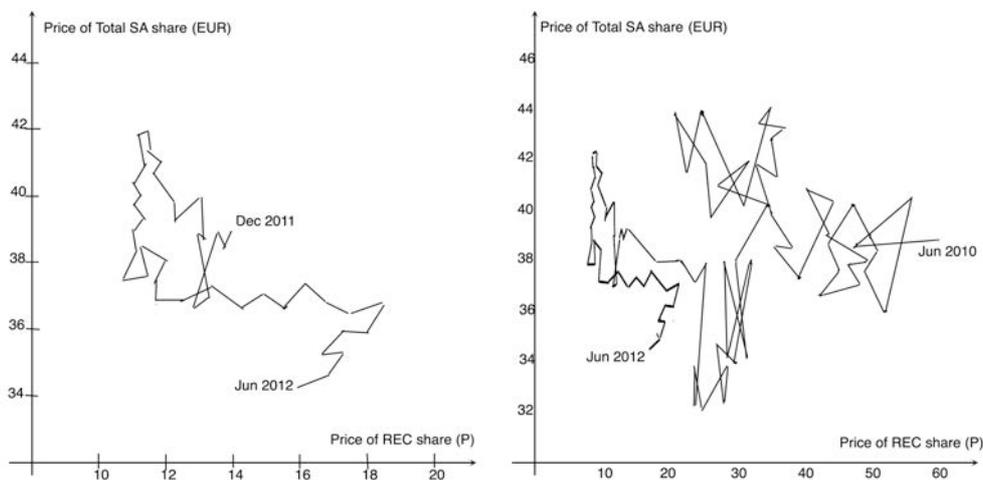
As we have repeatedly pointed out, uncertainty is costly and risk-aversion is strong, so a proper cost-benefit analysis will encourage industrial and other economic agents to change as little as possible. As Mireille Chiroleu-Assouline rightly observed “The main disadvantage of the quota market is the volatility in the price of permits, which arises from the confrontation between the supply of unused permits and the demand for additional permits, which in turn, fluctuate as a function of general economic conditions, of the expectations for the prices of different raw materials, of the available technologies, of the price of R&D, etc. These fluctuations are inherent in the operation of the market, the principle of which is to fix a price by mutual agreement (in their transactions) of the polluters so as to reduce the emissions as desired by the regulatory bodies.” But plans are always formed from a medium-term view

because the response times are inherently long, because of the slow pace of technological change and of decision-making. This is even more marked in sectors with diffuse emissions (transport, construction). “This volatility poses a problem for environmental efficiency when it becomes impossible for the players to observe any reliable long-term trend since, to take the example of the fight against the greenhouse effect and the European market (ETS), it is the predictability of the price of carbon which could encourage firms to innovate and invest to adopt sustainable cleaner technologies [...] whereas a tax makes the cost of pollution visible, transparent and predictable.”²⁰⁶.

But liberal ideology has complete faith in the market and believes taxes to be the ultimate evil.

The trends have disappeared: examples

If we study the price of two quantities such as the stock prices of two companies with interests in renewable energy, such as an oil company and a company producing material for photovoltaic cells, we will see clouds of points. Possibly, over a long time, one could deduce statistical points of comparison and principal components.

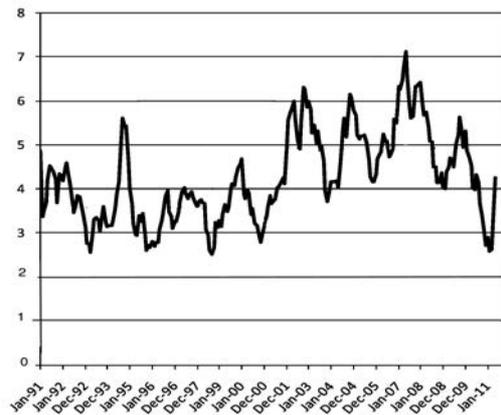


Comparative evolution in the share price of an oil company (Total SA) and a firm producing silicon for photovoltaic cells (Renewable Energy Corporation) over six months and over two years.

But certainly not trends with instantaneous significance. The share prices are extremely volatile and there are huge relative variations. Similarly if one took two quantities in the same sector, such as two textiles, e.g. wool and cotton, then the price ratio shows nothing definite and the price variations are not at all commensurate with the quantities produced or transported.

The only reliable thing that the markets show is volatility. We will come back to this in a moment, because thanks to this we can identify a typical characteristic of new market capitalism.

²⁰⁶ M. Chiroleu-Assouline, “La fiscalité environnementale, instrument économique par excellence”, *Revue Française de finances publiques*, 114 (2011) p17-25.



International prices of wool and cotton between 1991 and 2011. Note how the price can double with two years.

If we briefly look at the case of oil – at a global level – which is obviously at the heart of concerns about climate change, here again the price signal is nonexistent.



One sees in this diagram, which runs from 2003 to 2011, that the quantity of oil produced has stayed essentially constant, despite huge variations in price. In fact, if one looks very closely, it seems that the supply is *positively* correlated with the price. This could be explained by the fact that the producers open the valve a little more when prices are high, and also by the stock-management of the oil companies. These are external explanations. Note that the y-axis starts at 0. If we did not know the quantity of production, it would be absolutely impossible *a priori* to deduce it from the price.

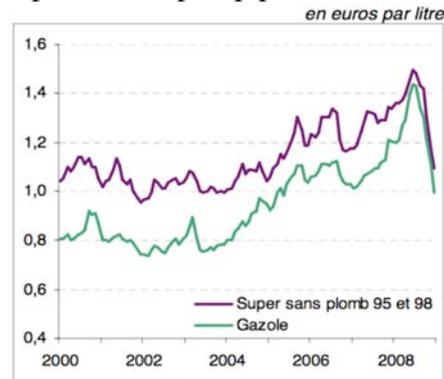
In an interesting article on the issue of peak oil, J. Murray and D. King offer an interpretation according to which production would follow demand until 2005, pursuing an upward trend despite the continuous increase in the price until it reached a ceiling of around 75 million barrels a day. The process (price and production) from 1998 to 2011 followed the diagram on the right below:



Two remarks are necessary. Firstly, the deviation from the plan is explained by the unexpected fall in prices caused by the subprime crisis. Then there is the fact that, according

to other authors, untapped reserves remain abundant, and their depletion in the coming two centuries is totally incompatible with a moderate climate change²⁰⁷. Finally, the most striking observation is that the variation in production (and, hence, in consumption) throughout this period is very small – the price signal is not working.

Now what is the price signal “at the pump”? Oil consumers have many misconceptions about this and their behaviour is far from being “economically rational”. Motorists do not make precise calculations for their choice of vehicle under uncertainty. The fuel at the pump is taxed and the international market price is “damped” by the delay caused by the refinement process and by storage time, so it is less volatile than the market price. Moreover, contrary to popular opinion, the pump price reflects the market price.



Source : DGEC, CPDP, calculs SOeS

Pump prices in France from 2000 to 2008

Opinion on price increases is based on a long period, the timescale of buying a new car. In this regard, in the five years 2000-2004 the price signal was primarily conveying stability. The year 2008 saw a steep decline following the fall in world prices, but what was its effect? In an interesting article Laurent Hivert and Jean-Luc Wingert remarked “For the last quarter [of 2008], we note that the vast majority of motorists say they have not changed their behaviour, i.e., they have continued to pay attention to their consumption, despite the decrease in prices. Is this just precaution? An expectation of future increases? Is it a temporary effect or permanent? Is it inertia and delaying behaviour of effects of a ‘media signal’ or ‘political signal’ that is stronger than the ‘price signal’?”²⁰⁸. There is undoubtedly a weak price signal, a blur that disperses actions. Everyone feels a general increase, but nobody really knows its magnitude at any given date. The economy does not provide the information and people look elsewhere, forming their own estimates of the long-term effects based on the benchmarks they remember.

The theorem of the unique trajectory

The question before us is to determine what we can and cannot see from market prices. Consider a commodity offered on a market, with an instantaneous price $p(t)$. The different factors that characterize the commodity can be represented by a parameter λ . This represents either a descriptive trait of the commodity or service, or some condition of its manufacture or supply.

²⁰⁷ Cf. H. Prévot, *Trop de pétrole*, Seuil 2007.

²⁰⁸ “Pour le dernier trimestre [de 2008], on retiendra donc qu’une très large majorité d’automobilistes déclare n’avoir rien changé à son comportement, c’est à dire avoir continué à faire attention à sa consommation, malgré la baisse des prix. Principe de précaution ? Anticipation de hausses futures ? Effet temporaire ou durable ? Inertie et retard des comportements, voire effets d’un « signal média » et d’un « signal politique » éventuellement plus forts que le « signal prix » ?”, L. Hivert et J.-L. Wingert “Automobile et automobilité : quelles évolutions de comportements face aux variations du prix des carburants de 2000 à 2008 ?” PREDIT 2010.

If the parameter λ is fixed, the price can be written as $p(t, \lambda)$. This indicates that we are considering the various evolutions of the price over time of commodities with different, but fixed, characteristics.

However, in general, λ varies with time. This is the interesting case, whether we know much about these changes, or whether we wish to deduce this information from the variation in the observed price, the price signal. In this case we write the parameter as $\lambda(t)$ and the price $p(t, \lambda(t))$. The question is then very simple mathematically: it is that of the elasticity of the parameter with respect to the observed price over a short period of time, i.e., to determine the trend of the parameter λ from the observed price. The result is the following

Theorem. Given a trajectory for a price, during a finite time interval, one cannot tell if the trajectory is that of $p(t, \lambda_0)$ or that of $p(t, \lambda(t))$. In particular, the trend in the parameter $d\lambda/dt$ is not visible in the trajectory $p(t, \lambda(t))$.

Like all theorems, this involves assumptions about the stochastic process represented by the price, about the function $\lambda(t)$ and about the kind of dependence of the stochastic process on the parameter. Let's just assume that we will make the usual assumptions of stochastic calculus and assume that the parameter only influences the drift and not the diffusion coefficient (the volatility) of the process. The mathematical basis of the argument is the Girsanov property, which says that changes in derivative only change the densities in the probability laws.

One cannot determine the evolutionary trends in the parameter from a single trajectory. But there has obviously only been one trajectory in economics, the historical one. This does not preclude us from determining some information about λ , but this information is necessarily vague, with low statistical likelihood and low confidence in general.

The fundamental law of market finance

A good economist today is someone who knows the neo-classical language and its refinements (cost-benefit analysis, bubbles, second-best world, etc.) and who discusses the improvements to Walras's ideas that are needed to account of the present, *taking offence at the disturbances that speculators bring to this analysis*. Over half the articles published in economics address the problem of speculation, even among the most "academically correct". This routine is comfortable and hypocritical. Ultimately, it is not the speculators that we should point the finger at. For over a century we have known of them and yet nothing has been done. Why? Because it is the institution of the market itself that is the problem.

Prohibit speculators and we will find the finest general balances governed by equations linking regular and significant variables. This is complete folly. As soon as a trend is noticeable enough for an entrepreneur (as defined by Keynes) to be able to use it to plan over the medium term, the set of expectations on the market will make it disappear.

I will focus here on the financial markets of the first neoliberal phrase, between 1980 and 1990, which dealt with equities, currencies, raw materials, and their derivatives, as well as bonds and interest rate options²⁰⁹. I will then go into the phenomena that are specific to the debt markets organized in the early 2000s.

²⁰⁹ It is well known that the volatility of global markets for agricultural products and currencies creates a rupture that is very destructive for local economies. "Exchange rates create problems, especially in developing countries, because they strongly influence prices both in financial markets and trade (as well as locally). Because of the mechanisms of the financial markets, these rates are very unstable, while the consequences of this instability, as the price signal for the 'real' economy, are far from positive, even if we could, finally, develop some short-term hedging." ("Les taux de change posent problème, et plus particulièrement dans les pays en développement, car

Let's summarize what we have observed in the markets. We see no trends. Moreover, if we want to protect ourselves from changes in any particular price, the tools exist, but they come at a price (one must buy derivatives). Finance is enriched by its economic inefficiency.

The idea to overcome the erasure of the price signal is simple. It is to take out an insurance policy tailored to the risk that one fears; derivatives are there for this. Their simple types (vanilla) are listed, and complex types can then be deduced for bespoke sales over the counter. Their price is much higher when the volatility is greater, as the theory explains precisely. One could state a rule:

The financial markets should be seen as a meteorological office whose forecasting system is broken and whose best solution is the sale of umbrellas, raincoats, suncreams and sunglasses. This raises plenty of money, but never tells you what tomorrow's weather will be.

Already in 1995 Marcel Boiteux had seen the basic features of the neoliberal revolution that was happening. "If the entrepreneur were alone in having to face uncertainty", he wrote, "he would have to resolve this. But, in contrast to the first category of risks, those of his own trade, the second category concerns other economic players as well. It is a lamentable waste that every individual should have to organize their own solutions in isolation. It is, obviously, much better that, with a healthy division of labour, these problems are dealt with by specialists, from whom non-specialists buy guarantees"²¹⁰. And he adds, "In this regard, the globalization of financial markets and the proliferation of derivatives can only have a positive effect: everyone will be able to find, almost made-to-measure, the 'product' that they need to hedge against the risk that they want to avoid"²¹¹. Thus, in principle, there is less waste, more specialized skill, and a healthy division of labour. In practice, however, what we observe is quite different. The first category of risks, those locally manageable, shrink to nothing, with the markets controlling everything, and in the most complete obscurity because of their permanent and excessive self-referencing. The 'specialists' do not see what is happening on the ground, the quality of projects or people, because they are just looking at their computer screens trying to set mathematical traps for the market.

Like many economists today, Marcel Boiteux believes that the only problems arise from global speculation which he sees in neo-classical terms like the 19th century mechanical analogy "But we can ask if it wouldn't be desirable, and possible, to give a little viscosity to the movement of capital – or derivatives – which now controls monetary policy: in the differential equation of motion, we need to strengthen the first degree term, the damping term." It is absolutely necessary to abandon this misleading analogy. With respect to time, market prices are not governed by a differential equation; it is not simply the suspension on a

ils conditionnent fortement les prix à la fois au niveau des marchés financiers et du commerce extérieur (ainsi qu'au niveau local). En raison des mécanismes des marchés financiers, ce taux est des plus instables, alors que les conséquences de cette instabilité, en tant que signaux de prix pour l'économie « réelle », sont loin d'être positives, même si l'on pouvait, in fine, élaborer une couverture à court terme ." M. Marcó del Pont (Argentine Central Bank) "Déséquilibres mondiaux et pays en développement" Revue de Stabilité Financière fév. 2011.

²¹⁰ "Si le chef d'entreprise était seul à devoir affronter les incertitudes, écrit-il, il faudrait bien qu'il s'y résolve. Mais, par opposition aux risques de première catégorie, ceux qui sont de son métier, la deuxième catégorie concerne bien d'autres agents économiques : ce serait un gaspillage regrettable que chacun doive s'organiser pour y faire face isolément. Il est, à l'évidence, bien préférable que, grâce à une saine division du travail, ces risques soient assumés par des spécialistes, à qui les non-spécialistes achèteront des garanties", M. Boiteux, "Les marchés financiers pour le chef d'entreprise et le chef de gouvernement" in *Risques et enjeux des marchés dérivés, Réflexions internationales, Actes du colloque*, B. Jacquillat et J.-M. Lasry eds, PUF 1995.

²¹¹ "A cet égard, la globalisation des marchés financiers et le pullulement des produits dérivés qu'on y traite ne peuvent avoir qu'un effet bénéfique : chacun sera en mesure d'y trouver, quasiment sur mesure, le 'produit' qu'il cherche pour se couvrir contre le risque qu'il ne veut pas assumer"

car with shock-absorbers. No, markets are not governed by any explicit equation. The only thing that is definitely confirmed practically and theoretically is that they *resemble* solutions of *stochastic differential equations*, which is totally different.

As to the question of seeing if one could apply some damping to them, this is complicated. I take the view that such “calming” is necessary for the next ten years, given the imperatives of environmental emergency. But in the long term more innovative ideas will be needed.

Should there be a tax on financial transactions, and if so, what type?

There is a kind of balance between the pure market logic which prevails when volatility is large, and the logic of economic policy – the fundamentals – which is visible, to some extent, when the volatility is small. A tax on financial transactions raises four sorts of questions which we could categorize as follows:

- a) if it is applied by a country or group of countries, the globalization of financial markets means that these countries will be penalized and the tax can be avoided.
- b) what institution should collect the tax and what will it do with these revenues?
- c) what is the economic basis for a tax to “calm” financial markets?
- d) is it possible to organize this tax so that it does not “kill” the management of options that are used as insurance for companies?

The first question is classical and applies to any financial regulation that goes beyond the incentive level of “prudent recommendations”. The second is related to this, and if we look at what has happened about greenhouse gas emissions, it is not unreasonable to think that such an institution could be at the European level to begin with²¹². The last question is important from the reformist point of view so that we do not add technical obstacles or misunderstandings to the already numerous difficulties that there will be in implementing such a wise cure.

The third question, the key one, is thus to establish whether it is possible for the tax to be economically virtuous? The economic value of a transaction tax has often been discussed²¹³. In general the reasoning is based on constructing a model for financial markets and studying the changes that the tax brings to their operation. The conclusions depend on the nature of the incompleteness considered. Often the tax does not reduce volatility. Sometimes it even increases it²¹⁴. It appears, however, that these arguments do not take into account the fact that changing the prices will lead agents to seek information from other sources than the market, and thus the tax reduces the self-reference in the market.

We use the term volatility in the sense of instantaneous agitation of a path (local quadratic variation to adopt a semi-martingale model). This quantity varies in the same direction as the uncertainty that rules on the asset side. We know from a brief mean-variance analysis that situations of high uncertainty can yield more and that financial markets are very strongly self-referential which is one of the causes of global instabilities²¹⁵. Arguments based on the no-arbitrage principle are very convincing in terms of the actions of an individual agent

²¹² On these two questions and the recent history of these debates, see Damette O., “Quel avenir pour une taxe Tobin ?” *Mondes en Développement* Vol.35-2007/4-n° 140.

²¹³ Cf for example Uppal R., “A Short Note on the Tobin Tax: The Costs and Benefits of a Tax on Financial Transactions” *EDHEC Risk Institute* July 2011, and its bibliography.

²¹⁴ Lanne M., Vesala T., “The effect of a transaction tax on exchange rate volatility” *Bank of Finland Research Discussion Papers* 11/2006.

²¹⁵ Information is lost by self-reference. One would rather be afraid than verify one’s sources. Hence the celebrated slogan “buy the rumour, sell the fact” which is a principle of speculation based on the efficacy of rumours. These behaviours were already noted by Keynes.

in an existing market, but they do not tell us how the market itself obtains relevant economic information.

If an economic agent wishes to make an investment involving shares of listed companies and currencies, there are two ways. On the one hand, he can trust exclusively in the market which, thanks to the listed prices for shares, currencies, raw materials and futures products related to these, gives him apparently all the information about the uncertainties involved. On the other, he can spend a set amount of money on enquiring for himself about the profitability of the business he intends to get involved in. This second method is the “old economic logic”²¹⁶ that was the main approach prior to the 1970s. It involved the use of experts to study the projects and engineers to assess the chances of success for the business innovations. This method is more expensive than the first, which is free. But it does not produce the information in the same way. The two ways become even more different when the volatility is large.

Hence the idea of taxing in proportion to volatility. Certainly if we tax transactions made in volatile markets, this will not change the uncertainties involved in these markets, and will not reduce the volatility of these markets. But it changes the situation for the investor between the use of the market for information, and the use of his own information. To run a business using only the market tools will become costly because of the tax, so encouraging people to find better quality information themselves or from competent providers.

Why would this be of better quality? Because it can take into account factors that the market cannot, for example the relevant links between the investor and the geographic region or the category of goods involved in the project. And, ultimately, the quality of the people in charge given the information received. In summary then, to tax volatility is to encourage the players to develop better economic information taking into account all relevant points of view.

To see how we can tax volatility, we must address the fourth question of the incompatibility of a tax, however small, with delta-neutral insurance options. The problem can be described in the following way: delta-neutral management requires a great number of transactions whose algebraic sum is small but the sum of whose absolute values may be large, potentially infinite. Currently the art is to optimize the number of transactions as a function of the costs induced by the market itself, i.e., what is called the bid-ask.

One possible approach for the tax is to tax only the absolute value of the algebraic balance of transactions by one agent on one asset, on a weekly or monthly basis. One should also make the tax proportional to the square of the volatility for technical reasons that I will not go into here.

The above argument, that the tax will encourage a better allocation of financial resources, will only be visible in the long term. At the start there will definitely be a penalty on the affected financial markets. But if this penalty is of an order of magnitude far below the fluctuations of activities of financial markets over time, the tax will not lead to as large a leak as some people think. The means of implementing the tax raise legal problems as to whether the tax is levied only on organized markets, and whether or not the site of the transaction and the identities of the agents are taken into account.

In this respect, the European directive MIF 2004/39/CE, which was clearly aimed at liberalizing the financial platforms in Europe, is under review. In the eyes of the Commission “The result after 3.5 years in force is more competition between venues in the trading of financial instruments, and more choice for investors in terms of service providers and available financial instruments, progress which has been compounded by technological advances. Overall, transaction costs have decreased and integration has increased”.

²¹⁶ Cf. N.Bouleau *Mathématiques et risques financiers* O. Jacob 2009, chapitre V.

Obviously, the fact that the reduction of transaction costs increases the self-reference of the market and relaxes its economic relevance has not been taken into account. There is reason to believe that the importance of this question has still not been appreciated by the advisors of the relevant Directorates General. The Commission is obliged to recognize, however, that new problems have arisen which justify changing the MIF directive (cf. COM(2011) 656 final). In fact, internet platforms have been developed which function as organized markets on which marketing strategies (similar to those used by telephone operators) further blur the nature of the information provided by the market. Thus the proposed amendment imposes “the mandatory trading of derivatives on organized venues, specific supervisory actions regarding financial instruments and positions in derivatives and the provision of services by third-country firms without a branch”.

It is clear that it would help if the tax were installed throughout the Eurozone, because the transaction costs and increased uncertainty of a detour to another currency would discourage circumventions of the tax. However, London is the principal place where Euro assets are exchanged, so the decision would require a greater European agreement. It seems then that the legal changes would have to be done at the level of the European institutions.

The introduction of such a tax in Europe, even a very small one, even if the revenue gained is of far smaller order than our sovereign debts, would have considerable institutional consequences. It would mean, effectively, that the Commission services have overcome the difficulties in the outline of the tax and its integration into European and international law. This simple fact carries a huge symbolic value, namely that Europe is politically capable of standing up to the spontaneous global financial order. She would then recover a credibility with the popular classes and those political parties (the Greens, and a good part of the left) that believe that international finance is running the planet badly. This issue seems to be motivation enough to go deeper into the technicalities of setting up the tax.

7. Creating debt markets: delegating economic intelligence to agencies

We now turn to the most recent innovation of the financial markets, the most extreme phase to date of the development of the market ideology. It is much more audacious than previous ones, and requires a special analysis.

Until the turn of the 20th and 21st centuries, credit functioned as a market in the traditional sense of the word, i.e., as agreements between borrowers and creditors in specific arrangements of projects and contracts conditioned by explanations and understandings in different contexts.

Was there a credit market? Yes, in the same sense that there is a labour market or a housing market: an exchange market like those the neoclassicists have tried to symbolize.

But the financial revolution won the credit field at the end of the 1990s. We could call this the third level of financialization. As we will explain in terms of political and decision-making power, it is the major step of neoliberalism, and has severe problems similar to those of the teeth of the market.

We will see that this market functions with truncated knowledge and in the presence of a conflict of interpretation under uncertainty: some have an interest in saying that things are going badly, which reduces the value of the debt, while others have an interest in making people believe that everything is working well. What has happened to the governments in Europe – namely that certain states that have higher rate of public deficit than of growth have had deflationary policies imposed on them, leading to recession – applies also to other cases of credit. The system cannot function properly.

What is new compared to other markets (currency, commodities) is that the conflict of interpretation, and the fact that the market has only truncated knowledge, requires the presence of third-party agencies to say “the truth”. The market does not automatically provide a price; it is these agencies that “understand” all that the market does not.

But these agencies are not global political governments elected according to policy programmes that detail their plans. They do not know the “things-in-themselves” of the economy, nor about the “desires” of humans.

In particular, they do not see the desire to save the planet.

Why does this market need such agencies where, say, the oil market doesn't? It is because of this truncated information. On the credit market one does not buy a quantity (of currency, stocks, or oil), one buys an indicator of quantity: a random variable that represents a lifetime of activity.

The hope is to mediate the contradictions of the market by the wisdom of the rating agencies. But these agencies are part of the system. The people in them are paid, they are part of society, their viewpoint is biased.

The third level of financialization

As we saw in the first chapter, the financial markets flourished rapidly in the 1980s throughout the world, and with strong connections between all the financial markets, from Chicago and New York to Hong-Kong, Singapore and Tokyo, thanks to computer networks. The match that lit these fireworks was the article by Black and Scholes, in 1973, where the idea of covering an option by an auxiliary portfolio (a so-called delta-neutral hedge) first appeared, and, behind this, the *Theory of arbitrage*, due to a stream of authors, including Robert Merton²¹⁷.

This theory allowed one to extend, over very diverse situations, a new way to put a price on quantities that depend on the future randomness in the market. The price given by

²¹⁷ Cf R. Merton, *Continuous-Time Finance*, Blackwell 1990. Cf also N. Bouleau, *Financial Markets and Martingales*, Springer 1998.

this theory is such that neither buyer nor seller can make a profit without risk. The theory of arbitrage provides a unique and accurate price in the case where the market is “complete”. This is a mathematical property, dependent on the model used to represent the market, which is never perfectly achieved in practice, but is considered to be a good approximation in the case of options for currency or stocks.

The assessment of this very clever and subtle stuff in the late 20th century was that it was “genius”. It allowed one to market options – which served as an insurance policy for businesses against the uncertainties of the markets – at costs much lower than before. It squeezed as much as possible out of risk-management and allowed the generalization of commodity futures, also called derivative products, to all listed assets. Hence the spectacular development of the financial markets in the late twentieth century.

Staff with good mathematical training, including stochastic calculus, were hired in the trading rooms – and called quants – and in conjunction with traders they perfected the whole theoretical and practical machinery as much as they could. After currency and stock options, they applied their ideas to the bond markets, i.e., to interest rates and interest rate options. This is a much more difficult area, but the logic of the arbitrage theory is – in the world of finance – so exciting that it has been stretched to its full potential.

Towards the end of the 1990s and at the start of the 2000s, the whole universe of financial economics was impregnated by the theory of arbitrage. Everything except credit. This was the ultimate step: whatever the cost, the crowning glory of the theory of arbitrage had to be attained – the organization of a global credit market, where one could buy and sell loan files, or hybrid packages comprised of credits and commodity futures. Thus financial institutions could diversify their files and not put all their eggs in one basket. Everyone would benefit. Consolidating various debts and other futures contracts in packages to be exchanged on the market is called *securitization*. This packaging has become an art where probabilistic calculations of risk are the new music.

But it was harder than it seemed. I mention this here, because we will see that the result of this new organization of debts for sale with the new derivatives products designed to encourage securitization had, as a corollary, to function with very poor information about real economic relations. Like the teeth of the market due to volatility, the debt market prevents us from seeing certain things that are fundamental for the motivations and plans of the actors in the economy.

Today, credit is organized in a global market. Banks lending to individuals and businesses can lend more than they hold as equity so long as they hold more than 8% of the risks they undertake²¹⁸. Note that this system, money multiplier for banks, private loans to countries, credit managed solely by the risk of default, a system which is a kind of private Keynesian multiplier, constantly replenished, is *incompatible with decrease*. This is seen very clearly when interest rates are above growth rates, such as in the Greece or other countries with low or negative growth. They then enter the absurdity of economic paralysis. This phenomenon is characteristic of Europe, but holds generally for the credit economy itself.

These packages, skilfully put together, are “rated” by “independent” rating agencies, of which the most important are Standard and Poor, Moody’s and Fitch Ratings (the “big three”). These ratings are used as the basis for probabilistic calculations that estimate the risk as a function of the duration and term of the loans and therefore have a benchmarking role in fixing the prices on the market for securitized assets.

Like the “classic” markets in commodities, stocks, currencies and bonds, the debt market was completed towards the end of the 1990s by a whole set of derivative products that

²¹⁸These constraints (the McDonough ratio, issued by the Basel Committee) are imposed on institutions whose regulatory authorities sit on the Bank for International Settlements. This includes the G10 and others, but not tax havens, and only the major banks of the United States.

are themselves bought and sold on the market. Among these, Credit Default Swaps (CDS) are the most widely used, and represent more than half of the market. Other common tools are Credit-Linked Notes (CLN), Total Return Swaps (TRS), Credit Spread Options (CSO), and structured products based on previous derivatives, such as Collateralized Debt Obligations (CDO). The principle of CDS, for example, is as follows: an establishment seeking to get rid of credit risk buys protection in the form of a periodic premium from another institution, acting as an insurer, which agrees to compensate the first in the event of a default or other event affecting the holder of the CDS.

In these sophisticated tools, there are exchanges, groups of securities (synthetic CDOs), distributions following deadlines, etc. But at heart there are just two activities: the qualitative estimates that constitute ratings, and the probabilistic calculations that underlie the prices that are formed.

Having established these details, our aim is to consider the way that capitalism has ruled our world since the start of the neoliberal period. Two levels of analysis are possible, both equally important.

The first level is that of the philosophy of knowledge, which considers the epistemological limits of the economic valuation of risks. Fundamentally this is about whether we can believe that capitalism is capable of managing the risks that global developments cause in the economy by the simple process of a global risk market organized as we have outlined. The delicate point of this case is that the economy applies to reality – geography, civilization, etc. – and not just to computers on traders’ desks. What is it that this immense financial machinery ultimately produces? Prices. These numbers are the final summary determining economic decisions in the face of uncertainty. It is not because this mathematization seems essential to the functioning of the markets that it is philosophically justified and acceptable, especially if one thinks of the future and of future generations.

The second level concerns the very nature of the economic object that is a debt, where, as we will see, the business of securitization applies with limited, truncated information, with which *one cannot see* the important things that are happening. The same defect as that caused by the volatility in stocks on organized markets can be seen here. Here it is not caused by volatility but because the focus is on just one economic parameter. Everything happens as if one believed that one could fly a plane just by looking at its shadow on the ground.

We will consider these two levels in turn.

The epistemological limits to the economic valuation of risks

Following the alert raised by Ulrich Beck, there has been many discussion about risks and it has often been noted that economic calculus was an imperfect tool, inappropriate even, particularly because it suppresses the long-term effects under any exponential discounting and correspondingly overemphasizes the present interest, a catastrophe far in the future “weighing” the same as a minor discomfort in the present. (Note here that the concept of discount rate has, in fact, because of neoliberalism, lost of a lot of relevance. It was a concept that claimed to be very useful for accurate calculations of public investment in the time of the sovereign state. But today it is the financial markets that set rates. The term structure of rates is fixed by the bond market and is imposed on states insofar as they have to borrow on the markets²¹⁹. This is even stricter in Europe where neither governments nor the ECB can create money except by express decision. “Lowering the discount rate” is a funny expression!

²¹⁹ Currently, sixteen of the richest nations have a government deficit of more than 50% of their GDP, with six owing more than 100% (FMI 2012).

Lowering for whom? Who will pay the difference between this and the market rate? For what purpose? Who will decide?)

We need to go further with the analysis to be able to understand how the environment is damaged; the concept of risk needs to be studied in all its aspects, historic, cognitive and, of course, in society's understanding of it.

Measuring risks is not a trivial operation. Among the damages that society can incur, let's consider the case of a flood. Already the description of such an event is not a simple thing: a flood is a phenomenon that happens in time and in space. Two floods on the same river are never identical; some will last a long time while others are brief, some will cover a large area while others move the banks of the river, and the economic value of the affected area depends to a degree on the changes in urbanization over the years. To "economize" this type of risk would require making estimates of the value of things that have been destroyed (habitat, factories, machinery, lands) but which were not for sale on any market and whose valuations are necessarily somewhat subjective because they are linked to a knowledge of what has happened to them.

When making comparisons between different floods by deducing things from laws of probabilities, using time series models, it would be a lie to say that there is only one way to do this, the truly scientific method. No, even with regard to the current of the river, according to whether one used statistics on the water level, or statistics on the flow, one would obtain different and incompatible results which could not give the same probabilities for the extreme values that constitute floods²²⁰. Anything that requires understanding is subject to a great variety of interpretations, and this is absolutely normal.

The probabilistic representation of risk is *a pair* of mathematical quantities: 1) a probability law that governs the states that can occur, 2) a random variable, i.e., a function which assigns a cost, profit or loss, to each state. This representation is much too elementary for considering risks. One is almost never in a situation where this model is adequately informed. One does not know the probabilities of rare events for which there is insufficient data. One does not know what correlations to take to evaluate the damages. And one never has a complete description of what can happen.

Mathematical techniques give the illusion of rationalization, especially in the financial world. The development of stochastic calculus after the second world war, by the school of Kyosi Itô (1915-2008), provided a mathematical language where the no-arbitrage principle is expressed in broad assumptions. Whence the processes of pricing and hedging options come from partial differential equations. Mathematization then invaded securitization and risk measures. Again, a mathematical innovation needs to be mentioned. To estimate the risk of a portfolio of random assets, the classical "value at risk" (VaR) method (cf. Chapter I-1) has been replaced by the more scholarly notion of "coherent risk measure". These new methods spread quickly. They enabled calculations on complex portfolios provided we assume that we know the probabilities of rare events, i.e., the tails of the laws that have a significant influence on the results. These, then, are the processes which, when one runs out of information, replace this ignorance with a probability law to continue the calculations.

It has often been pointed out in the commentaries on the crisis that the new products in these markets, CDOs and particularly CDSs, did not encourage players to be cautious. This is true, but the most important fact is that people were tricked into thinking that the risk of a portfolio was "in" the portfolio itself. The risk is interpretative by nature, and it turns out that the local interpretation (rating of portfolios by criteria grids) is inconsistent with a global interpretation, in the same way, for example, that a Kandinsky painting like *Yellow – red –*

²²⁰ Cf. N. Bouleau, *Philosophies des mathématiques et de la modélisation*, L'Harmattan 1999, p313-315.

blue can be seen as an abstract with no meaning beyond the splashes of colour, or as an allegory where a whole story is told²²¹.

Quantifying risks is not a trivial operation because it flattens reality into one single interpretation. Not only does everything outside the world of markets disappear, but also the economy itself is flattened, reduced to a summary meter-reading.

It is clear that the interpretative field is by nature plural and complex, and that collective decisions necessarily result from a political process. To mathematize a situation where uncertainty arises is to considerably simplify the situation, and opens the door to methods of “rational choice”, i.e., stochastic optimization. But does one gain anything by doing this?

Yes, if one believes that the key is to bring reality to monetization as much as possible, and one is not concerned by the fact that the projection of the multidimensional space of meaning onto the quantitatively valuable, i.e., onto a linear yardstick, can be done in various ways.

This mutilation of reality plays tricks on economic practice itself, as evidenced by the various crises. Obviously this reduction has extreme consequences for the environment because it establishes a relation of equivalence. A process, a raw material, a plant, a bacteria – ultimately a person, or society – is ultimately replaceable by an artificial device that is deemed to be “economically” equivalent. This phenomenon, already familiar in the context of labour and mechanization, takes on a vertiginous dimension when one thinks of biodiversity, where no real repairs are possible, or of the exploitation of natural resources or, more generally, of the inability to take account of the general interest in a situation with conflicting economic interests. One always ends up playing a game of “Red light, green light”²²².

This equivalence relation that is monetization evidently allows a considerable array of economic activity, since it facilitates all kinds of exchanges of goods and services. It is the reason behind the obsession with the use of cost-benefit analyses for decision-making, without seeing that the method itself *makes a decision*. A decision that is very particular and characteristic²²³. It is neither magical nor surprising, given that one has erased part of reality, that the solution this process gives does not satisfy all the conditions that pertain in reality.

What is lost by putting debts on a market

Now we move on to the second level. Uncertainty is everywhere in finance, but in the case of lending it is difficult to quantify risks because that requires *understanding* of the activities of the borrower and their context. For a long time it has been realized that this involved an unusual sort of evaluation which assumed that a level of *credibility* was assigned to the information provided by the counterparty and that one would be able to *understand* their plans. Thus there was often a moral, or even religious, dimension to such operations.

The loan is not an exchange but is a *long-term relationship* between the lender and the borrower. Under the ancien régime in France, corporal punishment and prison punished insolvent debtors. This rule remained mostly just a threat but was applied in a fairly random fashion. Pawnbroking, the usual realm of the usure, was tolerated with rates exceeding 20%.

In Max Weber’s famous interpretation of the birth of capitalism he recounts the following quote from an American: “Sir, for my part everybody may believe or not believe as he pleases; but if I saw a farmer or a businessman not belonging to any church at all, I wouldn’t trust him with fifty cents. Why pay me, if he doesn’t believe in anything?”²²⁴. There is a relationship of trust in the loan that the lender seeks to objectify but which remains fundamentally at the level of meaning, of understanding and of empathy.

²²¹ Cf. N. Bouleau, *Risk and Meaning, Aversaries in Art, Science and Philosophy*, Springer 2011.

²²² Cf Chap. II section 2.

²²³ Cf. *Vers une société sobre et désirable*, D. Bourg et A.Papaux eds, FNH-PUF 2010.

²²⁴ Max Weber, *The Protestant Sects and the Spirit of Capitalism* 1904-1905.

The important development is the change of banking which coincided with the Reagan-Thatcher era of neo-liberalism. Before this, the banks lent and called upon the skills of their own experts whose function in this environment was to understand the processes and the techniques of those businesses applying for loans and assess their relevance and potential. But at that time a new logic was born which was based not on such understanding, but on the no-arbitrage principle of the financial markets themselves²²⁵. For options on equities and currencies, this has put in place the teeth of the market that we discussed in the previous chapter. The extension of this idea to credit was a serious mistake for a different reason.

The creation of such a market seemed a good idea to everyone because it allowed each lending institution to diversify their portfolios by buying packages that were geographically and economically remote and selling a portion of its own to reduce the correlations. However, the subprime crisis, closely linked to these practices, no longer looks like a passing storm but rather the transition to an unstable and problematic regime. A number of recent phenomena, leading to real paradoxes, mean that one should question whether or not these good ideas were perhaps adopted a little too quickly by neoliberal economists driven by the fervour of young mathematical traders. Let's look at these things in more detail.

The credit market was historically born of public debts, bonds. At its heart was the possibility of disposing of a debt, for reasons particular to the lender, who might want, for example, to obtain a divisible evaluation, in the case of matters of inheritance or legacy²²⁶. The existence of a credit market allowed a long-term loan to operate with successive creditors. This question is very important for financing the preservation of the environment, but as the remarkable Dexia affair shows, the current functioning of the financial debt markets do not allow claims handovers in good conditions between short-term loans and long-term loans²²⁷.

When the lender sells the debt on the market a variety of situations can occur according to the nature of the loan. In the simplest case where the loan is granted with a fixed interest rate, upon resale, because there is always a risk of default – even for public debts as one sees in the news – the value of the loan reflects this risk through a lower value.

This way of managing the default risk has the consequence that the capital to be repaid by the borrower is reduced accordingly, for the simple reason that the borrower may redeem the debt at this price, or buy it from a third party who has purchased it at this price. So this means that the lender has “taken his loss” (which is what the creditor banks accepted for the Greek debt, on October 27th 2011: to exchange Greek bonds that they held against new securities whose value was reduced by 25%). One immediately hits legal and/or political issues about any information that makes it more likely that the borrower will default, since the borrower has an interest, ultimately, in making people believe in his difficulties so as to be able to redeem the debt at a good price, or redeem it by an ally, at least as regards the management of that debt, because doing so will damage his reputation as a good borrower in future. Specialists therefore use two notions: the *default risk*, which concerns the probability law of a total or partial inability to repay and the *credit risk*, which measures the reputation of the bad debtor.

Consider the case of an entrepreneur about to embark on a project, which obviously presents some uncertainties, who requests a bank loan for it. Various outcomes may arise from the project, with varying returns, and certain circumstances may prevent the borrower

²²⁵ Cf N. Bouleau, “Finance et opinion” *Esprit*, nov.1998.

²²⁶ Cf P.-C. Hautcœur “Marchés financiers et développement économique : une approche historique” *Regards croisés sur l'économie* 2008/1 n°2, 159-172, La Découverte

²²⁷ Dexia was born of the alliance between Crédit communal de Belgique and Crédit local de France, the successor to CAECL (Caisse d'aide à l'équipement des collectivités locales). The financial crisis had serious repercussions for this establishment as well as for local borrowing collectives

from repaying the loan.

Currently, to enter the credit market, the project will first be classified by risk matrices. If the risk is high the entrepreneur will only be offered high-interest loans. The chosen bank will, in any case, renegotiate the loan by securitizing the file on the markets. The loan agreement is made by conflating into one notion the interest rate, the quality of the project and the default and credit risks. *This conflation* has several consequences.

It is an initial estimate of the default risk that will most often determine the interest rate of the loan, rather than an understanding of the viability of the project, because the entrepreneur has access to a credit market where the correlation between default risk and loan rate is very strong²²⁸.

The relevance of the project is thus not properly taken into account. It may even happen that a highly profitable project is offered loans at the same average rate as an uneconomical project from a different entrepreneur: the work of understanding the profitability of an investment is poorly rewarded.

Put another way: investors cannot, by means of a loan, take advantage of a very profitable project with low default risk, because an entrepreneur in such a situation will easily obtain cheaper loans. This phenomenon is even more pronounced when the overall growth rate is low, which explains why it arises as a paradox now.

On the other hand, a project whose default risk appears high, will only obtain loans at a higher rate, not matter how profitable the project is. When the project isn't very profitable, the loan agreement is formed in the face of a *self-fulfilling presumption of risk*: the loan is agreed on the basis of an estimate of the default risk, but the interest rate specified in the agreement will itself significantly increase the risk of default. This is characteristic of the situation Greece and other European countries currently find themselves in.

Added to this is another difficulty, also caused by this conflation process: the default risk is estimated beforehand, but becomes more accurately known after the loan is agreed. If it increases, the bank will think that the loan is not sufficiently remunerated (the current position of banks holding bonds from European countries), but if the bank tries to sell this loan on the credit market, it will realize that the loss is made and that the rate corresponds, roughly, to the market value of the debt, given the new risk. Therefore the bank will prefer to keep the loan, and argue politically for exceptional procedures that reduce the default risk of the borrower (by putting pressure on the borrower so that he changes the configuration of probabilities that apply to him, from the viewpoint of the lender, if these pressures are effective, then the management of the project itself will be changed and its profitability can be severely affected²²⁹, cf. Greece, Italy, Spain... and the action of the banks towards European leaders). The banker can also buy CDS etc.

To this muddle is added the virtual impossibility in the securitized debt market of taking account of the correlations between files on both the profitability of these projects and their defaults. One is never protected from the propagation of interpretations triggered by the shocks of new information or rumours.

We have lost out by putting debts on a market. Creditors are encouraged to no longer involve themselves in understanding the entrepreneurs' projects and a trade has been organized to function with limited information, thus hampering economic incentives.

²²⁸ A usurer never sets the interest rate solely on the basis that the loan is likely to be repaid. The lender is not so stupid; he will take the utmost account of the strength of the borrower's need for the money. He will then ask for guarantees of repayment, collateral, payment schedule, etc.

²²⁹ because what counts is being almost guaranteed that a certain sum of money will be reimbursed. The use to which this money is put is secondary.

When faced with contradictions, consult an oracle

For securitization to work, the portfolios exchanged must be assessed by agencies and services attached to every institution to estimate the default risk and the impact that the cost of the loan will have on this. But is it appropriate to consult a third party? The intentions of the borrower are known only to himself and he is not inclined to reveal the risks he will take. Whichever way one looks at credit, the default risk is caused by the borrower, but the way that the cost of this risk is shared, between the borrower and the backer, is poorly managed by the market.

The wise approach is to predict in advance what the two parties will do in various scenarios and look for a balanced agreement that can be reviewed stage by stage: If the project works well, for which there must be clearly agreed criteria and weighted indicators, then the lender must profit. If the project goes badly, then guarantees must be provided about the equipment acquired, land, property ... We thus come back to the idea that the lender is involved in the project as is the case with corporate sponsorship. To keep open the possibility of loans changing hands over a long term, this suggests a transfer of genuine responsibility in OTC transactions supported by detailed contracts.

The key epistemological point is that the risk is interpretative in nature, which means that understanding it requires a level of engagement and involvement, which the standardization of the markets cannot provide, and of which the key is the contract. As Armand Hatchuel rightly emphasized, it is a humanely responsible management that generates wealth²³⁰.

What has been erased by the market? The particular details of the clauses in the notional contract between borrower and backer. They may provide timelines and partial criteria for success or failure, where the reciprocal commitments are reviewed. Such clauses can take account of social phenomena or exterior environments. An economy of contracts is an economy *without anonymity*. The interchangeability of creditors that the market organizes translates into a lack of co-responsibility between borrower and lender. This is a key issue for management of uncertainty and of the future. The financial markets have created irresponsibility.

Credit is just one example. There are numerous cases where the *economy protects anonymous individualism*. This leads to the idea that the contract should return to the centre of the economy, an idea that occurred to Michel Serres who proposed extending this to nature: "Back to nature, then! That means we must add to the exclusively social contract a natural contract of symbiosis and reciprocity in which our relationship to things would set aside mastery and possession in favour of admiring attention, reciprocity, contemplation, and respect; where knowledge would no longer imply property, nor action mastery, nor would property and mastery imply their excremental results and origins. An armistice contract in the objective war, a contract of symbiosis, for a symbiont recognizes the host's rights, whereas a parasite—which is what we are now—condemns to death the one he pillages and inhabits, not realizing that in the long run he's condemning himself to death too."²³¹

Agencies now play the role that in ancient times was played by the Oracle of Delphi, whose priests wrote subtle interpretations of what Pythia said while in a trance, to answer questions that Generals had before engaging in battles. The Oracle of Delphi had a Panhellenic reputation giving it a genuine role in international politics. Of the countless answers given by the Oracle, only 615 have been preserved, thanks to ancient authors or inscriptions, often in verse, and cleverly written²³². The Oracle of Delphi had the same tendency towards social conformity, and the same links with power, more or less

²³⁰ *Le Monde* 25-10-2011.

²³¹ *The Natural Contract*, Univ. of Michigan Press 1995.

²³² H. W. Parke, D. E. W. Wormell, *The Delphic Oracle*, Oxford 1956.

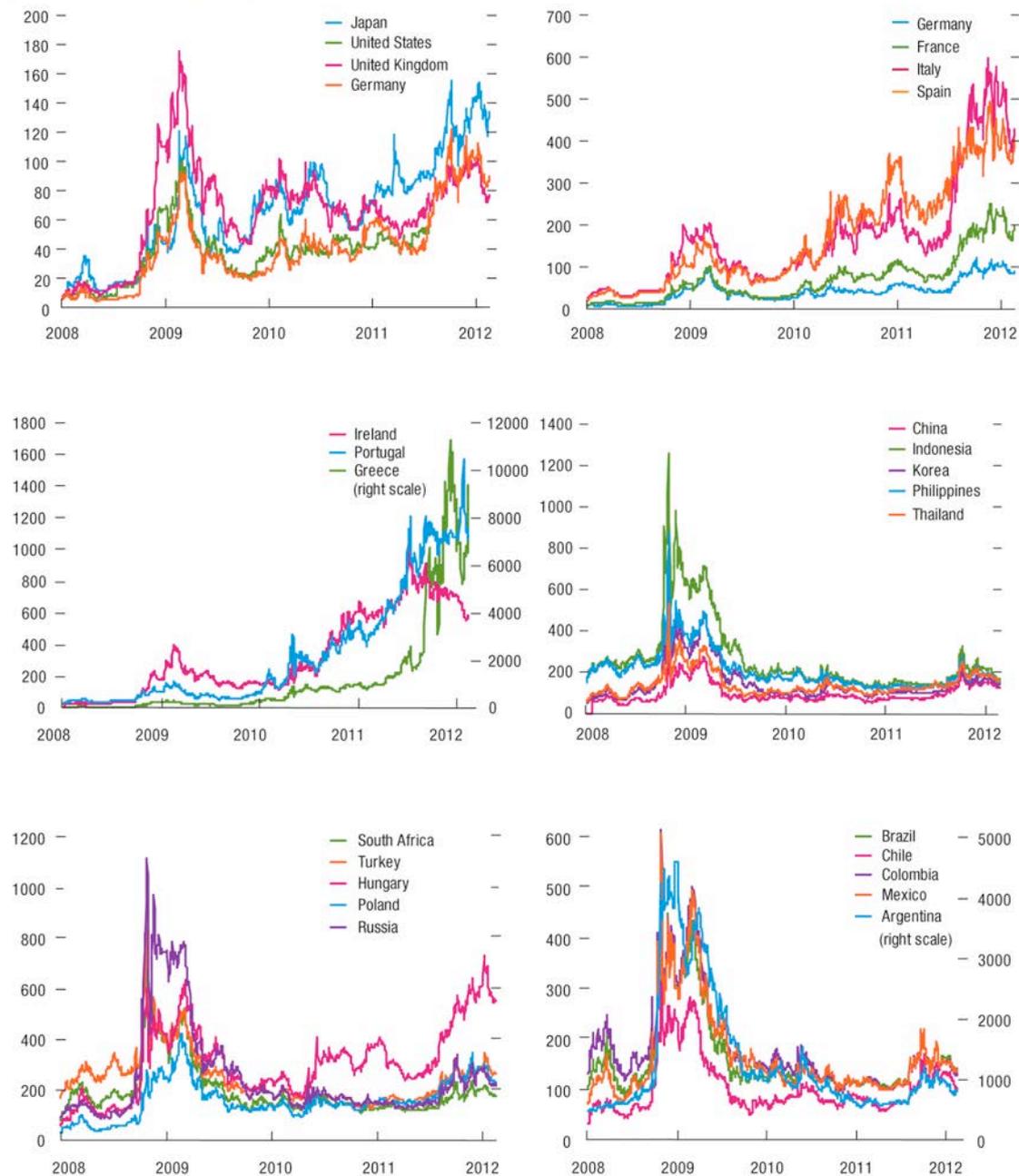
unconscious, that ratings agencies have today. Cicero wrote in *De Divinatione* “By the way, Demosthenes, who lived nearly three hundred years ago, used to say even then that the Pythian priestess 'philippized,' in other words, that she was Philip's ally. By this expression he meant to infer that she had been bribed by Philip. Hence we may conclude that in other instances the Delphic oracles were not entirely free of guile”²³³.

The power of market governance over the world is quite obvious since it now treats nations as businesses, and businesses of average or smaller size. For sovereign debts the sums involved are so large that the markets become de facto the principal features in the decision landscape for organizations like the IMF. Insurance rates, i.e. CDS, such as one can see on the derivatives markets, reflect the views of stakeholders about the financial credit risk (default risk + credit risk) for loans made to states. In its diagnosis of the overall stability, the IMF uses CDS. In doing so, instead of confining itself to the work of evaluating the real situation like a research and study organization, which would enable it to influence the markets, it amplifies the viewpoint of the CDS providers who are stakeholders in the conflict of interpretations.

²³³ *De Divinatione* Book II, LVII.

Figure 2. Sovereign Credit Default Swap Spreads

(Five-year tenors, in basis points)



Source: Bloomberg L.P.

Figures taken from the IMF report *Global Financial Stability Report, The Quest for Lasting Stability 2012*.

Two shortcomings of economic logic

The confusion and inadequacy in the way risks are treated are not unique to the credit market. There are two major shortcomings of liberal economic logic that neo-liberalism highlights. The first, particularly clear in the case of credit, is that *markets take little account of meanings*. That which gives meaning to the things we speak of, and makes them understandable to people, and can provide motives, this domain has always scared rationalists and has always been minimized by positivists, yet this is where all the essence of life is to be found. The second is that markets are bad at showing trends in prices. This is absolutely certain for financial markets, but the phenomenon is more general and has serious

consequences throughout the economy and its relation with everything else. We will go further into these two shortcomings, which can actually be seen as two sides of the same coin.

The fact that the markets take little account of meanings is fundamentally due to the naive belief that we can “weigh” the risks just as we might weigh gold. This is the counterpart of the fact that “the market” is the name given to an algorithm. Thus according to the teaching of all economics professors, the market seems to fulfil a task, as long as certain competition conditions hold, which is to calculate some sort of balance, between the desires of the seller and those of the buyer, which the neo-classicists called equilibrium. In doing so it starts from a social situation, necessarily complex, and extracts a number which – if there is only one currency – projects onto one single linear scale all the infinite-dimensional breadth of the world and its ideas. To buy one thing or another is not the same; the players have a past and a future. To sell to someone rich or someone poor does not justify the same price (Jules Dupuit). A car manufacturer works with subcontractors with whom a long-term relationship is forged. The choices are interdependent. To buy this and that is not the same thing as buying this and something else; economic agents have their plans. One number can never take complete account of a situation that concerns me and of which I only partially know the conditions and outlines.

This is the reason why some have dreamt of a globalization that is not financial: “Globalism reduces the new complexity of globality and globalization to a single (economic) dimension”, writes Ulrich Beck, “which is itself *conceived in linear fashion* as a constant expansion of dependence of the world market. All other dimensions (ecological globalization, cultural globalization, political polycentrism, the emergence of transnational spaces and identities) are treated, if at all, only with the assumption of the dominance of economic globalization. World society is thus truncated and falsified as world-market society. In this sense neoliberal globalism is a form of *one-dimensional* thinking and acting, a *monocausal*, economistic view of the world”²³⁴.

The key philosophical point is this constraint and this tension that the economy create by obliging everyone to base their decisions on one sole measure, a constraint that is gentle but firm. In the famous words of Jean-Pierre Dupuy, the economy contains violence, in both senses of the word “contains”. To oblige people to proceed to such a one-dimensional projection is not simple, it is the result of ongoing work by economists and the ruling classes to promote a political organization that promotes and facilitates this reduction. We see this to the point of caricature in Europe in the services of the Commission. I must admit here a personal response. As a mathematician, accustomed to handling large dimensional spaces or the famous infinite-dimensional function spaces, whose points are functions (Hilbert space and Banach spaces), that are so fruitful in so many problems, I constantly face the issue that these tools, despite their immense richness, remain an insufficient language for addressing the complexity of reality that is fleeting and of which we do not grasp, in physics or in applications, more than a few special cases. Why then impose on society such an impoverished way of thinking? This is a mutilation which, moreover, works very badly, causes enormous suffering, and does not remotely solve all the collective problems. For example, society can well work with a dozen currencies, each one related to a different register of activity and interconnected among themselves according to modifiable political procedures²³⁵... The heart of the matter is that this system of thought is *conformative* as we will explain in a few pages.

²³⁴ Beck U., *What is Globalization?* Polity Press 2000.

²³⁵ Cf Hallsmith G., Lietaer B., *Creating Wealth, Growing Local Economies with Local Currencies*, New Soc. Publishers 2011.

Uncertain situations are often open to several different interpretations, each of which propagates in an ensemble logically consistent with its own possibilities. We see that the trait of pragmatist philosophers (Peirce, Dewey, William James) of bringing to the scenario a unique interpretation which would be that of actual utility by erasing the unexpected and unknown interpretations that could arise in our spirit, this trait has serious consequences for thinking about uncertainty. Generally we live with many interpretations. For example, the view that the sun revolves around the earth is convenient in everyday life and coexists peacefully in our spirit with the heliocentric view that is less often useful. In physics, the particle interpretation of light is useful for some phenomena (e.g. the photoelectric effect) while the wave interpretation is useful for others (e.g. interference). In psychology we know from Freud that we can love and hate the same person at the same time. In sociology Max Weber has shown, in the face of the difficult problems of the sociologist's immersion in the society he studies, the methodological force of constructing idea-types that are obviously plural and each complete our understanding of institutions.

To arrive at the point of monetizing everything, one must fight to enforce interpretative monism. And there lies a perverse use of mathematics. What is the role, actually, of the use of mathematics in economics? In the classical thinking of Adam Smith, Ricardo, Jean-Baptiste Say, Stuart Mill, there is no need for mathematics. Maths appears with reasoning about maxima and their partial derivatives proposed by the neo-classicists in the middle of the 19th century (Dupuit, Cournot, Léon Walras, Jevons, Menger, Pareto, etc.), with a mathematical vocabulary taken from rational mechanics and the principle of least action, and therefore an approach to society that is simplistic in the extreme.

And this syntax is perfected to the esoteric heights of contemporary finance, a habit of scientific thought that remains fundamentally reductionist. How does the mathematization of reality lead to a monism? Maths will not lead to monism if it is used with competing models. In contrast, economic monism rests on the philosophical prejudice that its mathematical structure is the manifestation of its truth, that it speaks the truth because it is deductive, that the law of supply and demand, represented by curves – and not clouds of points – is true because one can develop it into a coherent theory as Lagrange and Hamilton did in mechanics from Newton's laws. This prejudice rests on a self-centred epistemological view that needs to be corrected. It can be formulated as “if our doctrine is true, then the others are not only false, but *rubbish*”. It is the *prejudice of analytic superiority*. It is a scientist credo not so distant from the neo-positivist creeds of the Vienna Circle and even Karl Popper. It makes economists believe that, by demanding a strict syntax, thanks to maths, they are constructing the only understanding of their domain that satisfies this logical requirement. But the principle “from fallacy anything follows” does not apply between theories; there is confusion between the relation of satisfaction (of a syntax by an interpretation) and the relation of implication (of a consequence by a premise)²³⁶.

All this is to say that the rational agent that our economists talk of only understands the world in one way: as a schematized universe in which economic reduction works. But in the domain of understanding and economic knowledge, pluralism is essential to overcome the crisis, as indicated in the epistemological study I made of this subject²³⁷.

Faced with this impoverishment of thought, I believe we quickly come to see the importance of contracts (which restore the idiosyncratic uniqueness of each entrepreneur), to fight against the anonymity of economic actions (shareholders who are only concerned with market capitalization, and investors who blindly entrust their savings to specialists in

²³⁶ Cf Shoenfield J. R., *Mathematical Logic*, Addison-Wesley, 1967. Lyndon R. C. *Notes on Logic*, Van Nostrand 1966. Kleene S. C., *Mathematical Logic*, Wiley 1967.

²³⁷ “Mathematics and Real World Knowledge” *Real-World Economics* issue 57, p90, <http://www.paecon.net/PAERreview/>

stochastic optimization) and to consider as normal the existence of multiple currencies even within the same country. These are the tools that we want for ecological transition²³⁸. That can only contribute more relevance to make a multidimensional life possible and to take this into account in trade. The global economy should permit various economic systems that overlap without interfering. Current economic thought goes too quickly to solutions; profitable action has too easy a legitimacy. With its logic of equivalence and substitution it can irreversibly destroy, and we can no longer allow this laxity. Our garden is too small for such methods.

The second serious deficiency, more technical in nature, comes from the very heart of the doctrine of free competition, namely that markets are bad at showing price trends.

Obviously this vagueness is prejudicial to economic operation: in the absence of clear information about trends, the head of a business is reluctant to invest because investment is a choice which engages with the future over a period of time and the decision is a function of the projections we form for the near or distant future. Moreover, many studies show that increased uncertainty, notably after shocks or crises, most often causes a decline in investment²³⁹. Regarding technological change, to take into account environmental problems, either local or global, this hinders the development of innovations and private involvement in applied research. The turmoil in global food prices and in the currency exchanges also have destructive effects on the agricultural economies that require choices of species and of material over time²⁴⁰.

Also there is an abundant literature on the disconnection between finance and the real economy: whole libraries of works and piles of articles denouncing financial bubbles, self-referencing of markets, the actions of speculators and their mimetic behaviour, self-fulfilling rumours, etc. Such a profusion of work strongly indicates something, and we tend to think that these reactions bear witness to a malfunctioning reality. But often these critiques, which would have us believe that we just need to remove speculators, who disrupt the efficiency of the market, and leave the good capitalism to make the economy “real”, are an easy posture and politically superficial. Certain observations should be made to clarify the scope of these recriminations.

First, the classical, Keynesian, distinction between speculators and entrepreneurs is not clear. The amusing metaphor of the beauty contest is only partially relevant to describe financial markets: it is a model at just one moment in time, and it doesn't show any of the volatile turmoil which is the phenomenology truly proper to finance. Keynes considered that, in contrast to the speculator, the entrepreneur takes choices and initiatives whose scope is the medium term “making superior long-term forecasts of the probable yield of an investment over its whole life”²⁴¹. This way of thinking is echoed by all those who believe that there are “fundamentals” to which market prices eventually converge in virtue of all kinds of efficiency theorems that mark the refinements of neo-classical ideas. There are damaging crises, largely caused by speculators, but year after year the restoring forces operate, or at least should operate.

If we take these arguments seriously, it would mean that one could imagine – and that one would want – a free-market economy with non-speculative markets where the price

²³⁸ Cf Longhurst N., Seyfang G., “Harnessing Grassroots Innovations: Complementary Currencies and Sustainability” International Conference on Community and Complementary Currencies, Lyon 2011. Kalinowski W., “Pluralité monétaire et stabilité économique : l'expérience suisse” Veblen Inst. 2011.

²³⁹ Cf. A. Zakhartchouk “Les chocs d'incertitude freinent l'activité” INSEE, March, 2012.

²⁴⁰ Volatility of exchange rates hampers growth cf. Aghion, Bacchetta, Rancière et Rogoff, “Exchange Rate Volatility and Productivity Growth: The Role of Financial Development”, *NBER Working Paper*, n° 12117 (March 2006).

²⁴¹ *General Theory* Chap 12, V.

would be true, reflecting a free competition without the perversity of “casino players”. But such an idea is purely platonic. A printer that stocks up on paper because they think the price will increase is a speculator. An industrialist that moves their factories from the centre to an out of town site is speculating on the real estate market, and if they move town, they are speculating on the labour market. Where is the boundary? It would be very difficult to define legally.

One must accept the conclusion that an economy where *the price trends* are visible is impossible or, at least, would require an arsenal of constraints following a baroque logic to prevent agents from taking proper account of trends, trends that normally express the future and of which one should obviously take account.

How then should we interpret these critical studies that demand greater consideration of the real economy? “The finance market is disconnected from the real economy, which is that of the fundamental values,” writes Olivier Mongin. “The finance market must be reconnected as much as possible to economic reality, and not succumb to the virtualities of ‘taking risks safely.’”²⁴² That expression refers to the fact that the speculator does take risks, of course, but only “watching” the world, without committing to a significant plan, permanently evading responsibility. In an interesting article about efficiency, David Bourghelle and Pauline Hyme go in the same direction “A market with plentiful liquidity naturally plunges players into an artificial world, erasing temporalities and exempting them from the constraints of the real economy”²⁴³. One could multiply the citations and economic celebrities have often ranted against the financial markets. How should one view the distant project implicit behind these denunciations so that they go beyond the myth of a market free of speculation?

Christian de Boissieu, Jean-Pierre Jouvét and Serge Guillon put us on the right track by commenting that “the financial markets, whatever their form, are profoundly different from commercial (or physical) markets. They are not there to buy or sell a product. [...] These markets, by design and operation, distance themselves from the concerns of the real economy, even if the physical fundamentals remain the major determinants of their behaviour.”²⁴⁴

The only assumption consistent with the above remarks is to think of the real economy, that which is described not in economics textbooks but in *geography* textbooks, which speaks of industrial production, of quantitative flow of energy and goods, of unemployment and other macro-economic parameters, but also of local trade, regional resources, of reputations established over time, and the perseverance of the players. This economy only exists with its own dynamics as long as *it is not driven by a system of market prices*. That is the criteria. This means we must be able to think of a social organization in which information on trends comes from something other than prices. This idea is not inconsistent with an economy based on organized price listings. The real economy can be described, in all logic, by saying that it is an economy in which the price varies because there are markets, but the players do not use price

²⁴² “La finance de marché est déconnectée de l'économie réelle qui est celle des valeurs fondamentales [...] il faut reconnecter autant que possible le marché de la finance à l'économie réelle, ne pas succomber aux virtualités de la 'prise de risque sans risque'”. O. Mongin, “Prégnance du modèle boursier et volatilité de la valeur” *Esprit* Nov 2008. We should also mention Lionel Jospin “ La crise financière : retour au réel” *Le Débat* 2009/1 n° 153; F. Morin “Produits dérivés et dérivés des dettes souveraines” *Le Débat* 2011/4 - n° 166

²⁴³ “Un marché doté d'une liquidité pléthorique plonge naturellement les acteurs dans un monde artificiel en écrasant les temporalités et en les exonérant des contraintes de l'économie réelle”. From “Du mythe de l'efficacité des marchés au krach : L'illusion de la liquidité boursière” *Revue de la régulation* 8, 2e semestre 2010.

²⁴⁴ “Les marchés financiers, quelle que soit leur forme, diffèrent profondément des marchés commerciaux (ou physiques). Ils n'ont pas pour objet l'achat ou la vente d'une production. [...] Ces marchés, de par leur conception et leur fonctionnement, s'éloignent des préoccupations de l'économie réelle, même si les fondamentaux physiques demeurent des déterminants majeurs de leurs comportements.” From “Prévenir et gérer l'instabilité des marchés agricoles” halshs-00646803, Sept 2010.

signals for the projections necessary for investments, since these are too vague and uncertain, but instead they use sources based in reality and the meanings we attach to it, information necessarily derived partly from politics, i.e., nation states, and partly from other autonomous institutions. Establishing such *information motors* is absolutely essential if we are to depart from the *business as usual* that financial uncertainty currently imposes.

The recent story that the state of North Carolina has enshrined in law that extrapolations about sea levels must be linear and not exponential is typical of a mentality that tries to make economics rule in everything, because it expresses the benefits, and tries to restrain any information produced otherwise²⁴⁵. This incident has a symbolic meaning. The legislators of North Carolina have not understood that a political system cannot function correctly, cannot move, if it restricts or manipulates the available knowledge. It is likely that other similar attitudes will be encountered when the *information motors* we have spoken of are being established.

Both deficiencies require action in the same direction: the establishment of organizations collecting high quality data for a description of the world, including both natural and social, without using temporal evolution of prices, in order to give information – obviously pluralist, thereby leaving both communism and capitalism – that will allow agents to place their real action in the multidimensional landscape of meanings. This is not the work that rating agencies do. They give ratings because the contradictions of the debt market demand a third party assessment. But they can contribute to this role if they provide not ratings, but structured information about the conditioning factors that they use. The Meadows team in *Limits to Growth* use grouped indicators based on quantities of: industrial production, food, population, pollution, resources, as well as global indices to give an idea of qualitative phenomena: index of human well-being, ecological footprint. The Worldwatch Institute, founded by Lester Brown, provides synthesized information, given in dollars, to compare levels of consumption (these are not prices, but indicators), and equally a large number of *interpretative texts* for complex situations that cause changes in the world²⁴⁶. *Observatories* of society and of nature are developing more and more, constructing motivations that the markets do not provide.

It is thanks to these watchful eyes that we can understand the world and that these disturbing inertias can change. We now better understand the fundamental lie of neo-liberalism: it is in the idea that the market is capable of piloting the economy by prices. This is not so, and the question is therefore that of understanding what makes us believe that it is. The answer still lies in the neo-classical theory, which is not a theory like the others. It is an intellectual construction which pushes people to believe in rules of behaviour – efficient markets, etc. – presented and understood as beneficial even though we know that they are bad globally. Michel Callon, who we quoted above, uses the term *performativity* to describe this trait of changing the object of study²⁴⁷.

It is fashionable in some entrepreneurial circles to argue that academic economics is simply a harmless discourse with no influence on reality as has been proved, since the 1970s, by the debate about mathematical techniques of calibration and prediction of random time series, started by the book by Box and Jenkins, who showed that purely technical prediction

²⁴⁵ The circulated Replacement House Bill 819 says “These rates [of sea level rise] shall only be determined using historical data, and these data shall be limited to the time period following the year 1900. Rates of sea-level rise may be extrapolated linearly. ...” Cf Huler Sc., “NC Considers Making Sea Level Rise Illegal” *Scientific American* May 30, 2012.

²⁴⁶ Cf. *State of the World, Transforming Cultures, From Consumerism to Sustainability*, The Worldwatch Institute 2010.

²⁴⁷ M. Callon “What does it mean to say that economics is performative?” CSI, working paper 5, 2006, Halshs.

can be better than arguments based on economic models²⁴⁸.

However, the development of the financial market brings, according to Donald MacKenzie, an example of such an influence: the discovery of the Black-Scholes formula, opening the possibility to new practices of hedging, called delta neutral, by the middle office and actually establishing new uses and new institutions²⁴⁹. Michel Callon uses this example to sociologically analyse the relationship between scientific thought and observed practice. This revealed the concept of *performativity*²⁵⁰. By this concept he means to go beyond the phenomena of “self-fulfilling prophecies” (the effect of an announcement by a major player), or the “sunspots” (beliefs), and also beyond the shifts from the descriptive to the prescriptive. Performativity is part of the wake of the pragmatic philosophy, as a consideration of *truth as success*, by the set of *socio-technical arrangements*²⁵¹.

But at this level should we not say that all knowledge is performative? That was basically Feyerabend’s thesis when he said “anything goes”, success as criterion between knowledge and illusion. Engineering, for example, obviously modifies behaviours: studying models of traffic and traffic-management provides service to those bodies responsible for traffic circulation in their daily work. Some medical discoveries have obviously changed, and sometimes upset, nursing practice. Calculations of fluid dynamics have changed methods of regulating irrigation. Nietzsche had already remarked that there could be no knowledge without relation to its object and, therefore, its disruption. There is also what the sociology of science says: that *all science is performative*, a thesis which is particularly provocative in the natural sciences, where researchers share a culture of objectivity and often work amongst themselves, omitting the social context and the conditioning arising from the scientific tools and community²⁵². Furthermore, this thesis, in some way, weakens the specifics of economic knowledge and it seems hardly arguable that the economy occupies a unique position in this respect, because it is the referential discourse of a number of decision-makers.

I remain convinced that the neo-classical theory holds a privileged role in these phenomena. Why has it been so easy to achieve what Léon Walras wished for when he wrote “Mr. P[areto] believes that the goal of science is to get closer and closer to reality by successive approximations. And I think the ultimate goal of science is to move reality closer to a certain ideal; and that is why I formulate this ideal”²⁵³?

I think the neo-classical theory is more than performative; it is *conformative*. This concept refers to the following relational characteristic: *a vision of the world is conformative*

²⁴⁸ G. Box, G. Jenkins, *Time Series Analysis*, Holden Day 1970.

²⁴⁹ D. MacKenzie “An Equation and its World : Bricolage, Exemplars, Disunity and Performativity in Financial Economics” *Social Studies of Science*, 33, 831-868, 2003.

²⁵⁰ M. Callon, “What does it mean to say that economics is performative ?” in *Do Economists Make Markets ? On Performativity of Economics*, D. MacKenzie, F. Muniesa, L. Siu (Eds) Princeton Univ. Press 2007.

²⁵¹ Cf. The seminar “Performativité et Politique : Au-delà de la sociologie économique” Toulouse 23-25 October 2008.

²⁵² Cf. M. Callon, P. Lacosmes, Y. Barthes, *Agir dans un monde incertain, essai sur la démocratie technique*, Seuil 2001. Michel Callon believes that economics is performative like all sciences “Economics, like the other sciences, serves to represent. But to account for what it calls the economy, it has to contribute in one way or another to the constitution of the object that it is accounting for – like any other scientific discipline.”

(“Elaborating the notion of performativity” *AEGIS* Vol 5 n1 2009, 18-28.). Nevertheless, it seems to me that some distinctions are necessary : a) performativity in biology with GMOs in which is also found plenty of engineering, b) that of astrophysics, which is performative because it improves and reinterprets previous interpretations, a category in which maths is also placed c) management, business, communications, which are performative through social action of those who know them, economics, while having some features in these three categories, is related mainly to the last where it still possess unique characteristics.

²⁵³ “M. P[areto] croit que le but de la science est de se rapprocher de plus en plus de la réalité par des approximations successives. Et moi je crois que le but final de la science est de rapprocher la réalité d’un certain idéal ; et c’est pourquoi je formule cet idéal”, *L. Walras «Œuvres diverses», in: Auguste et Léon Walras œuvres économiques complètes, Vol XIII*, édité par Dockès P., Mouchot C. et Potier J.-P., Economica 2000 p567.

if, in a social context where others seem to agree with this vision, you have to act as if you share them as well. Violence is conformative; carrying arms in the US is a conformative doctrine²⁵⁴. Systems for assessing performance are also conformative if they have a large audience. If you believe that many people take such ranking to reflect reality, then you will also be led to take it into account. We have seen that all universities have been taken, year after year, by the dynamics of the Shanghai ranking. For an institution of higher education to not worry about quantitative evaluation processes – despite their obvious reductionism – would be to take the risk of being misjudged. In Hindu society, to not recognize the caste system is to risk being considered untouchable. This is linked to the monism of the doctrine, a ranking is monist by definition, but conformism works above all if one is led to believe that others subscribe to a monism that is totally exclusive of all other forms of thought. Thus the absence of empathy and altruism is a conformative ethic. More generally, the fact of being in the position of having to deal with individuals who refer only to their personal interest, an interest finally reduced to one of accounting, will oblige you to follow the path imposed by the discussion of evaluating everything by its price and *to see nothing except for supply and demand*. It is as striking in an annual general meeting of the apartment owners of a residential block as in a conference such as that of Copenhagen in May 2009 over climate change.

To think that humanity can organize its own *evolution* using a system of prices given by markets is a dangerous vision derived from the conformative neo-classical doctrine, the liberal globalization has spread with ease for the same reasons. This brings us back to certain ideas of Ulrich Beck²⁵⁵.

²⁵⁴ The more killings there are – such as Aurora, Colorado in July – the more supporters carry weapons to defend themselves against unexpected violence.

²⁵⁵ Beck Ulrich, *What is Globalization?* Polity Press 2001.

IV. Dispelling the mist ?

When prices are what people study and the most important of these prices vary without indicating underlying trends, the big question is that of the overall direction and of governance. The global economy drives behaviours with a representation that is too poor, too reductionist, as if one could pilot a plane by only looking at its shadow on the ground. We have seen that putting debt on the market on a global level has been a decisive step in this reductionism.

In this chapter, I try to consider where the system will take us if we continue business as before without adopting the radical changes that are necessary to modify economic logic. I think that the defects in capitalism that we have highlighted in this book are so serious and grave that they cannot be fixed by small bandages. My goal is to raise awareness.

1. What is currently happening: the default choice of economic logic

The year 2012 marked the twentieth anniversary of the Rio summit and the twenty-fifth of the Brundtland report. It is time to take stock. It must be recognized that it is pathetic. We procrastinated, discussed the economic mechanisms of emissions trading or taxes. We built wind turbines and nuclear power plants. And then at Copenhagen we saw everyone take positions of minimum cost. We propose here to reflect on what will happen if, as up to now, this attitude of *what is best for me?* continues to govern international discussions.²⁵⁶

The result of these delays is that the Arctic ice-sheets are melting at a speed that surprised the scientists themselves, so that between Canada and the North Pole a new sea route has opened up. The economic experts from the CIA have calculated that it would help the exploitation of Arctic oil fields and shorten the Asia-Europe route by around 4000 nautical miles. Already Russia, Canada and Denmark are prospecting and negotiating amongst themselves.

The passage that explorers sought for centuries finally opens. It is symbolic. It strikes us as the result of a certain philosophy of the future that is worth clarifying.

Sustainable development: an ambivalent concept that delays action

The Rio conference of 1992 marked a global realization of the gravity and urgency of environmental problems. It revealed a broad consensus that development and the environment should not be seen as conflicting but that a synergy was possible between these two concepts and that this was the way forward. Reconciling ecologists and economists, the report of the UN Commission on the Environment and Development (the Brundtland report) prepared the Rio summit which led to five texts: Agenda 21 (the Programme of Action), the Rio Declaration (27 general principles on the responsibility of nations), principles relating to forests, the Convention on Climate Change, and the Convention on Biodiversity. The philosophy of sustainable development followed two main lines: the concept of balance between the different factors that contribute to the quality of life, and the requirement that current generations leave to future generations sufficient social, environmental and economic resources for them to have levels of well-being at least as high as ours.

The basis for this, as we mentioned in Chapter I-2, consisted of three “pillars”: economic, interpreting a goal of growth and economic efficiency by the sustainable development; social, expressing the fact that this development should be based on human need and thus meet the goal of social equity; and environmental, meaning that the objective of sustainable development should help to preserve, improve and enhance the environment and conserve resources for the long term.

These general ideas were based on numerous studies. The scenarios published at the time of the conference, notably “Energie pour un monde vivable” (1988), “Noé, nouvelles

²⁵⁶ As Dennis Meadows told *Le Monde* “Look at the major UN conferences on climate. Each delegation strives to avoid any agreement that would cause them more problems. China ensures that nobody imposes limits on CO2 emissions. The US discredits the idea of climate change. Previously, people exerted pressure for some meaningful action to come from these meetings. Since Copenhagen, and the utter failure of that summit, everyone understands that there is more pressure. Every country agrees to sign for peace and fraternity between people, for sustainable development. But that means nothing. The rich countries always promise a lot of money but never pay up.” (“Regardez les grandes conférences onusiennes sur le climat, chaque délégation s’évertue à éviter un accord qui leur poserait plus de problèmes que rien du tout. La Chine veille à ce que personne n’impose de limites d’émissions de CO2, les Etats-Unis viennent discréditer l’idée même qu’il y a un changement climatique. Avant, les populations exerçaient une espèce de pression pour que des mesures significatives sortent de ces réunions. Depuis Copenhague, et l’échec cuisant de ce sommet, tout le monde a compris qu’il n’y a plus de pression. Chaque pays est d’accord pour signer en faveur de la paix, de la fraternité entre les peuples, du développement durable, mais ça ne veut rien dire. Les pays riches promettent toujours beaucoup d’argent et n’en versent jamais.”), 15 June 2012.

options énergétiques” (1989), are indicative of the key assumptions that, it was thought, we could build on. a) A decrease in the *energy intensity* in the countries of the North, i.e., of the energy necessary for the production of one unit of GDP. It was felt that many savings could be made in the capacity of machines, in reducing waste, and by the use of materials whose manufacture required less energy. The calculations showed that significant gains could be achieved by improving transport and housing insulation. b) We counted on the fact that developing countries would use technology whose energy efficiency was similar to that in the best sectors of the time and we concluded that they could achieve in 2020 the standard of living of the inhabitants of Western Europe in 1975-1980 using three times less energy. c) It relied on a virtuous economic expectation that would rapidly boost renewable energy – solar, wind, hydro, tidal, wave, ocean thermal, geothermal and biofuels. In 2020 these could provide 15% of the energy needs of the North and 40% of those of the South, and two thirds of the global energy requirements by 2100. d) Global awareness would lead to the helping of poor countries by education and investment to curb population growth, so that there could be a harmonization of lifestyles, with the difference in energy consumption per capita, between poor and rich countries, reducing from 0.4 and 7.5 tons of oil equivalent in 1985, respectively, to 0.8 and 1.7 in 2100²⁵⁷.

These scenarios were probably not trying to predict the future, but merely demonstrate feasibility. Nevertheless, it is clear that the strength of the correlation between the developmental trajectories of countries and their energy consumption was underestimated. There is no need to go through the tables of figures, or the existing databases (Enerdata, Povcal, etc) which give a precise picture of the current situation: in thirty years it has not changed much. Emissions of CO₂ have remained constant since 2000 in OECD countries and more than doubled in China, increased by 40% in India, and globally by a quarter from 2000 to 2009²⁵⁸. Forested areas have decreased by 3.5%, and the decline in biodiversity and fish stocks has changed from being a potential threat, into an observed and measured fact. Negotiations are at a virtual standstill. We cannot say that nothing has been done, but the objective observation is that the changes over the past twenty years have had almost nothing to do with environmental policies. They are, almost exclusively, the consequence of traditional economic forces in a heightened international competition, even allowing for the relatively good conduct of the Western countries that is the result of very low growth.

Developments in the Third World have also been dominated by the violence of economic forces. The so-called development economics of the 1980s, which consisted in finding local patterns of trade and production that were suited to local ways of life, gradually evolving, has been replaced by the idea of a mono-economy where every country should adapt to the global demand in the global market²⁵⁹. This has resulted in an overexploitation of natural resources with profits poorly redistributed, taking advantage of all differences in wages, sanitary conditions, environmental requirements, which has diverted private investment in the Third World away from those sectors that are important for human development in these countries. The result has been an increase in the pollution and degradation of human life to an unprecedented level. Vandana Shiva writes “For the two thirds of humanity living in the South, nature's capital is their source of sustenance and

²⁵⁷ Cf. B. Dessus, *Atlas des énergies, pour un monde vivable*, fph-Syros 1994.

²⁵⁸ Source : OECD, January 2011. According to the International Energy Agency (IEA), 30.6 gigatons were issued in 2010, which is 5% more than the previous record in 2008. Coal reserves in the world, in the US, Russia and China in particular, are considerable and prolong the climatic problem well beyond “peak oil”. Given the inertia (80% of emissions by 2020 are already programmed), it is now almost impossible to limit the average temperature rise to 2° C beyond preindustrial levels.

²⁵⁹ While the World Bank and IMF implemented the policy of “structural adjustment”, world trade exploded. It has grown by a factor of five since 1980 (excluding imports and exports of oil).

livelihood. The destruction, diversion and takeover of their eco-systems in order to extract natural resources or dump waste generates a disproportionate burden for the poor”²⁶⁰. There are many aggravating factors: the lower one is, the more one gets pulled down. Weaknesses in health and education emphasize the short-time concerns and the neglect of public goods, resulting in the deterioration of ecosystems. The consequences for nature are often irreversible. Farmers in the Third World see their choices reduced, poverty and unsustainability are reinforced and prevent any lasting improvement in their well-being²⁶¹.

The nuclear industry, meanwhile, is symptomatic of a search for selfish gain regardless of risks caused to others. Four European countries have renounced nuclear power, while 24 reactors are being planned in Europe, of which six are already under construction. Currently there are more than 340 functioning nuclear reactors worldwide. Many were built in the 1970s and are obsolete. The issue of waste is becoming more serious. The proliferation of nuclear power plants in developing countries poses serious security issues, especially given the problems of corruption and terrorism. Since there is no international regulation about waste, how can one prevent Pakistan, Iran or other nuclear countries from buying waste storage sites in poorer countries? Currently 65 new reactors are under construction. By this trend, more and more accidents will happen, leaving permanent traces.

At the heart of this discussion, the dividing line between the positions on nuclear power, is the technology of nuclear fusion. The benefits of this are clearly explained in the recent work of André Lebeau “*Les horizons terrestres, réflexions sur la survie de l’humanité*”²⁶². Clean, safe, with no shortage of resources, this sector, thanks to the ITER project, is expected within fifty years. We have only then to “stand firm” for this time and then we will have boundless energy, almost at will. This position is similar to that of Valéry Giscard d’Estaing about CO₂ emissions: the concerns are transient; the problem will disappear with the exhaustion of fossil fuel resources. There are two observations to make. First, since fusion techniques haven’t yet been mastered, one cannot know all the advantages and disadvantages. The development may take a century or more; should we let the dirty and dangerous fission plants keep multiplying until then? Also, what does it mean to have energy at will? At whose will? The race will begin again with renewed intensity, on a planet where flora and fauna have hitherto known only the solar flux. There is far too little detail about the idea for it to form the basis of international collective action.

Unquestionably academics in economics of environment have not yet managed to build a theory both strong enough and simple enough to completely replace the dominant neo-classical theory. The critics of the globalized financial economy, who are numerous, possibly even forming a majority, have not managed to break the links between the theoreticians of stakeholder capitalism and the agents and decision-makers in industry and politics, nor to really thwart their influence in economic journals and the training of young elites. Any conceptual innovation to avoid the headlong rush to mathematize finance is presented as a “return to prehistoric economics”. Ultimately the economics of the environment is primarily concerned with what is feasible without any ideological or social change, and one may reasonably ask whether it is the environment or economic reasoning that it is trying to preserve.

²⁶⁰ Shiva V. “The World on the Edge” in *On the Edge, Living with Global Capitalism*, Hutton W. and Giddens A. eds, Vintage 2001.

²⁶¹ Cf B. Lallau “Pauvreté, durabilité et capacité de choix “ *Développement durable et territoires* oct. 2004. A detailed analysis of indicators shows that African countries have a greater impact on the environment, per unit of produced wealth, than European countries, cf. B. Kestemont, L. Frendo, E. Zaccai *Ecological Indicators* 11 (2011) 848–856.

²⁶² Gallimard 2011.

In the idea of sustainable development, with its three components – ecological, social and economic – there was also the desire to reconcile the North and the South and to apply the principles of public debate and precaution. That really meant abandoning the monism that dominates Western civilization. It was a much more revolutionary ambition than the discourse about harmony and synergy would suggest. It meant finally recognizing, and politically addressing, the diversity of dimensions specific to socio-natural reality, to construct a new form of coexistence. But, it did not happen, the techno-economic obsession has continued unabated.

It has not been properly appreciated that to counterbalance the natural imperialism of economic logic required action at all levels, and thus would require a lot of money! In twenty years, in contrast, the consensus about competition has been reinforced. What will this lead to in the long term? The captains of the economy know how to win, but the fate of the losers is left out of the picture. The poor are left to an external providence, that they themselves must find, while the wealthy are able to acquire all kinds of securities. The human born with a inheritance today is a protected species. As for the three pillars of sustainable development, the economic pillar has taken account of new tastes without really changing, the ecological pillar has evolved in public opinion but, in fact, has declined overall, and the social aspect has completely failed.

The default choice is an unequal dynamic

The threats announced by ecologists have now been relayed by the media so that they are known by everyone throughout the world. They are displayed on the walls of Chinese universities and spoken of both on the internet and in the small towns of Brittany. They were expressed the most frequently in universalist terms (Al Gore talking of a boiling frog, Nicolas Hulot and the Titanic, etc.): this could be serious for everybody. In a few decades they have certainly provoked reactions. Movements for environmental action (local exchange systems, recycling, fair trade, organic agriculture, micro-finance, etc.) experienced a real vitality. Others have disputed the claims of the scientific community, and although few in number, gained a disproportionate media audience while carefully playing with the epistemological legitimacy of the controversies. But most people, the vast majority, taken by immediate family and professional constraints have decided that between ‘business as usual’, and the alarmist predictions of the Club of Rome, the future is likely to take a middle path. In developed countries one is resigned to living with clouds which darken others’ lives. Specifically, the poverty in the world, the destitute billions with a life expectancy below forty, one can do nothing, it would be a drop of water in the desert. We sort our recycling and make absolutely sure that we pass on our inheritance²⁶³.

We must therefore consider both the strength of ‘business as usual’ and the weakness of catastrophism.

Business as usual is a conformist constraint. There are many sorts of conformism. Insofar as some have inherited social situations of abundance, financial privilege and legacies of possessions and land, while for others the means of exploiting their skills are socially refused them, and still others, the most numerous, have to fight to survive each day. It is a particularly painful conformism that consists in mobilizing the microphones and spotlights of the media to research and focus on small and totally futile things – the history of creams and ointments over the centuries, the etymology of names of pets, etc. The boredom of the bourgeoisie is used to occupy tables in bookstores and hours of listening to the radio, so that nothing changes.

²⁶³ In France, between 2004 and 2010, the inequality of wealth has grown, the ratio between the average wealth of the richest 10% and that of the poorest 50% is increased by nearly 10%, cf. *Les revenus et le patrimoine des ménages*, Insee 2011.

There is another sort of conformism that has been much more important historically and socially: The flow of money in the economy orients initiatives and professional efforts towards profit. The rich get richer, and there are more precious metals that come from the top of the economic volcano and which flow down the slopes, encouraging supporters of the system. Newspapers need money, films must be distributed in many cinemas to have any impact, radio and television broadcasts need funds, journalists must be paid. This manna is clearly beneficial only to those with employment and who are at a sufficiently powerful level that their actions can have a significant economic influence, those who will have an effect on the competitive performance of their employer. Thus this phenomenon tends to mark more clearly a boundary between those who reap and those who sow.

There are historic roots for business as usual, in the utilitarianism of John Stuart Mill, of whom we spoke earlier, but also in the continental positivism of Comte. The transition that Comte initiated, his positivist philosophy in thinking about science leading to the religion of humanity, is due to a particular characteristic of Comtian sociology, namely that it is conceived as biology – as understood in the 19th century – applied to society: History has its own laws and societies must comply with them.

*Positivism by its nature tends to strengthen public order by the development of a wise resignation [...]. It obviously can not be a genuine resignation, i.e., a permanent disposition to endure the inevitable ills, consistently and without any hope of compensation, that comes from a deep sense of invariable laws which rule all the various kinds of natural phenomena. It is thus essentially to positivist philosophy that such a disposition relates on any topic to which it applies and consequently also to political ills.*²⁶⁴

That is to say, the heavy burden of having to live, eating and sleeping every day, accepting illness, the weaknesses of the spirit in an unwanted social or moral context, without knowing the reasons or knowing where this will lead, the weight of the human condition and the lightness of being, positivist science can help to endure this because it is based in a consensus which gives the basis for the religion of humanity.

One of the problems apparent in this idea is that social laws are changing – Hegel and Marx are more to the point in saying that man, by his action, changes them – and thus, as the epistemology of the 20th century has shown, science does not develop as positivism suggested.

Comte's idea is nonetheless relevant as a question: if we need to be resigned, since religions have been disqualified as beliefs of the pre-scientific (and even pre-metaphysical) ages, wouldn't the acceptance of *inevitable ills, without hope of any compensation*, give rise to a need for scientific truth which would tend to restore positivism according to a sort of reality principle?

This is an issue exactly parallel with what we are currently experiencing with the economy. The neoliberal economy that has been developed over the past 30 years, is facing major difficulties: on the one hand there is a serious disagreement between the complex machinery, oiled by high-level mathematics, financial institutions and the operation of production and trade, and on the other, more deeply, there is the emergence of new problems due to the scarcity of resources and the degradation of the environment. In this theoretical disarray, faced with the vast non-violent protest movement, liberal economists adopt the

²⁶⁴ “Le positivisme tend puissamment par sa nature à consolider l'ordre public par le développement d'une sage résignation [...]. Il ne peut évidemment exister de vraie résignation, c'est-à-dire de disposition permanente à supporter avec constance et sans espoir de compensation quelconque, des maux inévitables, que par suite d'un profond sentiment des lois invariables qui régissent tous les divers genres de phénomènes naturels. C'est donc essentiellement à la philosophie positive que se rapporte une telle disposition à quelque sujet qu'elle s'applique et par conséquent aussi aux maux politiques”, A. Comte, *Système de politique positive*, Appendice III.

strategy of applying Comte's reasoning to the economy: the laws of the market economy are the only ones viable, they are based on private property and free trade, these being the only possible principles if we are to avoid dictatorships and preserve our freedom. It is therefore necessary to accept the rules of the game that consist in seeing your condition improve if, and only if, you earn more money in the context of a labour market ruled by neo-classical equilibriums. The inequalities form part of these laws; they should be accepted because they are the motor of economic drive for everyone. It is a strategy to make one accept the economy as it has been developed itself, by the game of profit and competition as the foundation just as undeniable as scientific truth.

The result is business as usual. Let's just play the game of competition, it will generate innovation and hence all the problems in every aspect of life will be solved.

In Comte's time there was no "alternative science" that could be brandished against resignation. Eventually, however, it was realized that scientific knowledge does not remotely follow the laws of positivism. That took more than a century.

Today it's the same. We do not have an alternative economics that has strong support. There are many good ideas, but they are scattered. The only way possible is to prove that the economy, according to its so-called principles, does not do a good job of managing economic business, neither at the level of resources, nor at the level of people's motivations, just as the naivety and fallacy of positivism were established.

Regarding catastrophism, the troubles do not come from the epithet "enlightened" that was given by Jean-Pierre Dupuy and is evoked *in absentia* by despotism; Hans Jonas had already envisaged a dictatorship as a last resort²⁶⁵. Instead, the troubles come from the metaphysical sublimation of this thesis "to think of the continuation of human experience as a result of the negation of self-destruction [...] with the hope that this future [...] although inevitable does not occur"²⁶⁶. This logical formulation bears a family resemblance to Popperian epistemology and, like it, does not provide any concrete tools for juggling the interpretations that are not resolved except in the distant future. Today it is a more precise formulation that calls out to us: "What catastrophes and for whom?" I think, in this regard, the methodological foundations that Max Weber proposed for sociology are the most interesting to transpose here because they concretely open onto political pluralism: effectively to draw "disaster-types" for debate.

It's such a reading that I propose, although obviously I accept that there are others. The absence of solidarity between the powerful and the weak has a long history that has taken a step further with neoliberal globalization and the financial markets²⁶⁷. Only in relation to periods of history that were times of progress and of the conquest of nature, now, things are frozen, territories, beliefs, affiliations, means of action. So that some have and others have not. Whatever the coefficients and the baskets of indices chosen as criteria, the standard of living in the world tends more and more, *as a percentage*, to the Heaviside function: close to zero for most, and close to one for the others.

²⁶⁵ Hans Jonas *Pour une éthique du futur*, Payot & Rivages 1998, p 112 *et seq.*

²⁶⁶ "penser la continuation de l'expérience humaine comme résultant de la négation d'une autodestruction [...] avec l'espoir que cet avenir [...] bien qu'inéluctable n'ait pas lieu", J.-P. Dupuy *Pour un catastrophisme éclairé, quand l'impossible est certain* Seuil 2002.

²⁶⁷ At the end of the 1970s, 1% of Americans accounted for 10% of the country's income. Now 1% account for 23.5% of the country's income. The other 99%, which is not just the black or Hispanic underclass, but average Americans, citizens, member of the glorious middle classes that are the strength of the US, where one knows that life is better than that of their parents and not as good as that of their children. This is called progress. Source *Le Monde* 15 Oct. 2011.

The Heaviside (or unit step) function gives the value 0 to the left of a certain point and 1 to the right of that point. It bears the name of the English engineer Oliver Heaviside (1850-1925), inventor of operational calculus. Many systems described as proportions or percentages, deterministic or probabilistic, asymptotically tend to 0 or 1 when their dynamic is local unless phenomena of transfer or coupling intervene. This is the new dynamic at work given the finiteness of space, of resources of minerals or fossil fuel, and of available energy flux.

Angelic universalism, naive irenicism, or simply generality, the discourse of sustainable development has faced a harsh reality: indifference of humans to “others” makes a fiction of our planet.

The path that emerges is wholly different: it is that the degradation of the natural and social environment will be such that it will limit the poor by despair and plagues of all sort while, on the other hand, the rich will not experience any risk to their future. There is a passage. *It is the new Northwest passage*²⁶⁸. It consists in not spending money for people in economic decline except to limit their environmental impact on the rich. The path is narrow, and requires a lot of tenacity and political ambiguity, but that way the route to economic progress remains open!

Recall – see Chapter II-1 – that the work of the Club of Rome updated a few years ago by the Meadows team from MIT, consisted in various scenarios depending on the hypotheses that one makes about consumption of energy, non-renewable resources and efforts about pollution, which all include an “overshoot” putting an end to the period of growth sooner or later, and that the excess, the exponential consumptions and the inertia mean that in many areas the possible equilibria have been exceeded and consequently lead to a decline. But then the modellers pull back, declaring quite explicitly that the “collapse” phenomena, that occur after the peaks, are beyond the reach of the models because they necessarily entail significant social changes that one cannot anticipate reliably. These academics are taken, like the IPCC experts, by the necessity of getting as close as possible to a scientific discourse. They have thus avoided studying who will really be the winners and losers in this business.

It is striking, however, that studies on the evolution of global poverty in the recent decades, conducted by the services of international organizations such as the UN, the World Bank and the IMF, note an improvement in the situation, only a slight improvement, but one that is general except for singular exceptions. Equally, the Human Development Index does not decrease. In contrast, studies by those organizations on inequalities, between countries, and even within countries (the Gini coefficient), record a sharp increase in ranges. According to a recent study there is more inequality in the United States than between countries each measured by their averages: “while the ratio of national income per head of the richest to the poorest country is 104 to 1 (Luxembourg to Sierra Leone), the ratio of the average CEO salary in large US corporations to that of an average US worker is 245 to 1.”²⁶⁹ Everywhere it is the growth in income for the richest quintile that is the main factor behind the growth in inequality: poverty itself is not getting worse²⁷⁰.

²⁶⁸ When Michel Serres wrote (Ed. de Minuit 1980) “I seek the passage between the exact sciences and the human sciences. Either modulo language or modulo control, between us and the world” (“Je cherche le passage entre la science exacte et les sciences humaines. Ou, à la langue près, ou, au contrôle près, entre nous et le monde”), for this project equally, the biggest challenge lies in “us”.

²⁶⁹ Bob Sutcliffe “The Unequalled and Unequal Twentieth Century” in *Global Inequality, Pattern and explanations* D. Held, A. Kaya, eds, Polity Press 2007.

²⁷⁰ Nevertheless, the worsening of poverty can be seen clearly between 1993 and 2003 for the poorest quintile in Latin America, and according to the World Watch Institute, the population with income below \$1.25 per day has increased between 2008 and 2009 in Latin America and sub-Saharan Africa, and the population classed as undernourished has grown by 12% between 2008 and 2009, reaching 1.02 billion globally.

It's curious. In twenty years the urban population has increased by 50%²⁷¹. Families, neighbourhoods accumulate worries. The statistics are not good at reflecting certain evolutions, because their tables do not see new problems. Many figures are provided by services more or less linked to local governments that have no interest in shedding light on the recession, this being synonymous with their ineffectiveness. We know that disasters can increase GDP. But the problem is much deeper. It is short-sighted to think that "open society" derives its unpredictable novelty only from scientific progress, a vision of wealthy people. It also produces misery, and continually, it builds new sufferings with disparate materials.

We again quote Vandana Shiva "Globalization is not merely a geographic phenomenon which is tearing down national barriers to capital. Globalization is also tearing down ethical and ecological limits on commerce. As everything becomes tradable, everything is for sale — genes, cells, plants, seeds, knowledge, water and even pollution [...] The poor are thus being doubly denied their right to life — first when the resources that sustain them are taken away from them in a free trade world, and then when the pollution and waste of the global economy are unequally and unjustly piled on them"²⁷².

Even with our criteria and indices, if we extrapolate the current curves, the phenomena of finiteness will impose their strict logic. Noting, for example, that after a plateau caused by the financial crisis, global consumption of oil has risen again to a record high of 87.4 millions of barrels a day, and similarly for other resources, we are convinced that major upheavals are in train. My thesis is that there is a high probability that they will create in physical and social geography a situation that is irreversible, unequal and extreme. A paradigmatic example was the Hurricane Katrina situation in Louisiana and New Orleans in August 2005. The predictable dangers had been forecast by the meteorologists. Wealthy families were able to leave but those too poor to pay for hotels had to stay and weather the storm. Survivors who had no savings lost everything and subsequently no solidarity has worked for them, developers even made a profit from the disaster²⁷³.

It should be recalled in this respect that scientists insisted that if global temperatures rise by more than about 2° C, then the change in the climate will no longer be manageable in the sense that serious irreversibilities will occur (decrease in ice caps, in the Earth's albedo, change in the cycle of general ocean currents, acidification of the sea, melting permafrost, etc.) and that seasonal irregularities will lead to impromptu and unforeseeable damage which will not allow anticipation of efficient economic and agricultural policies in the most vulnerable countries.

Everyone is afraid. The citizen does not say so directly, because of pride, shame, or because of concern for his family. We are afraid for the future and for all that connects us to the future: our legacies, our children. And when anxious, the attitude you take towards those who cannot reassure you goes beyond a lack of confidence; one cannot rely on them and they deserve only *contempt*. These catastrophists are worthless. The really important question is to know who can reassure us. Certainly not the poor, obviously.

The socialist former French minister of Foreign Affairs, Hubert Vedrine, wrote in 2005 "There is currently no alternative. Certainly, there is a level of consciousness that rises regularly. But leading to what? To an infinity of tiny measures *which do not touch the heart of the modern economic motor*. [...] we cannot completely exclude the possibility that, if our societies notice an imminent danger, of massive pollution, or tragic poverty, they will react brutally. People might perhaps be ready to support any power which claims to be able to maintain our way of life and consumption by authoritarian measures, notably regarding

²⁷¹ According to the United Nations, urban population since 2008 is more than 50% of the world population, and will exceed 60% by 2035, and be around 70% in 2050.

²⁷² *ibid.*

²⁷³ Cf. N. Klein, *The Shock Doctrine: the Rise of Disaster Capitalism*, Picador 2008.

energy usage. If our societies are suddenly confronted with visions of want that scare them, it is impossible to tell how they may react.”²⁷⁴

But Nicholas Stern’s report talked of 200 million people displaced by the middle of this century due to shortages of water, food or work. And Albert Jacquard concluded his book on global demographics, written at the time of the Rio summit, with the phrase “The only scenario compatible with the limits of the planet is that which admits a halving of energy consumption in the industrialized nations”²⁷⁵. That is what researchers in the subject believed at that time. Today this self-restraint is forgotten, not only by the leaders of the global economy, but also by most economics journalists, and also most households that manage a hard-earned inheritance. “In a world of globalized, deregulated commerce in which everything is tradable and economic strength is the only determinant of power and control”, writes V. Shiva, “resources move from the poor to the rich, and pollution moves from the rich to the poor. The result is a global environmental apartheid”²⁷⁶. The path which is becoming clearer and clearer does not seem to me to deserve the named apartheid, but is simply the result of a *general cost-benefit analysis* : it will be cheaper and safer to only spend money on preserving *our* environment (and some rare animals and plants in parks with full video-surveillance), not on helping the poor cope²⁷⁷. All that is needed is for every decision and negotiation to be handled by repeatedly asking “but who will pay?” and this solution will emerge on its own, without any tax or global government constraints. It is likely to be some time before political action becomes the outworking of a project based on reason and while it remains the expression of economic, media or military powers, the interest of each individual will remain the priority over the general interest.

A perspective of this kind has already been considered by several authors (and I think that those who support this view, act without revealing their belief). This is one of a number of repulsive scenarios considered by two American researchers to encourage us to choose a different path. They called this scenario “the fortress world” and described it thus: “The global poor become restive, desperate, dissatisfied by images of affluence, and angry cabals emerge to strike out against the rich. Messianic violence increases on all sides, but it only reinforces the fortress pattern. Everywhere, the rich withdraw into strongholds. The richer regions of the world erect ever-higher barriers to immigration. New schools of “realism” emerge to repeat, in a thousand different ways, that nothing can be done. Xenophobia and garrison culture become the norm. Food insecurity and disease dominate the lives of billions of people. Poor countries fragment and deteriorate.”²⁷⁸

²⁷⁴ “Il n’y a pas pour l’instant de solution de rechange. Certes, il y a un degré de conscience qui monte régulièrement. Mais vers quoi ? Vers une infinité de petites mesures *qui ne touchent pas au cœur du moteur économique moderne*. [...] on ne peut pas complètement exclure que, si nos sociétés prennent conscience d’un danger imminent, de pollution massive, ou de pénurie tragique, elles réagissent de façon brutale. Les gens seraient peut-être prêts à soutenir n’importe quel pouvoir qui prétendrait perpétuer notre mode de vie et de consommation par des mesures autoritaires, notamment en matière d’énergie. Si nos sociétés sont confrontées brusquement à des perspectives de manque qui les terrorisent, elles risquent de réagir n’importe comment.” *Le Monde*, 26 May 2005 (our emphasis).

²⁷⁵ “Le seul scénario compatible avec les limites de la planète est celui qui admet une diminution de moitié de la consommation d’énergie dans les pays industrialisés”, *L’explosion démographique*, Flammarion 1993.

²⁷⁶ *op. cit.* and she adds “If pollution and waste migrate to the South under ‘free trade’ and the knowledge, biological diversity and wealth created from it are travelling north through the regimes controlling intellectual property rights such as those associated with ‘free trade’ treaties like GATT, the inevitable outcome of globalization must be environmental apartheid”.

²⁷⁷ To help the poor to cope will be extremely expensive. It requires the creation of conditions of effective international cooperation to train teachers and doctors locally and to provide resources to promote economic shifts in lifestyles in accordance with the experienced usages. Unesco’s budget is tiny by comparison.

²⁷⁸ Athanasiou T., Bear P., *Dead Heat, Global Justice and Global Warming*, Seven Stories Press 2002.

What emerges clearly is the prospect of abandonment, of humanity splitting into two groups, not on a geographic basis, but on bases of economics and ethnicity – those who progress and those who regress. Those advancing come gradually to think, perversely, that civilization consists in winning, and that there are periods where self-confidence should prevail over altruism. Isn't this confirmed by "economic science", which is the same for all just like the freedom of enterprise? Thus the key reasons for exclusion must lie with those who are themselves excluded, and we certainly should not give them welfare. But this is much less thought out, reflected and Machiavellian as one might think. It is simply the force of the *business as usual* attitude doing its thing quietly and in all good faith.

In a famous article the economist John Kenneth Galbraith identifies six ways to feel good about the poor. 1) The bible: the poor suffer but will be rewarded in heaven after death. 2) Bentham's utilitarianism: good virtue is self-centred. 3) Malthusianism: the poor have too many children. 4) Social Darwinism: the elimination of the poor is natural. 5) Helping the poor hurts the economy. 6) The last reason is by far the most powerful in my view, namely psychological denial. Just as one avoids thinking of death or the arms race, which imperils the very survival of the human race, so one should avoid thinking of the poor, whether they be in Ethiopia, the South Bronx or Los Angeles. It is better to turn and think of more cheerful things. Galbraith believes that in recent years, the search for the best way to avoid any guilt about the poor has become one of the most important concerns in philosophy, literature and rhetoric.²⁷⁹ Was he thinking of John Rawls?

The central idea of John Rawls's work on fairness concerns this issue. It can be summarized as saying that a society where the richest have 100 and the poor have 2 is preferable to one where the richest have 3 and the others 1. This argument, which has supported growth and neoliberal doctrine over the past few decades, takes an entirely different light in a global context where for several of the key parameters about life the total consumption is limited. But as the limits (of fossil deposits, recoverable solar energy, etc.) are not known numerically with any certainty, this line of reasoning encourages the rich to grow without one being able to calculate how much this will deprive the poor.²⁸⁰

In the areas of friction between the two groups the tensions are most acute. We can hold our position or tumble down the slope. This can be clearly seen in many societies. In Greece, Spain, etc., the popular classes are confronted with contradictions that are felt to be intolerable. Arab countries see the profits made by the richest of their coreligionists in the world poorly shared by their leaders. China faces vertiginous inequalities in salaries. The large cities are where these tensions rupture society. The need to reduce energy consumption in transport works in favour of the most consolidated cities that are irrigated by efficient public transport networks. On the other hand, cities extend more and more with peri-urban areas that are poor and troubled, and city centres with exorbitant land prices which set in stone the social allegiances²⁸¹. Simply because of the liberal economy, rising transport costs tend not to gather the city into a coherent whole, but pauperize and disadvantage the peripheral areas where unemployment increases because jobs are harder to access²⁸². Only by

²⁷⁹ "How to get the poor off our conscience" *Harper's Magazine* 1985.

²⁸⁰ Cf. E. Szoc "La taille du gâteau et l'assiette du voisin, ce que Jackson fait à Rawls" in *Autour de Tim Jackson inventer la prospérité sans croissance*, revue Etopia n°9, 2011.

²⁸¹ See chapters 2 and 3 of Mike Davis's rightly celebrated work *Le pire des mondes possibles, de l'explosion urbaine au bidonville global*, La Découverte 2006.

²⁸² Youth unemployment in the OECD countries rose from 13.4% to 16.7% from 2002 to 2009 and reached more than 20% in 11 countries in Europe, including France. Public social spending has not changed from 2000 to 2007 as a percentage of GDP in the OECD countries.

political effort in favour of these outlying areas can the disconnection between the beautiful neighbourhoods downtown and the suburbs be avoided²⁸³.

The growth of urban social inequality is impressive and not well known. Without making a complete record that would be a big job given the disparities, we note some examples:

- the numerous wealthy “gated communities” in New-York
- the ethnic divisions in southwestern Los Angeles
- India, where the urban growth is still 2.5% per year, with 35 cities having populations greater than 1 million, where the rural population gathers in slums. In Mumbai half the population live in one of the biggest slums in the world.

- the growing number of “safe neighbourhoods” in South Africa, in Johannesburg, Pretoria, Cape Town, Durban.

- in Sao Paolo, one of the largest cities of the world, 44 out of the city’s 70 districts are slums. In the central districts are the wealthy classes, in the favelas violence is present and the youth only have short periods of education. There are “gated communities” in the centre of deprived neighbourhoods.

In all the megacities, especially in Mexico city which has more than 20 million inhabitants, the Human Development Index (HDI) (which takes into account access to care, nutrition, housing, access to running water, education) varies considerably from one area to another, even for environmental quality.²⁸⁴

Lately, the concept of debt – more precisely the risk of non-payment – for national economies and public finance has become increasingly important in political debates and the definition of economic policies throughout the world. Rating agencies are devoutly listened to as the Greeks and Romans interpreted the oracle of Delphi²⁸⁵. The bondholders are banks, insurance companies and pension funds and, with some variations between countries, behind these institutions one finds the households of the middle class and above, of the developed countries. It is essentially for these anonymous creditors that budgetary efforts are being demanded in the most poorly rated countries, which heavily penalizes public actions for ecological transition. How are these anonymous people, relatively few in the number²⁸⁶, able to make elected representatives of other countries defend them? Thanks to the zeal of diligent economists who use the risk of a crash to paralyse politicians with fear²⁸⁷.

Debt obviously also affects poor countries. It is estimated that with the natural growth in population 36 countries, representing 1.4 billion people, will experience shortages of water or arable land in 2025. Water and food will be the decisive factors in the split between those who go up and those who go down in the Heaviside curve. One part of the global middle class will adopt the extremely water-intensive Western diet and lifestyle. This will directly impact on the agriculture that counts for 70% of current water usage. In addition, cereal-exporting countries (the US, Canada, Argentina, Australia) will devote an increasingly significant

²⁸³ In the Paris region, mortgages are available at lower rates for downtown properties than for those at the periphery.

²⁸⁴ Cf *Grandes villes et urbanisation du monde en 50 cartes*, Ed. Le Monde Autrement, CD-ROM 2009.

²⁸⁵ It would have been infinitely more useful, as Marc Fleurbaey suggested, to establish an agency providing two ratings, one environmental and one social, for every product sold, about the conditions that prevailed in their manufacture. Cf. “La solidarité est-elle soluble dans l’individualisme” Et demain ? *Cahiers de l’IAU* n°158 June 2011.

²⁸⁶ If we consider only individual shareholders of listed companies, and not small savings accounts, then it amounts to 20% of the households in France, cf. *Les revenus et le patrimoine des ménages*, Insee 2011.

²⁸⁷ It’s a case of one “disaster-type” against another. Cf. for example, the article by P. Artus and L. Boone “Prendre ses pertes sur la dette de la Grèce est une fausse solution. Un défaut provoquerait un effet domino désastreux pour la zone euro” *Le Monde*, 27/9/2001.

proportion of land to the production of biofuels, which will reduce production of cereals and thus raise world prices. (These policies are not justified from an energy point of view, but are implemented for the balance of trade)²⁸⁸. And to this we also have to add a level of irregularity in global prices that is greater and more unpredictable, due to speculation and ‘weather-proofing’ that makes medium-term policies ineffective. As well as water supply, and famine risks (e.g. in the Horn of Africa in 2011), the countries which are at the bottom are faced with the usual gangrenes – insecurity, paramilitaries, traffickers, prostitution, drugs, diseases – that prevent them from recovering and risk putting them into that imprecise category of “failed states”.

Of course, poverty has always existed, but it seems to change its nature. Thanks to economic developments the material condition improves from one time to another, and builds the hope of better days. As Paul Bairoch has shown, during the period of urban population growth in the sixteenth century in Europe, famine was avoided by using more land for agriculture²⁸⁹. The industrial revolution was a series of balances and imbalances between capitalist profits and wage increases resulting from trade union fights for the redistribution of the benefits of progress and of consumption. Now the Third World has ceased to be an exporter of agricultural products and its food trade deficit is growing²⁹⁰. Capitalism has had this dexterity that after the decolonization period mining grew significantly in the Third World without having any effect on economic development. In the last twenty years of the last century, to service the huge debt, high interest rates lead to a balance sheet that was zero or even negative on the net flow of resources from the Third World²⁹¹. We knew long before Rio that “needs” to which we are accustomed in developed countries cannot – by simple arithmetic – be extended globally. This means that to preserve this (let alone increase as some politicians claim, talking of the growth that will soon return), most people will have to be kept at a lower level.

Returning to environmental policies, the argument repeated in all international conferences, that inaction may cost more than the immediate adoption of collaborative programmes of action, has not been convincing. Why? Because the impression has emerged that this argument only holds if one considers constraining measures that apply to everyone on the planet and that will lead to alterations and prohibitions which will limit the opportunities for development. Meanwhile, on the contrary, the cost may be lower and better controlled if one limits the spending to *adaptation*, to the depletion of resources and modifications to the environment, and that one stalls the agenda on these economically measurable necessities.

Under the rubric of “climate realism” the rich countries are managing to derail any international policy on reduction of greenhouse gas emissions that it is not based on a market in CO2 emissions. The sensible remarks made at the Copenhagen conference by NGOs, by the World Bank report, and by Nicholas Stern, that such a system would not allow less developed countries to move towards clean economic options except by large specific grants which were counted above aid for development, went unheeded. The idea is obvious and accepted even by the most neoliberal economists. These transfers of funds are needed for the physical efficacy of energy policy on the composition of the atmosphere and they are a legitimate way to mitigate the effect that market logic means that the rich countries, who are

²⁸⁸ The US, which produces 37% of the world’s corn, devoted a third of this in 2009 to the production of biofuels.

²⁸⁹ P. Bairoch *Victoires et déboires I, Histoire économique et sociale du monde du XVIème siècle à nos jours*, Gallimard 1997, p186ff.

²⁹⁰ *ibid* tome III p809ff.

²⁹¹ *ibid* tome III p 989. In Nigeria, the population reacts to an increase in pump prices in a country that is a major oil producer, but what can it do?

currently among the worst polluters, would be those most able to pay for the more emissions in the future. Market logic is so much thought of as normal, obviously, that these transfers, if they ever happen, will be seen as charity even though they are simply justice²⁹². “Climate realism” prioritizes spending on adaptation rather than on reducing emissions. This literature is growing, with an unspoken cynicism, the main argument of which is the following: although climate change creates a problem for everyone with variations here and there, the adaptation to these changes needs significant economic and financial means that the rich countries are better able to handle than others, which in the short term changes the terms for international discussions. In other words, *investments in reducing emissions and in adaptation are both useful, but only the latter will improve our relative position in the economic balance of power*.

At the heart of the rationale for the continuation of economic progress lies a more elaborate theory, that of “ecological modernization” which promotes absolute respect for the environment thanks to innovative technological breakthroughs which allow a gradual *decoupling* between energy and economy and thus between the economy and the environment. Based on the order of a decentralized liberal market, it is presented as a flexible and cheaper solution to environmental problems. This appealing utopia has supporters mainly in the most advanced societies, notably in Germany, Holland, Scandinavia (and in lesser measure in the US), where the service economy forms a significant part of the GDP and where the dream of *individualistic autonomy* seems a possible and promising route thanks to micro-wind turbines, photovoltaic cells, solar panels, thermal insulation, fuel cells, hybrid cars running on electricity and biofuels, etc., avoiding the transport infrastructure costs of conventional energy, along with the gradual implementation of efficient recycling²⁹³. This line of thought is spearheading an ideology based firmly on economic liberalism²⁹⁴. Experience and current achievements do not yet allow a test of the quality of life with a small, sustainable ecological footprint because they rely on economic structures that are still traditional and consuming. Nevertheless, they suggest that it is possible. This possibility opens a new political perspective that is very introverted. Leaving aside the “insoluble” problems of international negotiations with poor countries and developing countries, etc.... *it shows an example* of what needs to be done in an idealized experimental framework (while, back in the real world, Germany has requested an exemption from Brussels for CO2 emissions of high-powered cars so as to not penalize the automotive industry). This ideology, ultimately, doesn’t solve any of the problems of the planet, and weakens the solidarity with the Third World while strengthening among its followers the conviction that “everything would be fine if we were left alone”.

Climate realism and the theory of ecological modernization are presented to the general populace of our developed countries as an active response to the threat announced by ecologists. On every indicator – pollution, recycling, biodiversity, deforestation, etc – a

²⁹² The “Green Fund” announced at Copenhagen to help developing countries move towards a sustainable economy was reaffirmed in Cancun. But a commitment of \$30 billion in 2010-12 and then \$100 billion in 2020 became a doubtful promise undoubtedly including existing development aid. It was mentioned in Durban, and the terms of its implementation provoked a conflict between developing and developed countries in Rio in June 2012 that was not resolved.

²⁹³ For a more complete analysis and a sociological reflection on the mainstream of ecological modernization, see Gabrielle Bouleau “Dialogue transatlantique sur la modernisation écologique réflexive : construction et angles morts d’une idéologie environnementale européenne”, 2011, *AFSP*, Strasbourg, 30 août-2 sept. (to appear).

²⁹⁴ As Karin Bäckstrand and Eva Lövbrand note, the pivot of the argument in ecological modernization is “who should pay the costs?” considered in the context of liberal capitalism cf. “Climate governance beyond 2012: competing discourses of green governmentality, ecological modernization and civic environmentalism” in *The Social Construction of Climate Change*, Mary E. Pettenger editor Ashgate 2007.

discourse on corrective modification of usages according to a marginal economic analysis, receives, thanks to the media and the internet, the support of much good will. Where will it lead?

To take small steps towards a horrible victory, or build a dignified and sustainable pluralism?

Some people think that the selfishness of the rich is, over the long-term, completely imaginary. That even if they had the desire, more or less conscious, to secede, they could not do it. Firstly, because of the fractal-like overlap of social categories, and secondly because with the environmental issues of protecting biodiversity or preventing climate change, we are *all in the same boat*.

This is not clear. The failure of various attempts of fiscal policy to protect the environment cannot but make us stop and think. Imagine fifty years in the future. In all probability we will be faced with a very run-down planet. Will people then say “who is responsible? The rich must return what they took”? No, it is pointless to wash our historical laundry with endless quarrels. We would look at the current situation and discuss actions to be taken: “What shall we do?” would be the only reasonable question. It is like today: those who have acquired power (by taking resources) need the realism of pragmatically negotiated economic solutions, simply because they are in a position to impose them. Violence and wars will change nothing. They will simply be disqualified from public opinion and international bodies: one cannot build anything lasting from terrorism. In situations of conflicting interests the one who resists the longest is the one whose prosperity depends least on collective action.

Already today attitudes seem to have changed. On the greenhouse effect, the IPCC, an offshoot of the UN, originally had a warning function based on pooled scientific knowledge. But after the 4th report, the role of the scientific community has developed and evolved. By the international cooperation of twenty teams working on fifty models it has provided much better understanding of the development of climate change in various emission scenarios, not just in terms of global average temperatures, but also on changes in global and regional climates. The IPCC does not coordinate these studies but uses their data for its syntheses. In parallel with this, their economic studies on adaptation are enormously developed, comparing various global or regional energy policies to identify the least costly among those with an equivalent effect in terms of emissions. Inertia and adaptability are, in these models, translated into costs so as to facilitate comparisons. The balance is significant: it produces knowledge that is increasingly usable by economic agents to optimize their commercial expectations and their locations. The role of the UN is diminished. In these regional studies and investigations into the cost-effectiveness of different options, the researchers are doing science – certainly – but science useful for who? To those who have the economic means to take initiatives. As this happens obviously under increasingly severe conditions, solidarity becomes an increasingly more absurd idea²⁹⁵.

At the major international conference of Fontevraud²⁹⁶, organized by Jacques Theys in September 1996, the range of views on the threats posed by technology and profit on the environment led to a general agreement that the climate, at least, imposed a universal point of view which would restore a healthy turn for research away from “economically productive” science. This hope was the basis of the foundation of the association “Global chance”. Today this idea has expired. We can see how it was ephemeral. The international scientific community essentially only provides tools for optimizing expenditure on adaptation.

²⁹⁵ The climate community is preparing for the 5th report of the IPCC on 10-year forecasts. These are no longer scenarios but extrapolations of trends made possible by inertia. The effect of these new details may not strengthen the links between humans but simply change property prices.

²⁹⁶ “Quel environnement pour le XXIème siècle ? Environnement, maîtrise du long terme et démocratie”.

The question which then arises is whether the West – and the elites of those rapidly developing countries called “emerging” – is able to face up to this future or if it will continue to pretend to be unaware of it, all the while building horror under the guise of civilization and progress.

Where is this discordant world heading? We must not avoid this question. It leads inevitably towards two worlds, which move apart more and more while nesting one in the other, geographically and socially. On one side the destitute who survive burdened with all sorts of impossibilities and who are, in millions, left to the mercy of religious ideologues and manipulators. On the other side the “elite” who pursue the adventure of technological progress thanks to computing and biology while taking care not to let go of the levers of policing and military power. Over the long term this leads, in all likelihood, as several writers have predicted, to a differentiation of lifestyles creating two sociologically distinct strata of humans which, within a century or so, could end in the realization of transhumanist fantasies: two species that are biologically different, one improved by genetic prowess and not wanting to mingle with the other which is more savage, with all sorts of hereditary or societal dross. This is consistent with the mainstream of ecological modernization which welcomes microscopic high technology (generalized data processing allowing the tracking of objects in the economy and animals that one wants to protect, etc.)²⁹⁷.

Not wanting to take into account the *finiteness* that humanity currently faces, weighty old ideas of human biological progress are revived. “In all domains where the legacy of the Enlightenment proved decisive”, writes Luc Ferry, “the notion of the infinite has emerged [...] And it is in this very idea of this infinity that the human being, being now defined by its perfectibility, redevelops the question of meaning”²⁹⁸. The transhumanist fantasy has its origin in a differentialist philosophy. An extension of all the grand narratives of progress, this consists in seeing the future of mankind on the direction of those who have been the most successful in the liberal economic system. It is the fault denounced by Claude Lévi-Strauss.

*“In other words, does the distinction between the two types of history [stationary history and cumulative history] depend on the intrinsic nature of the cultures to which the terms are applied, or does it not rather result from the ethnocentric point of view which we always adopt in assessing the value of a different culture? We should thus regard as ‘cumulative’ any culture developing in a direction similar to our own, that is to say, whose development would appear to us to be significant [emphasis in the original]. Other cultures, on the contrary, would seem to us to be ‘stationary’, not necessarily because they are so in fact, but because the line of their development has no meaning for us, and cannot be measured in terms of the criteria we employ.”*²⁹⁹

But this fault goes way beyond anthropological comparisons.

There is a long-established idea that it would be unrealistic to try to escape a completely rational principle of evolution that consists in adjusting economic and political management according to the general competition laws of life, and that this would necessarily produce *excluded peoples*. The classical economists of the 17th century had noted that the rules of Christian charity were not the best advisors for the wealth of nations. Today the finitude of the planet changes the default ethics “at the margin” of economic development to a law that is implacable and numerically overwhelming. Economic ideology gets refined, and infiltrates itself into all the cogs, and resists, while pursuing the same monism. This indicates

²⁹⁷ The laissez-faire attitude to genetic modifications is supported by the theory of ecological modernization, cf. J. Wright and P. Kurian “Ecological modernization versus sustainable development: the case of genetic modification regulation in New Zealand” *Sustainable Development* Vol. 18, no. 6, 398 p. Nov 2010.

²⁹⁸ L. Ferry, *Le nouvel ordre écologique* Grasset 1992.

²⁹⁹ Cl. Lévi-Strauss *Race et histoire* (1952), Denoël 1987.

a preference for seriously damaging nature or the climate, and remaining better endowed, rather than for sharing anything. But the indefinite future is at stake.

Ecologico-scepticism and beliefs

Sceptics do not deny that the climate is changing. In France, for example, Claude Allègre or Vincent Courtillot do not deny the general increase in temperatures, nor the trends in various climatic parameters. What they struggle with, and why they are heard and relayed by the media, is the attribution of this change to mankind. It is the anthropogenic effect that they question.

Their exercise is made possible because the trajectory that the climate has *not* followed since the start of the industrial era is, and will remain, largely unknown. How can we know what would have happened “naturally” if humans had not burnt coal or oil? It will always be the case that the anthropogenic origin is a hypothesis and not a measured fact.

Unquestionably, the accumulation of indices, and particularly the rapidity of changes already seen compared with paleo-climatic variations provided by ice cores, makes their position harder to sustain. But the strength of the climate-sceptic current is surprising. The role of lobbying on behalf of the energy industry is obviously very important³⁰⁰, and as Olivier Godard noted, these strategies of provoking doubt do not need to provide an alternative truth in order to be effective. Edwin Zaccai emphasized the immense difficulty of the economic reorientation necessary to follow the paths suggested by the IPCC. The necessary changes cause alarm; they risk changing the distribution of advantages and disadvantages in society. If we follow the recommendations outlined by experts on the basis of long-term predictions, isn't there a risk, as so often in economics, arising from being the first to act?³⁰¹

In the international context, why is there such an echo of climate scepticism in the United States? A New York Times survey before the November 2010 elections stated that “*Only one of the Republicans running for the Senate accepts the scientific consensus that humans are responsible for global warming*” (Oct.18, 2010). As for voters, a survey at a Pew Center on October 27th, indicated that amongst the Republican electorate only a minority of 16% believed that the Earth is warming because of human activities. Overall, the survey shows a rise in climate scepticism in the US since 2006: 63% of Americans believe in global warming, but only 38% think that it is caused by human activity. Recently, after a press conference by Agence Science-Press in December 2011, a comparative study of 10 major British newspapers and two from each of the following countries: USA (*New York Times* and *Wall Street Journal*), France (*Le Monde* and *Le Figaro*), Brazil, China and India, showed that 80% of the climate sceptic quotations are in the British and American dailies, predominantly the latter.

Would this great country, which has always placed science at the highest of civilized values, abandon the principles that were the very foundation of its culture?

What is happening there?

³⁰⁰ The Climate Action Network Europe (RAC Europe) published a study criticizing the funding paid by industrialists to American candidates. According to this NGO, “306.000 euros were paid in 2010 by the biggest European polluters to Senators who were climate sceptics or otherwise opposed to the law against climate change.” (“306.000 euros ont été distribués en 2010 par les principaux pollueurs européens aux climato-sceptiques et autres opposants à la loi de lutte contre les changements climatiques, élus au Sénat américain.”) This sum corresponds to “nearly 80% of the total funds committed by these companies to subsidize candidates during their campaign for the midterm elections in 2010.” (“près de 80% du total des financements engagés par ces entreprises pour subventionner des candidats durant leur campagne pour les élections de mi-mandat 2010.”)

³⁰¹ Cf Zaccai E., Gemenne F., Decroly J.-M., *Controverses climatiques sciences et politique* Presses de Science-Po 2012; O. Godard “Le climat, l'imposeur et le sophiste” *Alternatives Economiques*, 12 March 2010, “Le climato-scepticisme médiatique en France, un sophisme moderne”, Ec. Polytechnique, Sept 2011.

This is the first time that science has said “the whole of humanity is to blame”. But this is intolerable, especially to those who claim to be at the forefront. Man has always, up to now, needed a moral guarantee that discharges him from the burden of responsibility, this terrible burden of knowing how weak and prone to evil he is, inclined to odious behaviours that he despises. This need is very strong. Deeper than the moral values inculcated by the nuclear family, more compelling than the superego noted by psychoanalysis which comes from the childhood environment through parental and filial love, here this is historical, social, civilizational. The Catholic liturgy speaks of “the Lamb who takes away the sins of the world”. Exegesis indicates that in the Old Testament, to celebrate the Passover, a lamb was slain and we have kept the phrase used by John the Baptist, saying it during mass. Jesus died on the cross for the *redemption* of our sins, to allow the world to be saved and not succumb permanently to evil.

If a growth such as the West has experienced is no longer possible, if the climate is blowing up, if biodiversity is collapsing, it must mean that God no longer loves us. We would be in a vacuum, without knowing where our own absurdity will take us. The anxiety is like that of the Incas massacred by the conquistadors who thought that the gods they worshipped had lost their power.

It is in the land of the puritans, for whom *the grace* of God has such an importance and played a role in the birth of capitalism, that one finds the strongest climate sceptic reaction. Now who speaks, who accuses? It is science, that part of knowledge that Richard Rorty, one of the philosophers most representative of American civilization, takes as an example of better organization of social decision³⁰². If God is still on our side, then that cannot be real science, it must be a group of self-proclaimed experts who are followed by the conformity of mediocre academics.

In *Des choses cachées* René Girard starts from the judgement of Solomon. Two prostitutes are arguing about a baby, each telling the King that the child is theirs and that the other has stolen it. So Solomon brought a sword and proposed cutting the infant in two so as to give half to each woman. One of the women accepted this, but the other refused and preferred to renounce her child so as to save him. In our common language we could say that the bad prostitute accepted the sacrifice while the good prostitute sacrificed herself to save the child. René Girard explains that at the beginning of his work he thought it more appropriate to not use the same word “sacrifice” in both situations since in the first case it concerns a real immolation, and in the second a *renunciation* “so that the child might live”. But he finally concluded that this evolution in the meaning of the term is rightly highly significant of Christ’s message. It is the passage from the ancient religions to the true sense of the sacrifice of the Christ, the “difference between the archaic sacrifice, which turns against a third the violence of those who are fighting, and the sacrifice in the Christian sense which consists in relinquishing all selfish claims, even to one’s own life if necessary, so as to avoid killing”.³⁰³

The ethical question facing the Christian today therefore is whether one should give thanks to Christ for having thus “taken away the sins of the world” or endeavour to continue this example by possibly sacrificing oneself so that “humanity can live”, sacrificing in Girard’s *renunciation* sense. In other words, it seems necessary to question the evolution in Christian practices by distinguishing more clearly between those two interpretations which merge in liturgy and worship: the one which convinces the believer that he is himself saved or soon will be and will be part of the flock led by the Good Shepherd, a long story in which the

³⁰² Cf. especially Rorty R., “Science and Solidarity” in *The Rhetoric of the Human Sciences*, Nelson J. S., Megill A., and McCloskey D. N., Eds, Univ. of Wisconsin Press 1987.

³⁰³ “différence entre le sacrifice archaïque, qui détourne contre une victime tierce la violence de ceux qui se battent, et le sacrifice au sens chrétien qui consiste à renoncer à toute revendication égoïste, à la vie s’il le faut, pour ne pas tuer”. R. Girard *Les origines de la culture*, Desclée de Brouwer 2004.

Church had the role of defining the frontiers of the flock itself in the political, and even military, sense, and the other which insists on this message of universality that the sacrifice of Christ was to save *all* men, a message which is extremely important today and completely changes the role that Christianity can play in ecological transition.

This opposition clearly changes the context in which ordinary man perceives the message from the political and scientific elites. What is the actual consequence of not attributing climate change to human activity? In the two cases it must be taken into account, economic efforts are required. But if the change is not anthropogenic, the average citizen is unable to see the effect of their own behaviour in this business, and is thus completely absolved of any responsibility. The elites, the media, politicians do not agree, therefore my economic life remains normal and legitimate. An immense relief is thus brought to millions to households struggling with everyday difficulties, and that justifies them in not changing their behaviours except in the measure that they are obliged to by changes in the economy, prices, the market, resulting from changes in the climate, which is obviously very slowly. While doubt is common among the experts, the democratic game makes it impossible to consider paying for North-South transfers such as those proposed in the Green Fund project³⁰⁴.

In fact, there is a dizzying distance between the experts and the average citizen about whether the doubt is there. Also Christians, like all citizens, take account of the economic constraints they face and have not changed their “generosity balance”, except in the unique case where they both give credence to what the majority of scientists say and also give more weight to the universalism of the Christian message than to the moral comfort coming from redemption. To put it another way, the “tranquil” Christian life, where all goes well because Christ died for us, often experienced as such in the parishes, can also be a factor in *laissez-faire* economics.

I do not speak here of Judaism, Islam, Buddhism or Hinduism, or other religions. The role of religions should be examined in detail, but I leave this to historians and sociologists³⁰⁵. Nevertheless, one can not fail to be appalled at seeing the wasteful and short-sighted luxury practised in the Emirates (Dubai, Abu Dhabi) with their oil revenues – including artificial ski slopes – without really contributing to helping other countries, Muslim or not, to advance in the global North-South problems. Their wealth, unique in the world, but ephemeral, should be a lever for long-term action.

Humanity is in the process of getting trapped in a dramatic shrivelling-up, of selfishness leading to armed conflict to safeguard our “standard of living”. As Marie-José Mondzain rightly says, this calls for more than just indignation, one should “take account of the indignity that is silent, without noise, without the expressive possibilities as those who have no voice, no shelter, no words, cut off from their tongue, their country. What we need is not an awakening of the conscience but an awakening of political action. This organization is cynical and rational, rational yes because it is consistent with its justifications, it has financial justifications, it has economics experts and it has the rationality of profits. There is a

³⁰⁴ Transfer mechanism proposed in the Copenhagen conference, but broken down by the Rio+20 summit. Cf. note.

³⁰⁵ See particularly Latour B., Gagliardi P., Eds, *Les atmosphères de la politique, dialogue pour un monde commun*, Les empêcheurs de penser en rond 2006, cited above. We also mention John Dewey in *A Common Faith* “If I have said anything about religions and religion that seems harsh, I have said those things because of a firm belief that the claim on the part of religions to possess a monopoly of ideals and of the supernatural means by which alone, it is alleged, they can be furthered, stands in the way of the realization of distinctively religious values inherent in natural experience.”

legitimacy based in the rationality itself of capital and neoliberal capitalism in its violence which is supported by economic science.”³⁰⁶

What makes it so difficult to change course to avoid this indignity? One key part is Western monologism³⁰⁷ with its usual weapons: the limitless affirmation of the individual, the cost-benefit analyses which allow one to monetarize everything, even ethics, the belief that technology can solve all problems and, finally, the management of the category of risk by throwing doubt at everything, on the causes of pollution and climate change, so that finally all truth fades except the true caesura between the haves and the have-nots.

We must abandon “sustainable development”, that ambiguous expression turned into a dysfunctional slogan, and focus the action on *dignified, durable co-existence*, placing itself absolutely and institutionally, at all levels, within a pluralist framework with mutual respect for civilizations, religions and habits. This means making its respect for different views a fundamental value of all doctrines including our own, and to admit that others also can contribute to the *binding consultation* that the global problems impose on us³⁰⁸. Now the Communist adventure has failed with its conquering progressive scientism, we must recognize the responsibility of neoliberal logic and *urgently put in place the collective dimension of the planet in a pluralist fashion*.

Obviously this transition and the progress of international political institutions will require compromise, procedures, *and a lot of money*. The initiative is necessarily on the side of those who have.

The background philosophy can only be *pluralism*. The idea is ancient and simple: build representative processes that allow decisions to be made *as if we were a small group of humans*. This does not obviously have anything to do with relativism, which is a common misconception. It does not mean accepting anything and everything, but that the world is open to many readings and interpretations, which in practice are not myriad and which have the right to exist as long as they admit, of course, that they are one of many.

Pluralism is not a utopia. We have experienced it in various forms in our pluralist parliamentary systems. Divergent interests, reconcilable disagreements, we have lived with each other for twenty-five centuries and seen that these are often resolved.

I do not remotely claim that this is easy. There are, unfortunately, many ideologies, religions and political doctrines currently in the world, which are not ready to make any concession with the others, and which turn the pride of their followers to violence. But,

³⁰⁶ “qu'on se rende compte de l'indignité silencieuse, sans bruit, sans possibilité expressive de ceux qui sont sans voix, sans abri, sans parole, coupés de leur langue, de leur pays. Ce qu'on attend ce n'est pas un réveil des consciences mais un réveil de l'action politique. Cette organisation est cynique et rationnelle, rationnelle oui parce qu'elle a ses justifications comptables, elle a ses justifications financières, elle a ses experts économiques et elle a la rationalité des profits. Il y a une légitimité qui s'établit dans la rationalité même du capital et du capitalisme néolibéral dans sa violence qui est soutenue par la science économique.” France Culture 24/6/11.

³⁰⁷ Which was also the source of Chinese materialism by the vector of Marxism and enrolled the institutions of Brazil in the philosophy of progress by the influence of the positivism of Auguste Comte.

³⁰⁸ One has to go further than taking the “common references” that John Dewey proposed as basis for the American way of life (*Democracy and Education* 1916). I refer to the excellent article that Jean-Pierre Dupuy wrote about John Rawls, where he concluded “Either the world currently developed isolates itself, which would mean it increasingly shields itself in many different ways from the attacks that the resentment of those left behind will engender, each one more cruel and abominable, or another way of relating to the world, to nature, to things and to beings, must be invented, which will have the property of being able to be universalized to the scale of humanity” (“Ou bien le monde actuellement développé s'isole, ce qui voudra dire de plus en plus qu'il se protège par des boucliers de toutes sortes contre les agressions que le ressentiment des laissés pour compte concevra chaque fois plus cruelles et plus abominables, ou bien s'invente un autre mode de rapport au monde, à la nature, aux choses et aux êtres, qui aura la propriété de pouvoir être universalisé à l'échelle de l'humanité”), In “Les béances d'une philosophie raisonnable” *rev. de Philosophie Economique* n°7, 2003/1, p 33-59.

ultimately, collective action, such as the current UN peacekeepers, can have no legitimacy except on a basis of accepted pluralism, which global problems should reinforce.

All that is needed is for us to want the future to not be dictated by economic interest, itself identified by indicators of profit. If the only prospective studies taken into account by leaders of developed countries are those which scrutinize technical innovations and try to gauge the customers that they might appeal to, to see their impact on the economic forces involved, taking into account the place they can be given by the media as a function of journalists' agendas, which is largely what happens today, then politics has already resigned.

2. Seeing reality means giving up the speculative financial markets

It is customary to conclude an essay by opening a window to the East, where the sun rises, and to offer reasons for hope. But in this work I am not speaking of solutions. You may ask, well then, what should we do? It is one thing to criticize, but to act, that is something else...

In this book, because economics is a social science, we have come to discuss themes touching on sociology, ecology and also history, religion, and issues concerning major philosophical choices. Our analysis leads, in summary, to three major conclusions.

Neoliberal economics is a system that is incapable of taking account of the environment and the planet's limits. It rules by financial markets which prevent the expected economic reactions. This is without any doubt due to the fact that the system is the result of an organization set up to conquer the world but, now that the world is conquered, the problem is how to administer it.

Monetarization of non-marketable goods is not the answer. It is, in fact, a bad idea. That is not to say that we should not pay dearly for those injured by accidents or by acts arising from profit-driven risk-taking that are to the detriment to the common good.

The prospect of opening the infinite in continuing the race by the "perfecting" of man by biological means is a philosophy that undermines the core values of civilization and which, under the constraints that the planet imposes on us, will lead to a collapse of society that is morally intolerable.

In fact, of course, these three conclusions are also three unresolved questions, for which we need answers. a) How to theorize an economy that preserves the planet? b) How to achieve behaviours that look after the collective good? c) How to move towards a pluralism, at a global level, that has enough legitimacy to be politically active?

A whole book would be needed for each of these questions. I have fairly clear personal views on each of these points but is it really necessary to describe them here? The answers should not be at the level of an individual thinker but only in relevant collective action.

All that I will say here on question a) is that the changes needed to the market economy are, in my view, very significant, and much more radical than previously thought by most economic and political agents.

On question b) it is essential to construct legal and international institutional structures to monitor and care for the environment, and punish those who damage it.

Regarding question c) I lean towards an international strengthening of the links *between moderates of all persuasions*. It is the moderates at the centre of systems rooted in history who can fight against ideological extremes, both capitalist and fundamentalist, to establish the structures of a pluralism that will facilitate an international politics of instruction and openness.

The main thesis I am defending is that the state of the planet, characterized qualitatively and quantitatively, is not taken account of by the current operation of the economy. The reason that I've highlighted, because it concerns the boiler of the economic motor that is finance, is capital. But this is not the only reason. More generally it is the blindness created by the liberal economy which prevents the commencement of the change in direction that the times demand. The correct term is *scotomization*. Originally introduced by psychoanalysts, it denotes those phenomena, more frequent than one would think, of negative hallucinations. Where a hallucination makes one see things that don't exist, an overinterpretation often linked to fears and traces of emotional traumas, a scotomization is where certain elements of reality disappear or are erased. You enter a room and you do not see a person because you expected there to be nobody there. The economy has prefabricated an idea of the world where limits do not exist; they have been *scotomized*. Financialized free trade shines a blue light on the world, and everything becomes blue. Those are the prices, and you see nothing else but them. In a

blue world, how can you explain that there are other colours? There is only one possibility in my opinion, it is to show that the blue light is artificial, coming from a spotlight pointing at the stage of our theatre.

This realization – that the liberal economy is not an ideology that facilitates ecological transition and that firstly we need to reduce the role of speculative markets worldwide – is the essential precondition necessary so that the actions of all committed individuals who work for the climate, for water, for the wetlands and for forests, who fight against famine, against the overexploitation of resources, against risk-taking for profit, are not to, in spite themselves, rapidly brought back to this monochromatic world.

This scotomization works by *social phenomena of erasure*. The most powerful is – as we discussed – the speculative market which hides the information essential for any dynamic change: information about rates of change. But there are others, in particular, with regard to responsibilities, by *escapement mechanisms*. It is rare in physics to find cases where a device causes an effect on a system without the system, in turn, influencing the device (this is even a law in quantum mechanics: the observer always disrupts and is disrupted). The most relevant example is the escapement in a clock. This is the mechanism which makes the regulator receive a push from the spring or weight, but it (almost) always makes the same movement, as if the role played by the source of energy were invisible, it beats its rhythm of oscillation as if the source didn't exist. There is an escapement of responsibility for the shareholder: he contributes and he is not responsible. Capitalism as it has developed since the 1980s with the now global neoliberal model, gives a primary place to the remuneration of the shareholder. The philosophy is that one should richly reward the judicious choice of those who invest funds in successful or promising businesses. It is well rewarded because this act is very important for the growth of the economy. And moreover, from the outset, the investor is absolved of responsibility for what is done with the money. Pollution, environmental impact, sprains to labour rights, tax evasion, etc., the shareholder is immune; the worst that can happen is the loss of the money invested. Community is thereby deprived of a lever now essential to the challenges of the century. It seems obvious that the future, to reduce risks, will restrain or redirect these mechanisms that are very intelligent but designed for other purposes.

The idea of nature and what its degradation means

To understand what the teeth of the market are in the process of devouring, to clarify this issue that is much debated but often in a confusing fashion, and to avoid the unfortunately numerous superficial clichés, we need to be more precise about what we mean when we talk of nature, something we have only touched on in one aspect so far (chapter III-4).

The word nature comes from the Latin *natura*. The root *na* or *gna* gave *nascere* and *gignere* and, in Greek, γίγνομαι, to become, to be born, and the suffix *urus, tri, tor*, names the actor, so *natura* means then “the engenderer, the force that gives birth to”³⁰⁹. This all-encompassing concept, “nature”, is not strictly a descriptive noun like a set, or a concept that unites beings with the same characteristics. Nature designates the totality of beings in the universe. But unlike the terms “all” or “being”, it adds the idea of the fecundity of the world. It is currently used in the sense of the order that governs existence and the succession of beings, and as the force that personifies this system and its laws. Also as an attribute of a being, it also often signifies the characteristics that come from its constitution or birth and not those changes caused by exterior actions.

If, as a first approach, we follow the advice of Ferdinand de Saussure in his *Cours de linguistique générale* we can narrow down its meaning by using its opposites; for the term

³⁰⁹ “l'engendrante, la force qui engendre” in Littré's *Dictionnaire de la langue française*.

‘nature’ they are old and important. The first is the duality *natural-supernatural*, which refers to religious belief, in which nature brings together those phenomena that arise by themselves without divine intervention. Among the Greeks the distinction is not as clear as the break between that which is intentional and that which is necessary (*automaton*) as, for Aristotle, nature has its intentions. Light bodies rise, etc., and springs and mountains have their gods who, even if they are not on Mount Olympus, nevertheless have their prerogatives. Gradually science, in its historical development, in understanding the regularity and sequences of phenomena, replaced the will of Zeus or Poseidon about storms or tempests with the *properties* of nature. As the Stoic Seneca wrote: “There are differences of interpretation, however, between our countrymen and the Tuscans, the latter of whom possess consummate skill in the explanation of the meaning of lightning. We think that because clouds collide, therefore lightning is emitted; they hold that clouds collide in order that lightning may be emitted.”³¹⁰ And science retains this function of emancipation and disenchantment that the Enlightenment philosophers developed and that the materialists use against the Church in support of naturality. D’Holbach wrote in his *System of Nature* (1781): “Do not put down to a God that you have never known who contradicts himself, and that wicked men of all countries make speak according to their interests, the rules of your duties which are clear and precise and that nature shows you clearly”.³¹¹

The second opposition *natural-artificial* is more delicate. Certainly things in nature have a spontaneous evolution that is not shared with tools which stay as they have been made. But when man developed agriculture, husbandry, medicine, where natural beings have been domesticated or diverted to new uses, the distinction became less clear. Labour disturbs the earth but without expelling life. The opposition took a different turn after the outcome of the controversy over “spontaneous creation”. Beer is an artificial product, produced from yeast. Mould, germs, bacteria are everywhere, and the “engenderer” seems more generous than ever. But the constantly growing power of technology reintroduces this rupture on a grand scale. “A tract of land”, writes Heidegger, “is challenged into the putting out of coal and ore. The earth now reveals itself as a coal-mining district, the soil as a mineral deposit. The field that the peasant formerly cultivated and set in order [*bestellte*] appears differently than it did when to set in order still meant to take care of and to maintain”³¹². Overall, technology and nature seem more and more to oppose each other.

Finally, the duality *nature-culture* marks a distinction about transmission. On one side, the bodily heritage of the animal womb of the human species and structures of the innate, while on the other, tools and their permanence, writing, books, education, the knowledge which form the aim of individual education and of collective behaviour. Here again the two formative sources of man which seem somehow to complete and harmonize themselves in the idiosyncratic traits of each individual, become conflicts at social and political levels when modernity comes to evict cultural habits which have always accompanied ethnic transmissions. There is something in culture which is thought of as natural and, it must be added, there is something in nature which is thought of as cultural.

³¹⁰ Sénèque *Questions naturelles*, II, 32, quoted in G. Matheron, *Estimer et choisir*, Ecole des Mines, 1978 ; *Estimating and Choosing, an Essay on Probability and its Practice*, trans. Hasofer, Springer 1989.

³¹¹ “Ne va pas faire descendre d'un Dieu que tu ne connaîtras jamais, recommande d'Holbach, qui se contredit lui-même, et que des hommes pervers font en tout pays parler suivant leurs intérêts, les règles de tes devoirs qui sont clairs et précis et que la nature te montre évidemment”. Fayard 1990. (This passage is taken from the *Discours Préliminaire* which is in the 1770 edition in the Bibliothèque Nationale de Paris, but is missing from the English editions. It could have been added by Naigeon, friend of d'Holbach and of Diderot).

³¹² Martin Heidegger, “The Question of technology” (1953).

Philosophers have talked a lot about nature, with very different intentions. Aristotle aimed to understand the movements of the *physis* (nature), while since Francis Bacon, and then Descartes, the clearly stated ambition has been to possess and master. Man has a Promethean outlook, because he is subject to God being involved in his power. He may conquer, dominate and transform nature. Kant's concern is more properly philosophical. In separating the appearances or phenomena of things-in-themselves or noumena that we can not know but which underpin the very existence of phenomena, he makes it impossible to know anything outside the domain of science, such as beauty, freedom, ethics, and the whole noumenal world except for some principle generalities at the conceptual level, i.e., transcendental philosophy. In reaction, Goethe, Schelling and Hegel, in his early work, introduced a philosophy of nature (*naturphilosophie*) which aims to restore a metaphysical place for the recent discoveries in science. Hegel then departed from this way to replace nature in the landscape by the general coming of the Spirit: it is ordered in increasing level of complexity and its limit, its frontier is reached when one achieves self-awareness, i.e., in man. The working man, shaping the future of history, becomes the privileged benchmark, and this dialectic humanism, proposed as an alternative discourse to the science of its time, would be the departure point for Marx's materialist "reversal". But Goethe, as much as Hegel, lived in a time so exuberant of science – it was the great bifurcation of the two cultures, at the time of Gauss and Cauchy who launched mathematics towards new ambitions – so their position in this respect was rapidly obsolete and gave way to the encyclopedic positivism of Auguste Comte followed by the scientist-philosophers Claude Bernard, Ernst Mach, Pierre Duhem, etc.

As a philosophy of nature, as much as a synthesis demarcating itself from science, one should also mention the path sketched by Bergson who aimed to judge science as a whole, product of an industrious intelligence, according to the model of rational mechanics begun by Newton and perfected in the physics of Maxwell and the thermodynamicists. *The creative evolution* applies to the Darwinian "revolution" to mark the specificity of the being to which man pertains. But, at the start of the 20th century, is a philosophy of nature still possible without going against the science whose inventive capacities it denies and whose absolute limits it wishes to define? That is what was tried by Maurice Merleau-Ponty³¹³, who aimed not to confine philosophy to the domains of human subjectivity or history, and the logician-mathematician Alfred Whitehead by a relational ontology, reconciling permanence with what is to come, and existence as a process³¹⁴.

However, during the last century, this issue was no longer put in these terms. Firstly because science had changed its view of nature and provided essential knowledge about threats, balances, precautions, and the care needed to cease the destructive irreversibility of which technology is now capable. Secondly because it is no longer up to philosophy to respond directly to natural beings, it has been displaced and now interrogates the social crucible of science. Helped by the strength of the methodological foundations of sociology (Emily Durkheim, Gabriel Tarde, Max Weber, etc.) it studies "the nature of science", the taboos of what "produces" science and its "product" technology. The 20th century is that of epistemology (Popper, Bachelard, Kuhn, Lakatos, Feyerabend, etc.), of philosophy of technology (Heidegger, Habermas, Ellul, Gorz, etc.) and of the sociology of innovation (Ulrich Beck, Bruno Latour, Michel Callon, Antony Giddens, etc.).

³¹³ "whatever the nature of the world and being, *we are*. By nature in us, we can know Nature, and vice versa, it is about us that the beings of this same space tell us." ("de quelque nature que soient le monde et l'etre, *nous en sommes*. Par la nature en nous, nous pouvons connaître la Nature, et réciproquement c'est de nous que nous parlent les vivants et même l'espace") M. Merleau-Ponty *La nature*, Notes cours au Collège de France (1959-60) Seuil 1994.

³¹⁴ *Nature and Life*. 1934. Univ. of Chicago Press.

At the same time science profoundly changed our understanding by the emergence of two fundamental notions which are the epicentres of the contemporary understanding of nature. On the one hand is the notion of a reproductive open system thanks to which physics and biology can develop without the old criticisms of incoherence, a non-reductive entity which opens up phenomena that elude mechanics. On the other hand is the notion of the biosphere as a set of habitats and ecosystems characterized by the interdependence of these systems among themselves and of their regulation over long time scales.

The discovery of open systems, the culmination of at least a century of increasingly heightened vitalistic dualism, was unexpectedly simple. We have already mentioned it. The notable works of Ilya Prigogine on imbalanced systems answered the big question of life, about which so much metaphysical passion had been invested, with the simple observation that open systems that are traversed by energy and material match the criteria of unpredictability with which we think of characterizing the living. The discovery of the double helix complemented this understanding and this trivialization by implementing the transmission of characteristics of species and the combinatorics of evolution. But the one and the other, thereby, revealed the immensity of ignorance we face since these “divergent” systems escape the determinism on which positivism had constructed its doctrine, and that moreover, was found in the complex mutual configurations that are ecosystems. It was “the end of omniscience”³¹⁵.

“If the fear of exhaustion, of levelling of productive differences, was decisive for the interpretation of the second principle, it was the biological model which constituted the key source of inspiration about history that has been followed: the abandonment of the restriction of the thermodynamics to systems artificially cut from the world, its metamorphosis into a science of the world populated by beings capable of evolving and innovating, of beings that we cannot, except to enslave, make predictable and controllable”³¹⁶.

The reasons for this unpredictability and incontrollability stem from “weak stability”, self-organization, divergence from trajectories, sensitivity to initial conditions, Brownian and quantum indeterminism, strange attractors.

“The first physicists had very wisely chosen objects eminently reducible to mathematical modelling. Objects which belong to the very narrow class of dynamical systems for which the trajectory can be defined meaningfully. The history of modern physics is linked to the discovery of the limited validity of concepts arising from such systems whose description can be given completely and deterministically, to the discovery, at the very heart of mathematical physics of the ‘sublunary’ world”³¹⁷.

The end of omniscience gives content back to nature: *the definitively incomprehensible*. “The paths of nature cannot be predicted with certainty, the part due to chance is irreducible, and much more decisive than Aristotle himself understood: bifurcatory

³¹⁵ “la fin de l'omniscience”. I. Prigogine and I. Stengers *La nouvelle Alliance* Gallimard 1979, particularly p101-116.

³¹⁶ “Si la hantise de l'épuisement, du nivellement des différences productrices, fut déterminante pour l'interprétation du second principe, c'est le modèle biologique qui a constitué la source d'inspiration décisive en ce qui concerne l'histoire qui a suivi : l'abandon de la restriction de la thermodynamique au systèmes artificiellement coupés du monde, sa métamorphose en une science du monde peuplé d'êtres capables d'évoluer et d'innover, d'êtres dont nous ne pouvons, sauf à les asservir, rendre le comportement prévisible et contrôlable”

³¹⁷ “Les premiers physiciens avaient fort judicieusement choisi des objets éminemment réductibles à une modélisation mathématique, des objets qui appartiennent tous à la classe assez restreinte des systèmes dynamiques pour lesquels la trajectoire peut être définie avec sens. L'histoire de la physique contemporaine est liée à la découverte de la validité limitée des concepts mis au points à propos de tels systèmes dont la description peut se donner comme complète et déterministe, à la découverte, au sein même de la physique mathématique, du monde «sublunaire»”, *ibid.*

nature, is that where tiny differences, insignificant fluctuations, can, if occurring in appropriate circumstances, invade the whole system, causing a fundamentally new regime. “And as these authors rightly emphasized, “the crisis we have just described burst out with more force as our confidence was blinder”³¹⁸, confidence in science, in technology and in economic progress.

In parallel there was a renewed study of this sort of sociology of living beings, namely *ecology*. Following work of Vladimir Vernadsky, the concept of the *biosphere* has been globally accepted. One studies the open system Earth with its cycles: of water, of carbon, of nitrogen, etc. Biology captures the influence of epigenesis, of the context, of society on the ontogenetic development of individuals. Everywhere one sees the disruptive, invasive, constraining influence of human society³¹⁹.

We thus arrive at an acceptance of nature which takes account of scientific knowledge without taking it as a complete and absolute container but, rather, seeing its limits and appreciating the vastness of our ignorance that science itself compels us to acknowledge. The worries about nature are the translation of our judgement of dependence with regard to the reproductive open systems of which we are a part, and that we see being constituted in ecosystems with that unpredictability and uncontrollability, partial no doubt, but irreducible, which concerns us and is precious to us because it looks like a sister to our own freedom.

Thus the first reaction that comes to mind, the only one in the popular understanding of ecology, is to preserve, in the most absolute and rigorous sense, at least at first, those parts of nature to be conserved intact as a reserve, as ‘original’ regions. A huge literature has been devoted to this feeling of attachment to a golden age where we were still among the animals and in “balance” with them.

How should one think of the idea of a natural park? Humanity, continuing its technological development, would preserve, in strictly protected zones, the natural nature that benefits us by its climatic role and by an interface carefully controlled and filtered in both directions. The history of American natural parks gives a very good idea of the scope and limits of such an ambition. The creation of the great parks dates from the 19th century, well before the ecological movement, in the middle of the industrial revolution. The aim was to rightly preserve the beauty of American geographical sites and not let them be ruined by uncoordinated private initiatives that would “denature” them. It needs a *cultural* will in those countries that do not have Roman ruins, or Romanesque churches, to maintain their waterfalls, geysers, the wildlife and plants out of reach of urban pressure and the networks of land use planning. And from the start it has been understood that this work requires a budget just as, at the same time, for the historic monuments in Europe.

The management of this *wilderness* is, however, extremely difficult, and becoming more so, it seems, on two levels. Firstly our understanding of the phenomena of natural selection leads us to try to copy what we know to be the cause of the observed variety: the giant sequoias are the way they are because it has the specific advantage that it “responds” to the fires that spontaneously occur to varying extents. The absence of such conflagrations disrupted the flora and prevented the giant sequoias from reproducing. Human intervention was thus considered necessary to produce a certain rhythm of forest fires, the management and result of which is uncertain. Later invasive species, plants, insects or others, caused

³¹⁸ “Les chemins de la nature ne peuvent être prévus avec certitude, la part d'accident y est irréductible, et bien plus décisive qu'Aristote lui-même ne l'entendait : la nature bifurquante, est celle où de petites différences, des fluctuations insignifiantes, peuvent si elle se produisent dans des circonstances opportunes, envahir tout le système, engendrer un régime de fonctionnement nouveau.”

“la crise que nous venons de décrire éclate avec d'autant plus de force que la confiance était aveugle”

³¹⁹ Cf Wilson E. O. *In Search of Nature*, Penguin 1996, p153ff.

considerable problems in these parks, notably today because of the displacement of species caused by climate change. In any case, people, visitors or janitors, unintentionally introduced species that accompanied them. Millions of dollars are necessary for management. The business is complicated by the fact that some of the parks are inhabited by people, and further complicated by the fact that there are some people in America with ancestral customs. “A discrepancy in the guiding objectives at the heart of the park plays out everyday in the resource managers of the National Park Service and other agencies in the management of wildlife”, writes David Graber. “While many culturalists have dispelled the myth that the parklands are not affected by past activities of the human race, they raise the terrifying possibility that there isn’t actually any *wild* life in the parks: the parks are constructions. That does not preclude a type of park that combines the preservation of biodiversity with the preservation of cultural objects. Compromise is possible. But such a site is even further away from wilderness.”³²⁰ It seems that creating a framework which approximately maintains what happens when human influence is light is more and more difficult and more and more expensive.

We thus come to the conclusion that preservation can hardly mean anything other than *caretaking*, using our knowledge to try to make spaces on the planet meet the targets which seem to us important in function of physical and biological laws, and also by reason of purely political and cultural desires specifying certain requirements. This is a very delicate and multifaceted art, that of being gardener of the biosphere. Basically nature is what lives and we do not know why, it includes certain disorders and diseases, yet we are unable to say exactly what good health means. This joins the emphasis placed on *care* by some philosophical currents, and that which is now called “preservation of the environment” is thus explained by saying that it means the work of protection-production of *conditions of existence*, a truly new mission given to economic activity “conceived as a subsystem interacting with the entire human ecosystem”³²¹.

Attach to this conclusion all the relevance and wisdom that is needed for the question of preserving nature, and it remains the case that many indicators are alarming, whose meaning fits perfectly with *the caretaking of the preservation-production of the conditions of existence*, without playing with words. This is a reasonably convincing programme for going towards a world where knowledge and resources are devoted to the maintenance of so-called natural equilibria, to be thought of as a “new economics” necessarily adaptive to human and social development.

But it must be admitted that this is not at all what’s actually happening. What is the nature of the environmental aggression that is currently worrying us deeply? This key point needs to be clarified. It comes from the accumulation of unwanted effects. Four significant problems at the frontier of the economy should be mentioned: a) The spread of waste that is of negative economic value and whose natural dissemination is unchecked. b) The projection

³²⁰ “Un désaccord dans les objectifs à suivre au sein d’un parc se joue tous les jours parmi les gestionnaires de ressources du National Park Service et d’autres agences de gestion de la vie sauvage. Alors que les culturalistes ont bien dissipé le mythe selon lequel les terres des parcs ne sont pas affectées par les affaires passées du genre humain, ils soulèvent la possibilité, terrifiante, qu’il n’existe en fait pas de vie sauvage dans les parcs : les parcs sont des constructions. Cela n’interdit pas un genre de parc qui associe la préservation de la diversité biologique à la préservation d’objets culturels. Le compromis est possible. Mais un tel site s’éloigne encore plus de la *wilderness*.” D. M. Graber “Une approche résolue du biocentrisme : le dilemme de la wilderness dans les parcs nationaux” *Ecologie & politique* n°40, 167-178, 2010. Also see the work by John C. Miles *Wilderness in National Parks : Playground or Preserve*, Univ. Washington Press 2009, <http://muse.jhu.edu/books/9780295990392>.

³²¹ “conçue comme un sous-système en interaction avec l’ensemble de l’écosystème humain” B. Perret thus spoke of the symbiotic economy (*Le capitalisme est-il durable ? Carnets Nord* 2008.)

of the components of the environment on a linear scale by means of contingent valuation or any other method that gives a monetarized value. This is even more reductive when applied to nature than to the artificial because it is poorly understood and its interpretation is open. Certainly the assigned prices cannot give economic information relevant to action. c) For the same reason uncertainty about the environment, consisting fundamentally in not knowing, does not allow one to probabilize to use economic optimization processes. d) Also at the frontier is the question of future generations, which economists handle with such cheerfulness that one might ask what would happen if they tackled questions of euthanasia or eugenics in the same way.

To some extent, our optimism leads us to believe that everything that concerns the concept of *pressure*, urban, demographic etc., can be dealt with, in effect, by implementing a policy of care. But the worry, rightly, sees more accidents, more irreversible damage, sees the *growth of inert zones*, more erosion of species. Why are nuclear catastrophes, which will become more frequent with the proliferation of nuclear power stations, more worrying than other things? Because they definitively neutralize a part of the domain of life. Nuclear power is characterized by a permanent complication of technology which has the unique feature of being punctuated by major accidents. Today it is impossible to draw the outline of the area polluted by the Chernobyl explosion because the rains and rivers have carried radioactive elements and deposited them far and wide, diluted or concentrated at random. The problem is encroachment by surprise, by irreversible deeds. Ulrich Beck was the first to have clarified the philosophical and sociological import of the notion of *technological risk* as something that goes beyond common knowledge and scientific understanding, and thus challenges all the care policies one might wish for. Certainly there have always been risks, the usual argument, enterprising man is necessarily always subject to uncertainty. But there is the gradual uncertainty and the brutal surprise attacks that extend, in small or great steps, the inert minerality of the powerful physical or chemical laws that technology uses and believes it masters because they are economically profitable.

It takes a degree of calm, a certain tranquillity, for the gardener to work on an appropriate time scale. But he is worried. This “caretaking”, is that not too naive a solution to the problem? What will we forget by trusting in this philosophy? It fails to take account of the balance of power. The economy, the main motor of human activity, has taken a pattern with global neo-liberalism which makes it incapable of taking account of the damage that builds up as unpleasant surprises and which accompany the innovations which form the origin of its movements³²² and its progress.

“Surprise” has always been an effective strategy that living things use for hunting. The beast stops before jumping, the antlion makes the base of his sandpit explode without warning to send an ant hurtling towards him. It is also by surprise that prices change and that economic interests consume the common good and all that the markets do not see.

The process by which scientific knowledge emerges is more or less fortuitous, that is to say it follows one path among many (the phenomenon of path dependence). The talent of the researchers in developing fruitful interpretations, of course, and also the role of social configurations in the game of epistemic development, form the two sides to this internalist and externalist dialectic of the history of discovery. In this vast effect of influence and influence (as Derrida would say) – a kind of generalized performativity science → technology → society → science, the “open society” of Popper is looped with one sole fixed primary motor: financial capitalism is both for science, for society and for nature.

³²² Cf Boltanski L., Chiapello E., *The New Spirit of Capitalism*, Helliott G. tr., Verso 2007.

It is the market that will decide the cost of cloning a champion dairy cow, according to its spot price, as a function of the cost compared with a surrogate mother and an artificial uterus. What will be the spot price of the DNA of a Nobel prize winner, or scientist? There are scientists and scientists, and the rating agencies will have to clarify the criteria...

And if we don't change course?

Before discussing where the pursuit of economic progress, which the two last centuries have accustomed us to, will take us, at the risk of misunderstanding, we absolutely must clarify some logical and philosophical problems at the heart of the question of change: what is the margin between the possible and what will actually happen? Can we support the idea that technology so strongly enframes (*Gestell*) an irrevocable right over man that it will, in any case, rule the world?

The logical difficulty of the relation between the future and the possible is well illustrated by a recent article by Edgar Morin: "Our model of civilization will thus receive terrible blows because of these problems of energy, ecology and behaviours. And this is to say nothing of the enormous problems raised by science at the level of those manipulations that can be applied to our genetic legacy"³²³. Neo-liberalism needs to be regulated, he continues, the illusion of continual progress is collapsing. "Here are some of the things that prove that these processes lead us to the abyss. These are the factors which we must face, calmly and clearly". According to this complacency-free picture the conclusion that Edgar Morin proposes can be summarized as: *it is very bad but the worst is never guaranteed, there is the unforeseen; this might save us, it has done so in the past*. "So I think that the processes which remain invisible and minor in the present could develop and grow, coalescing one with another, a metamorphism like that of the naked grub from the chrysalis which transforms, through a self-destruction that simultaneously reveals itself to be a self-construction, into a very different being, the butterfly or dragonfly, with new qualities"³²⁴.

Personally, I do not find this picture convincing, nor encouraging. On the contrary, this seems a form of words calculated to make one accept the unacceptable, as, for example, in India, metempsychosis makes one accept and endure the caste system. What is this improbability that might arrive, that we should hope for? A new secular god? We observe that we are heading for catastrophe, but what is coming may surprise us. In other words, we see the wall, that is the forecast, but *the possible is much greater than one can foresee*. This idea, as we will see, is very fair and logically well-founded, but is formulated here in a passive form of trust which makes it too compatible with the *laissez-faire* mindset. Hope can only be based on the precise designation of the institutions that must be changed in order to change course.

In this respect, Gilbert Hottois explicitly takes a stand for the thesis that these famous improbabilities come from the crucible of scientific research: "The disappearance of the universal belief in values and absolute references, based in religion and the metaphysical. All

³²³ "Notre modèle de civilisation va donc recevoir des coups terribles du fait de ces problèmes énergétiques, écologiques et de comportement. Et je n'ai pas parlé des problèmes énormes soulevés par la science au niveau des manipulations qu'elle peut opérer sur notre capital génétique", "Here are some of the things that prove that these processes lead us to the abyss. These are the factors which we must face, calmly and clearly". In "Le probable et l'incertain" Revue *Nouvelles clés*, n°43, 2004.

³²⁴ "Je pense donc que des processus encore invisibles et minoritaires dans le présent peuvent se développer et créer, en s'alliant les uns aux autres, une métamorphose comme le ver tout nu de la chrysalide qui se transforme, au cours d'une autodestruction qui se révèle en fait être en même temps une autoconstruction, en un être très différent, le papillon ou la libellule, doté de qualités nouvelles" *Ibid.* Cf. also "Redresseurs d'espérance pour une planète en détresse" *Entropia* n°6, 181-189, 2009, where E. Morin wrote "Hope is based on human possibilities not yet explored, and it builds on the improbable." ("L'espérance se fonde sur les possibilités humaines encore inexploitées, et elle mise sur l'improbable.")

values and norms appear henceforth as decided by men, individuals or collectively. This anthropocentricity is explained in cultural and historical relativism, in the individualism and pluralism of democratic societies. Since there are no more limits or transcendent prohibitions, nothing can in principle stop anything possible from being attempted”³²⁵.

One thus sees that the path that Edgar Morin hoped for, being left open to the uncertainty beyond the probable, cannot exist unless we are able to make a general ontological distinction between the path that the future will take and the strictly larger field of possibilities.

Science, producer of knowledge, is at the heart of the issue. If science goes, without anyone knowing in which direction, can one hope that it will help to redirect things? Its essence is normally that of taking into account things that have never been seen before. What do researchers in the market economy do? They rummage, they interpret and they make discoveries. Businesses only take those things that they hope are profitable, which they protect by patents. So we have a mechanism where everyone has a specific role, the researcher uses science and available technology, and what is economically viable is launched. The only obstacle is the precautionary principle in countries where this operationally weak legal term is applicable. Let us be more precise in our analysis. What is the science used by researchers? It may be the stock of universal knowledge, but it can also be less-universal knowledge about particular categories, social classes, specific subpopulations. For example, drugs or treatments which reduce the effect of genes in relation to skin colour will only be for people of colour. As the system we described is driven by economic profit, it cannot fail to be improved by *segmentation of the market* (cf. Jules Dupuit). It necessarily results in pressure on researchers to develop *scientific knowledge that is itself segmented*, i.e., tending to concern those humans who can pay and thus driven by the desires of affluent populations. This will be reinforced by public funding, because the higher-rate tax-payers will be reluctant to fund research done for pleasure or the care of people who are not paying for it.

Changing the trajectory of humanity by science is an issue that biologists are repeatedly asked about. Let’s see how a great scientist addresses this issue.

In *Le jeu des possibles*³²⁶, written in 1981, François Jacob shared the traditional view held by numerous scientists before the business of blood contaminated by the AIDS virus (in the 1980s), Mad Cow disease (in the 1990s) and the catastrophe of the AZF factory in Toulouse (2001), revived discussion of the precautionary principle. He wrote “It is true that the innovations of science can be used for the best and for the worst, they are sources of misery as well as blessings. But what kills, and what enslaves, is not science, but rather interests and ideology [...] And evil does not only come from situations where one intentionally uses science to cause destruction. It may also be a distant and unpredictable consequence of actions carried out for the good of humanity. Who could have predicted overpopulation as a result of developments in medicine? Or the spread of bacteria resistant to antibiotics as a result of the very use of these drugs? Or pollution as a consequence of the use of fertilizer to improve harvests?”³²⁷

³²⁵ “Disparition de la croyance universelle en des valeurs et des références absolues, fondées dans la religion et la métaphysique. Toutes les valeurs et les normes apparaissent désormais comme décidées par des hommes, individus ou collectivités. Cet anthropocentrisme s’explique dans le relativisme culturel et historique, dans l’individualisme et le pluralisme des sociétés démocratiques. Puisqu’il n’y a plus de limites ou d’interdits transcendants rien ne s’oppose en principe à ce que n’importe quel possible soit un jour tenté”. *Le Monde, dossiers et documents*, septembre 2004.

³²⁶ Fayard, 1981.

³²⁷ “Il est vrai que les innovations de la science peuvent servir au meilleur comme au pire, qu’elles sont sources de malheurs comme de bienfaits. Mais ce qui tue et ce qui asservit, ce n’est pas la science. Ce sont l’intérêt et l’idéologie [...] Et le mal ne vient pas seulement de situations où l’on utilise intentionnellement la science à des fins de destruction. Il peut aussi être une conséquence lointaine et imprévisible d’actions mises en œuvre pour le

These three examples are not well chosen; in each of these cases one could have expected more hindsight on the part of scientists who could have perfectly known the consequences of these technologies, thanks to their understanding, but they did not focus their intelligence on this line of thought.

François Jacob's conclusion, justifying the title of his book, is an interesting plea for diversity. "Diversity is a way of warding off the possible. It works as a type of insurance against the future [...] Selection from a variety of pre-existing structures seems to be a means frequently used in the natural world for dealing with an unknown future: short-term future with molecular diversity as one observes in the production of antibodies by vertebrates, long-term future with the diversity of species [...] and especially with the diversity of individuals which form the main target of natural selection"³²⁸. François Jacob also addresses cultural diversity and thinks of this as a precious wealth for responding to possible uncertainties in the future. He defends this thesis without departing from a monist conception of scientific knowledge independent of all contextual interpretation (we are still in 1981): "In humans, natural diversity is further strengthened by cultural diversity which permits humanity to better adapt itself to varying conditions of life and to better use the world's resources."³²⁹ He insists on the importance of culture and that of our creative talent for interpretations: "Our imagination presents us with a continually renewed image of the possible. And it is to this image that we endlessly compare what we fear and what we hope. It is to the possible that we adjust our desires and dislikes."³³⁰ But he does not explicitly go beyond the step of saying that our imagination, and thus our reading of the possibilities, is largely shaped by our culture, in other words, by context. Also, after reading this work, one has the feeling that cultural diversity is, in the eyes of François Jacob, an approval for the social landscape, but which has no impact on the conduct of science, and can never have, as he says: "There is no means of saying where a given area of research will lead. That is why one cannot choose some aspects of science and reject others."³³¹

Twenty years later, François Jacob took a much more nuanced position³³². His discussion of genetic engineering and anthropotechnology is primarily a history of eugenics³³³. He shows how, to Francis Galton and others, improving the species was primarily a concern of scientists really keen to do good, based on proven knowledge for the improvement of species of domestic animals. How the readings that influenced Hitler were scientific articles and how the gradual progression led from these to Josef Mengele's activities in Auschwitz. "With the wisdom of hindsight, it is easy today to recognize that most of the ideas that inspired the eugenics movement were unjustified. And yet many of its followers

bien de l'humanité. Qui aurait pu prévoir la surpopulation comme suite aux développements de la médecine ? Ou la dissémination de germes résistants aux antibiotiques comme suite à l'usage même de ces médicaments ? Ou la pollution comme suite à l'emploi d'engrais permettant d'améliorer les récoltes ?"

³²⁸ "La diversité est une façon de parer au possible. Elle fonctionne comme une sorte d'assurance sur l'avenir [...] La sélection dans une diversité de structures préexistantes semble être un moyen fréquemment utilisé dans le monde vivant pour faire face à un avenir inconnu : avenir à court terme avec la diversité moléculaire telle qu'on l'observe dans la production des anticorps par les vertébrés; avenir à long terme avec la diversité des espèces [...] et surtout avec la diversité des individus qui forment la cible principale de la sélection naturelle"

³²⁹ "Chez les êtres humains, la diversité naturelle est encore renforcée par la diversité culturelle qui permet à l'humanité de mieux s'adapter à des conditions de vie variées et à mieux utiliser les ressources du monde."

³³⁰ "Notre imagination déploie devant nous l'image toujours renouvelée du possible. Et c'est à cette image que nous confrontons sans cesse ce que nous craignons et ce que nous espérons. C'est à ce possible que nous ajustons nos désirs et nos répugnances."

³³¹ "Il n'y a aucun moyen de dire où va mener un domaine de recherche donné. C'est pourquoi on ne peut choisir certains aspects de la science et rejeter les autres."

³³² *Of Flies, Mice, and Men*, tr. *La souris, la mouche et l'homme*, O. Jacob 1997.

³³³ *ibid.*

were perfectly respectable men of science who thought they were acting in the public interest. So where did they go wrong?"

The answer that François Jacob gives to this question is curious. He does not renounce the fundamental principles of separation that he displayed in *Le jeu des possibles*; he believes that these scientists have not put the boundary in the right place. This is an essentially positivist attitude, because it consists in narrowing the field of knowledge to exclude the responsibilities which arise from the active role of the subject and its interpretative faculties. "Where they went wrong", he writes, "was in not examining critically enough the very concept of eugenics and what it implied. In particular, they did not correctly evaluate its social consequences. The danger for the scientist is to not test the limits of his science, and thus of his knowledge. It's to mix what he believes and what he knows."

Less full and more attentive than twenty years earlier, François Jacob nevertheless remains close to Jacques Monod's philosophy of science; he believes in a scientific community clearly sharing certain values. In 2000, about manipulations that affect the genetic heritage of mankind, he writes "it is possible, using this technique, to add a new genetic trait, for example, a gene that could confer certain advantages on humans. This is currently being done in animals and plants. But in the case of humans, the aim is different. It violates the genetic heritage of humankind. The point is no longer to heal someone, but to modify him, to mould him. And all biologists seem to agree: avoid this at all costs". François Jacob is *completely* wrong on this last point: today most biologists, on the contrary, are completely in agreement with this direction. Transhumanists – whose slogans we will read shortly – are the ones making the most noise, but there is also a silent army, particularly in the former communist countries now soaked in materialism, where genetic engineering is well underway. Currents that one could call *secular messianisms*, which aim to be the last vestiges of encouragement and caution in a world that is totally disenchanting having completely run out of religious hope, and which provide ideological support for financial capitalism, morally support the adventurous biology of the market. These are Saint-Simonians, but two centuries late.

The contradiction of achieving all possibilities

This brings us to what is often called the *law of Gabor* and what he himself called the first law of technological civilization: *that which can happen will happen*. Gabor put it this way: progress applies new technologies and creates new industries without finding out whether or not they are desirable³³⁴.

Evidently Gabor strongly opposed this law. Nevertheless, he viewed it as a fact, sad but true, in society as it is organized today. He takes the example of the space race, attempted but, in fact, leading to an impasse, a prestige operation that created popular enthusiasm, but Gabor considers that the seam is more or less exhausted. His diagnosis is close to that of Hans Jonas on the dynamic that drives technology: "you can, so you should, so you do."³³⁵ Both denounced the laxity that comes from only taking into account the market, what it can absorb and its potential appetite.

After this finding, the theses of Jonas and Gabor diverge. Jonas turned to a dramatic mysticism, imagining a dictatorship as a last resort. Gabor is optimistic, having a 'boy-scout'-like confidence in engineers, and in project-teams like the one that successfully organized the Apollo project, with the aim of carrying out a rescue by redirecting things.

Today it is rather in the field of anthropotechnology that *the law of lawlessness* of technological civilization holds. A scientific and triumphalist literature builds on this idea to

³³⁴ See D. Gabor, *Inventing the Future* (1963) ; "Technologie, le pour et le contre" in G.R. Urban *Survivre au futur?* Mercure de France 1973; *The Mature Society*, Praeger Publishers 1972.

³³⁵ Jonas H., *Le principe responsabilité*, (1979) éd. du Cerf 1990.

cut short attempts to limit research on ethical grounds. Transhumanists insist that this law holds and that nothing can stop it. The book edited by John Brockman, *The New Humanists*³³⁶, is worth mentioning. Some twenty distinguished scientists from leading universities proclaim their fabulous expectations of future society, scientific and technological, and its conquest of the universe: the exponential growth in intelligence of future man-machines, the fact that ethical concerns are not consistent with Darwinism: “The ethical debates are like stones in a stream. The water runs around them. You haven't seen any biological technology held up for one week by any of these debates”, “the very concept of technological advance is so deeply ingrained in our society, that it's an enormous imperative”.

The key phrase summarizing the philosophy of these top researchers is “science is the only game in the city”.

That captures the lack of reflection of these scholars on their activity, which is the only pleasure in the world, as well as the ignorance of everyone around them³³⁷. In the final discussion, other scientists, addressing their colleagues, highlight this trait: “your essay, as it is, is curiously paranoid. You no longer need to be! You've largely won”. Obviously, all genetic manipulations should be tried; mankind must evolve to conquer the universe. One really has to see this book in the flesh to realize the astonishing mix of bar-room philosophy and adolescent fantasies, struggling to be comforted by the foolish hopes that university professors can hold, even from UCLA, MIT, Harvard etc.

“One will not stop all possible research from being undertaken one day” is the most false and misleading argument possible. It is argued, not just by transhumanists but by all those who see a monism leading the world and love to position themselves in this unique perspective. Liberals meanwhile, see it as the result of free trade itself in the sense that everything is possible on the market and that the variety of potential buyers gives every opportunity to every innovation³³⁸. Many literary intellectuals and politicians agree because they take scientific activity to be what the great scientists say it is, something that one can not understand from outside. This slogan implies that, on the fundamental issues related to anthropotechnology, one can only *note* where the technology is and, possibly, act politically after the event, to prevent anything that appears to be too dangerous and destabilizing. This conciliatory attitude is based on respect for *scientific territory*, as if it were a private game reserve. It lazily condones the ambivalent discourse of research, both pure and useful, independent of all cultural or historic interpretation, however socially relevant. This conformism to techno-science is strongly reminiscent of the political position of certain pacifists which have been, historically, the game of the worst totalitarian regimes.

Given the crucial role it plays in what epistemological systems can tell us of the future, it is essential to analyse this argument in a completely rigorous way³³⁹.

Although abandoned by most philosophers of science in the 20th century, Kuhn, Feyerabend, Quine, etc. but also by thinkers such as Gadamer, Lacan, Derrida, the primary view of scientific knowledge, as a lifting of the curtain that hides reality, is tenacious. The thesis fits perfectly since to lift this or that part of the curtain then does not matter. It is admitted that there is a *commutativity of dates and research results*. However, one

³³⁶ *The New Humanists* edited by John Brockman, Barnes et Noble 2003

³³⁷ Dennis Gabor speaks of “compulsive innovation” in Roy, R. and Wield, D. *Product design and technological innovation*, Open University Press 1986.

³³⁸ In this respect, while the students of May 1968 took the slogan “il est interdit d'interdire” (“prohibitions prohibited”) they obviously demanded exactly what capitalism wanted.

³³⁹ In what follows, our argument is distinct from that of Quine in “On what there is”, based on the notion of “ontological commitment”, where he writes “little real advance in such analysis is to be hoped for in expanding our universe to include so-called *possible entities*” W. V. O. Quine *From a logical point of view* Harper 1953 p4, we develop a diachronic or sequential argument.

immediately has the feeling wherever this simplistic idea exists, that it thinks as if science did not change the world.

From a logical point of view, the claim “one will not stop all possible research from being undertaken one day” is self-contradictory. The term “possible” here takes different meanings, the conditional mode and the indicative mode, just as *what will be* does not cover the same as *what could be*. The realm of the possible is much larger.³⁴⁰

To see this contradiction concretely, let’s take the key case of anthropotechnology. As soon as man transformed himself – let’s simply say that in certain countries, in certain laboratories, men are conceived, artificially changed in their biological being by technology – the motivations for these future transformations, the moral values and the fantasies founded on the fads on which these labs attempt to build, will also be changed. The role of modified humans will depend on the modifications they have received. Everything can be imagined here, a) that these humans no longer carry certain pathological genes and seek to procreate among themselves so as not to damage their genetic material, thus leading to two or more races/classes/societies, b) that certain physical characteristics of these humans (big legs on the females, sexual performance in the men, etc.) foment a global fad, creating pressure on these labs, etc. By our reasoning, the details of this *feedback* are not important for their motives and interests, we *necessarily* arrive at a vision of the world in which the possible futures of humankind are made of different and *incomparable* paths according to the changes which are first applied. The choices, the relative effort involved, the priorities of research today has thus a huge impact on what will happen in the medium term.

This argument will not convince those many people who, like Francis Fukuyama for example, rightly want to avoid the excesses of anthropotechnology and intend to establish political institutions which guarantee dignity for all human beings³⁴¹. We should also take a step back and consider the question from a logical point of view, establishing what the structure is of this *way of thinking*: the backbone of the proof that we have outlined is the same as that of *Cantor’s diagonal argument*. In terms of real numbers (let’s say a sequence of 0s and 1s), the future is formed by numbers that *we can write* or *designate* without ambiguity. It is a countable set; one could imagine these numbers written on a large parchment. However, the *possible* real numbers, those that *could* be written, form an uncountable set³⁴². The future cannot exhaust the possible.

This proof would not apply if the world were so simple that chemical combinatorics did not diverge, for example, if molecules could not have more than 10 atoms and that one could therefore know all of them. The realm of the possible explodes with regard to the future because the combinations grow vertiginously, the combination of atoms in molecules, the assemblies of biological constituents - amino acids and proteins – in the cells of plants and animals, and because – a key factor – the context of ontogenetic development has a huge influence on the production of every living being. This epigenesis defies any complete description and the set of all situations, in the cytoplasm, in the placenta, in childhood, in social environment, is in perpetual motion and complexity. And, of course, *we act*, being social beings and thus construct our own story.

Thus we arrive at the conclusion opposite to the slogan quoted (and condemned) by Dennis Gabor: *Only some of the possible investigations will be carried out.*

³⁴⁰ John Dewey put a similar idea at the heart of his philosophy: “All possibilities, as possibilities are ideal in character. The artist, scientist, citizen, parent, as far as they are actuated by the spirit of their callings, are controlled by the unseen. For all endeavour for the better is moved by faith in what is possible, not by adherence to the actual.” *A Common Faith* 1934.

³⁴¹ F. Fukuyama, *Our posthuman future*, profile books 2003.

³⁴² I refer to online encyclopedias for a more detailed discussion. The reader interested by the more advanced questions of logic and of real numbers can consult <http://halshs.archives-ouvertes.fr/halshs-00008321/fr/>.

This changes everything. The question is now that of knowing if researchers have anything to say, at the present moment, about the direction that has been taken. Or if these processes can only be the result of *chance* in researchers' findings. Of course these researchers, in their readings, motives and interpretations, are greatly influenced by their own context.

There can be no Manichean response; it is not black and white. Obviously no political institution is capable of an injunction preventing science from discovering this or that. Research policies can only be formulated in terms of priorities and ethical warnings. Even that sort of guidance would be useful, but it is not currently being given; there is no real *plurality* in the directions that science and technology are taking because public funds are being cut and private funds are mainly directed towards short-term profit.

But, on the contrary, when the transhumanists write, in their triumphalist discourse: "The ethical debates are like stones in a stream ...", the arrogance of these academics, certain of their victory, is based on the conviction that *in a liberal system*, any novelty that is perceived by someone as conveying an advantage to themselves or their offspring, will find a market, no matter what moral objections there might be, and can thus be financed.

Anthropotechnology designs a future which could lead man towards the most appalling hatred and violence. It is worth making the effort to see this to understand that, regarding genetic technology, scientists today are in a situation where ingenuity is no longer relevant. About the scholars who contributed to the Manhattan project after the bombs at Hiroshima and Nagasaki, Karl Jaspers wrote "It seems to me that most scholars did not fully realize the extent of things. Thus they did not reach the point of considering the new limit situation [...] Also the way numerous scholars acted and thought displayed a peculiar attitude: afraid of what they have done, they claimed, in a spirit of peace, a solution, all the while developing the science further. Men of such intelligence want and do not want, they behave like children and speak of a tragedy"³⁴³

Let's review this. Suppose that one believes that Monsanto-like marketing-strategies are the generic example of economic operation and that the neoliberal model is the only sustainable reality, technological innovation will be gradually become more ethically guided due to the company's financial interests, and their laboratories will only use science to patent more molecules and more genes. Then, de facto, one prevents the *possible* from taking the whole epistemological field, since the possible will be confined to what is beneficial to these companies. In such a universe, the researchers are children without social or political responsibility. They play their games like gifted teenagers with video games. The forces and means of communication strengthen the system and Morin's improbable finds a niche in the lucky randomness of the devices manipulated by researchers in a confined atmosphere cut off from all social and environmental problems.

The mature society, as Gabor claims, has to be completely different. It needs the feedback loop of monism to be broken. It needs plural readings of the world to provide open possibilities, and that can only be done if researchers accept their social and cultural anchors, and thereby have the means to deepen the representations created by users and their associations. Science must be organized so that it resembles pluralist parliamentary systems.

The strictly logical argument above is simply a rigorous basis that reinforces common sense: at the level of the mechanisms of the market, many innovations do not succeed, such as the Wankel rotary engine, the betamax video system, ... at the level of alternative technologies, respecting the environment, many things could have been done but were not. Only some of the possible avenues of research will ever be pursued. The choices to be made have, thus, full value and paramount importance for the future. Scientists have an

³⁴³ Karl Jaspers *Die Atombombe und die Zukunft des Menschen*, Piper and Co 1958.

irreplaceable role in this analysis of the possibilities. They can no longer play the game of meeting innovation by chance, as one falls in love by chance³⁴⁴; we have too often heard this story which avoids all responsibility. Consideration needs to be given, firstly, to the *organizational conditions* that will allow them to make these reflections, seminars on these choices and open debates with civil society.

The teeth of the market will continue to work

Those serious authors who have contemplated the state of the world and the trends with significant impact on the planet, all reach the conclusion that the economy manages things badly, because *it does not see* the damage it causes. An excellent example of these lucid writers, Lester Brown, writes in *Plan B* “The key to restructuring the economy is the creation of an honest market, one that tells us the ecological truth”. To his mind the weakness of the current market that need to be addressed are a) ”it does not incorporate the direct costs of providing goods or services into prices”, b) ”it does not value nature's services properly” and c) ”it does not respect the sustainable yield thresholds of natural systems such as fisheries, forests, rangelands and aquifers”. For this, overheads need to be incorporated into prices: “if we want to determine the full cost of burning gasoline, we need to calculate the indirect costs of doing so. [...] Calculating the expenses of treating smoking-related illnesses and absenteeism shows that each pack of cigarettes smoked in the United States costs society \$7.18”. Calculating the real costs, “creating an honest market”, supposes that the market takes account of the value of services offered by nature. In 2003 Lester Brown expressed his thoughts before the Copenhagen conference: by a system of taxes and the implementation of a proper evaluation of nature’s services (thanks to a long and appropriate cost-benefit analysis), it promotes the establishment of sustainable development. Its objective is laudable and we cannot fail to agree with the principle: “If we can get the market to tell the truth, then we can avoid being blindsided by faulty accounting systems that lead to bankruptcy”³⁴⁵. That is the central idea of his Plan B: make corrections by taxes so that the market speaks truly.

And then there was Copenhagen and its consequences. Biofuels were developed in the United States on fields previously dedicated to the world grain market...

Plan B does not work. First, of course, because it is not in the interest of the many economic players who seek immediate profit, and because there is a violent political reaction against taxes. But that is not all. A market that speaks the truth must firstly be *a market that speaks*, and thus a market that calms itself. This is the first thing that a referee says in a dispute “calm down!”

The idea of plan B is a gentle therapy. It is not a placebo; it has begun timidly to have some effect. But as it does nothing to calm the storm in the prices of corn, soya, oil, iron, the dollar, etc., it is not a policy that can change the disorder that suffocates the agriculture and local economic activity that most of the world’s population rely on³⁴⁶.

The wise response is to say that plan B can be a transitional step to help accept the idea of an increased role of national and international institutions in the management of the common good, and of taxes to implement environmental policies, but only as one step because the problem is much more serious than that.

³⁴⁴ Cf. N. Bouleau *Risk and Meaning*, op. cit. Chap. XV.

³⁴⁵ Brown L., *Plan B, Rescuing a Planet under Stress and a Civilization in Trouble*, Earth Policy Inst. 2003.

³⁴⁶ In *Prosperity without Growth* (op. cit.) Tim Jackson subscribed to an idea similar to Brown’s plan B, albeit with a different vocabulary (that of ecological macroeconomics). He also advocates (p175-176) an economic valuation of natural capital as set out in the reports of The Economics of Ecosystems and Biodiversity (TEEB) by a cost-benefit analysis extended to living beings. This “economization” can only be a temporary bandage, for the same reasons.

To further our thinking about what could happen, imagine a world which carries on as present, i.e., with the same means of guidance based almost exclusively on market prices, a world which turns a deaf ear to scientists' warnings and which pursues the political objective of gaining the best economic position. This means maintaining the dominant discourse which consists in only considering one subentity within the overall competition: one nation, or one company, or household or, ultimately, one individual, pursuing the idea that, in the growing difficulties that may occur, the economically strongest will always be the best placed. In other words, suppose that the game of Red light, green light continues (cf. Chapter II-2).

Such a perspective is, of all the hypotheses, the most likely one now judging by the trends observed by all serious indicators – i.e., those quantitative measures that do not involve prices. It will remain the most likely for some time, for the strong reason that these objective quantitative changes are not relayed by prices and are from very indirect information whose scientific detail is complicated and difficult to follow. These come from scientific facts but with a pessimistic twist. Normally science is neither sad nor happy, it explains the observations made and, so far, by the services it has provided (in machinery, medicine, electronics) its announcements and even its promises have been met with optimism. Today the scientific discourse about limits cannot be understood in details, so does not help us to manage our daily lives and, moreover, is sad! At least the economy tells us how better to live by paying careful attention to prices!

Thus, by inertia, the serious consequences announced by so many specialists will injure or incapacitate our environment for long periods, many centuries, and sometimes permanently. The death of corals, for example, may have repercussions on the scale of the evolution of species, the result of millions of years of life reduced to something inert. The poor will obviously be affected the most. Unlike in Karl Marx's time, when the capitalists, in their management of worth, were careful to make sure the proletariat had enough to renew the labour force and maintain, by their children, the population of workers, today it is no longer a concern. The regulation of the world's population can now be achieved by means of the degradation of the common goods (air, water) and the reduction in the generosity of nature which affects primarily the economically weakest.

I want to follow this hypothesis through to the situation where the rich have "won". By this I mean that they have taken the logic of ecological modernization and climatic realism to its limits: prioritized *adaptation*, increased research into technological mutations and, above all, adopted a pragmatic policy of give and take towards the poor countries: economic aid for subsistence on the express condition that the common goods like air and water remain in such a state that the consequences be bearable and manageable for the lifestyle of the developed countries. This may be hard to imagine, but it's a hypothesis.

Either politicians in western democracies are short-sighted and do not see beyond the next election or – and this is certainly the case for the think-tanks that advise them – when they continue to speak of revival, of development and growth, they have in their head a long-term image of some kind of ideal landscaped city where the environment is cared for by a well-managed sustainable development policy, thanks to highly active research laboratories which overcome the loss of biodiversity by a huge programme of genetic engineering aimed at creating living beings which provide the best service that one could hope for.

The vanishing point of complete trust in the market economy is necessarily such a secure gated garden city, guarded well with plenty of surveillance cameras... But the problems of piloting in a liberal economy dominated by speculative-valued markets remain the same. Biology will be embroiled in patent systems and ownership of living and, as we do not always see the trends, the machine will be without any system of navigation or control. Volatility, temporary fads, rumours and accidents (nuclear, biological, nanotechnological, etc.) will do their damage inside the flowery city.

In fact, evicting the poor will not change this type of problem because the poor do not have much economic weight; their regions have only the economic weight of third-rate businesses. The teeth of the market will continue to chew.

We cannot avoid obstacles that we do not see.

References

- Ackerman F., Heinzerling L. "Pricing the priceless : Cost-Benefit Analysis and Environmental Protection" *Univ. of Pennsylvania Law Review* Vol 150 (2002) 1553-1584.
- Angenot M., *Les grands récits militants des XIXe et XXe siècles, religions de l'humanité et sciences de l'histoire*, L'Harmattan 2000.
- Artus P., A. d'Autume, Ph. Chalmin et J.-M. Chevalier, *et al.* "Les effets d'un prix du pétrole élevé et volatil" CAE Rapport 2010.
- Austin J. L., *How to do Things with Words*, Clarendon 1962.
- Bachelier L., *Calcul des probabilités* (1912).
- Bairoch P., *Histoire économique et sociale du monde du XVIème siècle à nos jours*, Gallimard 1997
- Beck U., *Risiko Gesellschaft : Auf dem Weg in eine andere Moderne*, 1986; *What is Globalization ?* Polity Press 2000.
- Bénicourt E., Guerrien B. *La théorie économique néoclassique*, La Découverte 1999.
- Boltanski L., Chiapello E., *The New Spirit of Capitalism*, Helliott G. tr., Verso 2007.
- Bouleau N., *Philosophies des mathématiques et de la modélisation*, L'Harmattan 1999 ; *Financial Markets and Martingales*, Springer 2004 ; *Risk and Meaning, Adversaries in Art, Science and Philosophy*, Springer 2011.
- Bouleau N., Lamberton D., "Residual Risks and Hedging Strategies in Markovian Markets" *Stochastic Processes and Appl.* 33, 131-150 (1989).
- Bourg D., A. Papaux eds, *Vers une société sobre et désirable*, FNH-PUF 2010.
- Bourg D., Whiteside K. *Vers une démocratie écologique, le citoyen, le savant, le politique* Seuil 2010
- Boyer R., Chavance B., Godard O., eds, *Les figures de l'irréversibilité en économie*, Ecole des Hautes Etudes en Sciences Sociales 1991.
- Braudel F., *La dynamique du capitalisme*, Arthaud 1985.
- Brown L. R., *Plan B, Rescuing a Planet under Stress and a Civilization in Trouble*, Earth Policy Inst. 2003 ; *Eco-économie*, Seuil 2003
- Calame P., *Essai sur l'æconomie*, Ed. Ch. L. Mayer 2009.
- Callon M., P. Lacosmes, Y. Barthes, *Acting in an Uncertain World. An Essay on Technical Democracy*. MIT Press. 2009.
- Chomsky Noam, *Profit over People, Neoliberalism and global order*, Seven Story Press 1999.
- Commoner B., *Science and survival* Viking Press 1963; *The Closing Circle, Nature, Man and Technology*, Knopf 1968; *Making Peace with the Planet*, New Press 1975; *Science and Survival*, Viking Press 1963.
- Comte A., *Physique sociale, Cours de philosophie positive leçons 46 à 60*, J.-P. Enthoven ed., Hermann 1975 ; *The Correspondence of John Stuart Mill and Auguste Comte*. O. Haac ed., Transaction Publishers 1995.
- Costanza, R., L. J. Graumlich, and W. Steffen (eds.) *Sustainability or Collapse: An Integrated History and future of People on Earth*. MIT Press 2007.
- Cournot A., *Recherches sur les principes mathématiques de la théorie des richesses*, (1838).
- Daly H. E., Farley J., *Ecological Economics, Principles and applications*, Islandpress 2011.
- Dana R.-A., Jeanblanc-Picqué M., *Marchés financiers en temps continu*, Valorisation et équilibre, Economica 1994.
- Deléage J.-P. *Histoire de l'écologie, une science de l'homme et de la nature*, La Découverte 1991.
- Dessus B., *Atlas des énergies, pour un monde vivable*, fph-Syros 1994.
- Dewey J., *Democracy and Education* 1916 ; *A Common Faith*, 1934; *The theory of Valuation* 1939.
- Diamond J., *Collapse : How Societies Choose to Fail Or Succeed*, Penguin 2011
- Duchatel J., Gaberell L., *La propriété intellectuelle contre la biodiversité ? Géopolitique de la diversité biologique*, CETIM 2011.
- Dumont R., Rosier B., *The Hungry Future*, Deutsch 1969.
- Dupuy J.-P., *Pour un catastrophisme éclairé, quand l'impossible est certain* Seuil 2002 ; *L'avenir de l'économie*, Flammarion 2012.
- Ellul J., *Le système technicien* Calman-Lévy 1977.
- Fukuyama F., *Our posthuman future*, profile books 2003.
- Fullbrook E., edr, *Real World Economics: A Post-Autistic Economics Reader*, Anthem Press (2007).

- Gabor D., *Inventing the Future* (1963) : *The Mature Society* Praeger Publishers, 1972.
- Georgescu-Roegen N., *The Entropy Law and the Economic Process*, Harvard Univ. Press 1971.
- Giddens A., Hutton W. eds, *On the Edge, Living with Global Capitalism*, Vintage 2001.
- Girard R., *Les origines de la culture*, Desclée de Brouwer 2004.
- Giraud G., *La théorie des jeux*, Flammarion 2009.
- Guesnerie R., *L'économie de marché*, Le Pommier 2006.
- Guerrien B., *Dictionnaire d'analyse économique, microéconomie, macroéconomie, théorie des jeux*, La Découverte 1996; *L'illusion économique* Omniscience 2007.
- Hanley N. "Are there Environmental Limits to Cost Benefit Analysis ?" *Env. and Resource Economics* 2 (1992) 33-59
- Harris G., *Seeking Sustainability in an Age of Complexity*, Cambridge Univ. Press 2007.
- Hayek F., "The Use of Knowledge in Society" *The Amer. Economic Review*, XXXV, n4, 519-530, 1945.
- Heelas P., Lash S., Morris P., eds, *Detraditionalization, Critical Reflections on Authority and Identity*, Blackwell 1996.
- Hull J. C., *Options, Futures, and other Derivatives*, Prentice Hall 1993.
- Jackson T., *Prosperity Without Growth: Economics for a Finite Planet* Earthscan 2009.
- Jacob F., *Le jeu des possibles* Fayard, 1981 ; *La souris, la mouche et l'homme*, O. Jacob 2000.
- Jacquard A., *L'explosion démographique*, Flammarion 1993.
- Jaspers K., *Die Atombombe und die Zukunft des Menschen*, Piper and Co 1958.
- Jonas H., *The Imperative of Responsibility: In Search of Ethics for the Technological Age* (1979) University of Chicago Press, 1984; With Cornille S. and Ivernel Ph., *Pour une éthique du futur*, Payot & Rivages 1998.
- Keynes J. M., *The Economics Consequences of the Peace*, 1919 ; *Théorie générale de l'emploi, de l'intérêt et de la monnaie* (1939) Payot 1969
- Lamberton D., Lapeyre B., *Introduction to Stochastic Calculus Applied to Finance*, Chapman and Hall 1996.
- Latouche S., *Farewell to Growth*, Polity (2010).
- Latour B., *Politics of Nature: How to Bring the Sciences into Democracy* Orient Longman (2007).
- Lavignotte St., *La décroissance est-elle souhaitable ?* Textuel 2009.
- Laville J.-L., Cattani A. D., eds, *Dictionnaire de l'autre économie* Gallimard 2006.
- Lévi-Strauss Cl., *Race and history* (1952), Nabu Press 2011.
- Malinvaud E., *Statistical Methods of Econometrics*, North-Holland 1970
- Malthus Th., *An Essay on the Principle of Population* (1798).
- Marx K., *Capital* vol. I (1867) vol. II (1885) vol. III (1894); *Manuscripts of 1844 ; Wage Labour and Capital* 1847.
- Meadows D. H., D. L. Meadows, J. Randers and W. Behrens III, *The Limits to Growth*, Universe Books, 1972.
- Meadows D. et al., *Limits to Growth the 30-year update* Earthscan 2004.
- Merton R. K., *Social Theory and Social Structure* (1949).
- Merton R. C., *Continuous-Time Finance*, Blackwell 1990.
- Michaels D., *Doubt is their product*, Oxford Univ. Press 2008.
- Mill J. St., *System of Logic, Ratiocinative and Inductive* 1843 ; *On Liberty* 1859 ; *Utilitarianism* 1861 ; *Auguste Comte and Positivism* 1865.
- Naouri A., *Le couple et l'enfant*, O. Jacob 2005.
- Oreskes N. and Conway E. M., *Merchants of Doubt : How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*, Bloomsbury Press 2010.
- Pearce D., Atkinson G., Mourato S. "Analyse Coûts-bénéfices et environnement, développements récents" OCDE 2006
- Perret B., *Le capitalisme est-il durable ?*, Carnets Nord 2008.
- Portait R. et Poncet P., *Finance de marché*, Dalloz 2008.
- Prévot H., *Trop de pétrole*, Seuil 2007.
- Prigogine I., Stengers I., *La Nouvelle Alliance*, Gallimard 1979.
- Proudhon P.-J., *Les malthusiens* (1849)

- Ragni L., "La méthode mathématique chez Walras et Cournot : comparaison et enjeux de discordance" *Cahiers d'économie Politique L'Harmattan* 2011/1, n° 60, 149-178.
- Ricardo D., *On the Principles of Political Economy and Taxation* 1817.
- Samuelson P. A., "Proof that Properly Anticipated Prices Fluctuate Randomly" *Management Review* 6:2 (1965) ; "Mathematics of Speculative Price" *SIAM Review*, Vol 15, n°1, Jan 1973. (Appendix by R. C. Merton "Continuous-time Speculative Processes").
- Sapir J., *Les trous noirs de la science économique*, Albin Michel 2000.
- Say J.-B., *Cours à l'Athénée* (1819)
- Schrödinger E., *What is life?*, McMillan 1946.
- Sen Amartya, *The Idea of Justice*, Harvard Univ. Press, Allen Lane, 2009.
- Serres M., *The Natural Contract*, Univ. of Michigan Press 1995.
- Smith A., *An inquiry into the Nature and Causes of the Wealth of Nations* (1776).
- Solow R. "The Economics of Resources or the Resources of Economics" Ely Lecture, *The American Economic Review*, Vol. 64, No. 2, (1974), 1-14.
- Steffen W. and al., *Global Change and the Earth System, a Planet under Pressure*, Springer 2004.
- Stern N., *Review on the Economics of Climate Change*, http://www.hm-treasury.gov.uk/sternreview_index.htm
- Stiglitz J., *The Price of Inequality, How Today's Divided Society Endangers Our Future*, Norton & Co 2012.
- Tirole J., *The Theory of Industrial Organization* MIT Press 1988 ; *Politique climatique, une nouvelle architecture internationale*, Doc. Française 2009
- Turgot, *Plan d'un ouvrage sur le commerce, la circulation et l'intérêt de l'argent, la richesse des états* (1753-54)
- Urban G. R. *Can we Survive Our future ?* St. Martin's Press, 1972.
- Walras A., *De la nature des richesses* (1831)
- Walras L., *Esquisse d'une doctrine économique et sociale* (1898) ; *Eléments d'économie politique pure*, 4ème éd. 1902.
- Weber Max, *The Protestant Ethic and the Spirit of Capitalism* 1904-1905.
- Wilson E. O. *In Search of Nature*, Penguin 1996.
- Worldwatch Institute, *2010 State of the World, Transforming Cultures, from Consumerism to sustainability*, Norton and Co 2010.
- Zaccai E., Gemenne F., Decroly J.-M., *Controverses climatiques sciences et politique* Presses de Science-Po 2012
- Zelenko I., *La finance carbone*, Dunod 2012.

Blurb

Since the Brundtland report in 1987, at the start of the series of United Nations Conferences on the Environment and Development, the world population has grown by more than it was in the time of Adam Smith. Oil consumption has increased by 40% and the trend is similar for other exhaustible resources, such as metal and fish. The loss of biodiversity continues to reduce flora and fauna at an almost constant rate. Deforestation approximately equivalent to the area of England occurs every year.

Despite all the warnings from scientists, *the rate* of degradation is not decreasing. But economic activity - consumption and saving – has grown faster than the global population. Why does the world not adapt to the boundary conditions of the planet? Why is nature being devoured?

This work responds to this question in a very professional way: the economy is badly run, and not for the reasons stated by Marxists.

Over the past 25 years, finance has held the wheel of the global supertanker. By globalization, by the increase of savings, and by the technical innovations of the financial markets, its power over the economy has become dominant. Finance is in charge. But the price-signal that it produces is surrounded by fog. The author explains why this is, and analyses the consequences for the near future.

Author

Nicolas Bouleau is a mathematician and economist, specializing in the financial markets. He is known both for his mathematical advances in potential theory and for his essays in economics and philosophy. He has published more than 150 articles and a dozen books. He is a member of the scientific board of the *Fondation Nicolas Hulot* and recipient of the *prix Montyon* of the *Académie des Sciences française*. He teaches philosophy of science at the *Paris-Est* University and at the *Institut des Sciences Politiques de Paris*.