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THE ERRATIC BEHAVIOR OF THE NATURAL RESOURCES MARKET AND THE IMPACT ON THE LANDSCAPE-CULTURAL MOSAIC

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Abstract*. The objective of this paper is eminently theoretical and aims to shed light on the way how the global market is dominated by antagonistic forces or actors (multinational corporations, ecological movements, national or supra-national governments) that create instability and chaotic fluctuations in natural resource and commodity markets with unpredictable impacts on the landscape-cultural mosaic. There is a contrast between the speed of financial actions, that operate with extremely fast times and repercussions, and the speed of ecological actions whose impact, especially on the landscape, is rather slow. The role of governments ends up following now one and now the other instance creating an additional factor of instability. Consequently, the effectiveness of the activities of the three actors overlaps, with different times, creating a system that even in the simplest cases has proven to lead to chaotic situations. The methodological reference will be to the Lotka-Volterra model which, as is well known, in the case of 2 actors leads to a situation of equilibrium, whereas when the actors are three or more gives rise to large ranges of deterministic chaos as supported also by Game theory.*

Keywords*: Natural resource under-remuneration, interference between oil and corn markets, landscape-cultural mosaic, Say's law, Lotka-Volterra and predator-prey models, ecological movements.*

Introduction

Though this be madness, yet there is method in't
Shakespeare, Hamlet, II, 2

It has been proven that the natural resource market is subject to unexpected patterns that create astonishment among operators because it does not follow the economic rules. Recent example is the oil market whose prices from June 2014 to December 2015 have drastically plummeted and from March to May 2016 suddenly strongly increased.

This research is structured as follows: I) a short excursus in the history of economic thinking to reaffirm how the remuneration of natural resources was a neglected topic, a real black hole in the economy; (II) rehabilitation attempt of the concept of absolute and relative rent (Ricardo, 1821), and assessment of the impact of its dynamics following innovations and discoveries of new mineral deposits (omitted in this work); III) discussion of how and why the global

market for natural resources dominated by antagonist forces or actors, particularly Market, Government and Ecologists, is systematically under-evaluated and subject to instability and chaotic fluctuations (Lotka, 1925; Volterra, 1931) with unpredictable impacts on the landscape-cultural mosaic.

Theoretical analysis of market behavior

According to J. B. Say 'Supply creates its own demand' (1803). This means that in the economy there is never overproduction in the long run because a permanent economic equilibrium between global demand for goods and services and the related supply arises. Say was convinced that the market left to himself tends to reach the equilibrium of full employment. At any shift from this balance corresponds an automatic readjustment by market forces towards a national income of full employment. There are 2 corollaries of the law: - A each production generates an equivalent amount of income; - B all income is always spent entirely (directly or indirectly). That means that there is a kind of 'identity' between supply (production-income) and demand (consumption-investment).

$$Y = C + I \text{ and } S = I$$

In the past, this neoclassical theory of the automatic equilibrium between supply and demand was already criticized by Malthus. For him, an increasing volume of production creates the need to find outlets, by no means automatic, in the market, such as relatively to exports or consumption of wealthy classes, and so on. J. M. Keynes (1936), in The General Theory of Occupation, Interest and Money, demolished Say's theory (1803) and demonstrates that the level of equilibrium of a capitalist economy could be both in a situation of high unemployment and in the opposite situation of full employment (Keynes). In Keynesian theory is the aggregate demand that determines the level of economic activity and national income (in the short term) and not the supply.

Say's law stated the dogma of entrepreneurial or industrial liberalism: it is necessary to produce frantically to increase national wealth. Free trade is not possible for prolonged crises, as products are paid with products and not with money, which is only a representative commodity. The supply is always able to create its own demand: every seller is also a buyer. For Say, the remedy of the crisis did not have to be so much found in restrictive import measures as in the increase of those exports that can be exported.

This Law becomes invalid in periods of major depression like that of 1929-33 and of crisis like the one currently under way, also for the strong accumulation of unsold stocks (Krugman, 2015). In this case, following Keynes, there is a lack of aggregate demand which entails an oversupply and unemployment (Keynes, 1936). Oversupply also creates the fall in commodity prices, such as oil, and makes the production of alternative energy not convenient in spite of the support

of the state (Chang et al., 2015). On the other hand, anyone who has business experience knows that the costs are almost always certain, at any one time, whereas the revenues and receivables arising from income and sales are always uncertain.

Adam Smith in his famous book 'The Wealth of Nations' spoke about "the invisible hand" to describe the forces that led the market and its prices to a full employment equilibrium, but the approach of the classical economics was referring to a market of free and pure competition whose assumptions nowadays seem unrealistic (Smith, 1776). So much so that already in the last century, the French economist François Perroux argued that the free competition was an extreme, and strictly speaking, a pathologic case of the economic policy, proposing instead the interpretative key of competition between agents at various levels for the market dominance and launched the famous 'law of dominance' (Perroux, 1973). Nevertheless, the market, dominated by the so called imperfections or market failures (non- atomistic structure, prevalence of scale economies, asymmetric information, externalities, etc.), continues to be strongly ungovernable and the prices that come about have erratic behaviours especially regarding products or services that are natural resource intensive, even though Keynes had demonstrated that there might be an equilibrium of underemployment.

The concept of natural capital and the under-remuneration of natural resources

Contrary to economists, scholars of the problems of complexity give a very lata or holistic definition of natural capital that also extends to goods and services not directly monetized that do not have a market value because they are not rare and / or do not give a direct or immediate benefit.

In fact natural capital, defined in gross terms, contains all the tangible and intangible aspects of the biosphere that man uses directly or indirectly with the exclusion of the value it adds to these materials. It is all those goods and services essential to maintain life on earth and includes that part of nature called "natural capital that sustains life" as such the ability to renew resources through the use of biomass and to absorb the waste that is called the regenerative capacity of the biosphere (Wackernagel *et al*., 2004, p. 3) that someone would talk about homeostasis (Bunyard and Goldsmith, 1992).

A more accurate definition of natural capital refers to "a stock of natural assets capable of generating a flow of value in the future in terms of goods and services" (Rees, 1996, pp. 3-4). For example, a forest or a stock of fish can provide a flow of timber or fish that is potentially sustainable year after year. The stock that produces this flow is the "natural capital" and the sustainable flow is "natural income." Furthermore, natural capital also provides services, such as for example the waste assimilation capacity, erosion and flooding control, and

protection from ultraviolet radiation (the ozone layer is a form of natural capital). These life support services are considered natural income. Since the flow of services from ecosystems often requires that they function as intact systems, the structure and system diversity can be an important component of the natural capital.

There are three major classes of natural capital:

i) renewable natural capital, such as living species and ecosystems. This capital reproduces itself and is self-powered using solar energy and photosynthesis. These forms can result in salable goods as in the example fibers derived from wood, but may also provide essential services not accounted for in advance (eg. The climatic control);

ii) rechargeable natural capital, as such as the underground water and the ozone layer, which is not alive, but often depends on its renewal solar energy engine;

iii) non-renewable natural capital, that is the fossil fuel and other minerals, that is analogous to the stocks - its use implies the destruction of part of the pre-existing stock.

As it is known, the availability of natural resources, namely minerals, water, energy and food is a very important issue (World Economic Forum), but one must not confuse the exhaustible natural resources such as oil and mining products with renewable ones even if the boundary between the two is increasingly fuzzy as a result of the action of technological progress. Due to it, new resource stocks can be discovered or exploited where before it was considered unthinkable, as in the depths of the oceans or intermingled to other components.

This paper follows the approach of a previous work in which it was argued that, due to the prevailing criterion of labor-value in classical economics, the remuneration of exhaustible natural resources, represented e.g. by the mining rent, has never been entirely accounted for in the costs of production and therefore the neglected part has never contributed to form the price (Immler, 1985, 1987; Chang et al., 2004). "Hans Immler .. argues that the role and function of the natural environment, and its neglect, have been disregarded both in the formulation of economic theories of value and in regard to their long-term consequences …" (Karsten, 1987, p. 390). The nature was viewed as a free goods (Hobbes) infinitely available and self-generating (Ricardo) and not as a category of value (Smith).

The consequence has been that the natural-resource commodities are systematically under-priced (Slade, 1992). According to this important research, new technology, innovation, and the discovery of new stocks or low-cost substitutes have helped to reduce the extraction and processing costs and thus the prices of natural resources (Slade, 1992, p. 19) rather than to improve their remuneration with an adequate rent. Following the Nobel Laureate Amartya Sen, the ethical and egalitarian goal of socio-economic resources, that also affects the distribution of the rent of natural resources, must be achieved by

maximizing the capabilities of all citizens, choosing the best among the possible opportunities of to be and to do (functioning; Sen, 1987). This can be obtained trying to re-invest the rent of mineral resources in source countries so as to maximize educational and cultural levels, ecological sensitivity, and of course to improve both the food system and health and socio-economic conditions. A reconciliation between weak and strong sustainability could be a solution (Rennings and Wiggering, 1987) on the one side to avoid compromising the environment for future generations and on the other to fill the described inhuman gaps often existing in the natural resource-rich countries.

Natural resources market vs. commodity market

The latest researches demonstrate that countries the richest in natural resources are those that have suffered a lower economic development, and indicate this phenomenon as "the curse of the abundance of natural resources" (Sachs and Warner, 2001). In fact these countries, even where the rampant capitalism was not able to exploit natural resources with the method of cost free appropriation of the rent, are internally stirred with civil or religious wars and externally with land invasions or otherwise (Chang, 2004).

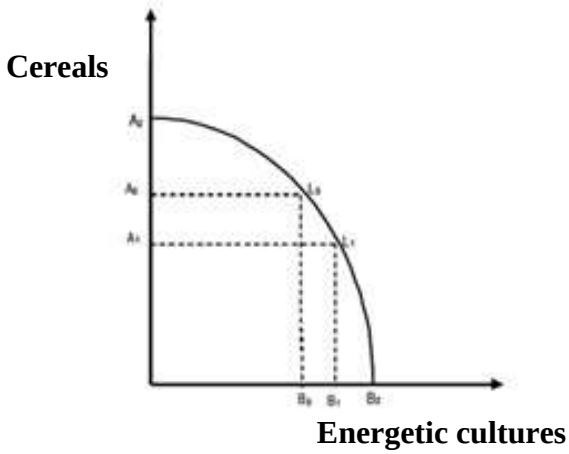

Figure 1. **Transformation curve Cereals and Energetic cultures**

Moreover the markets of natural resources and raw materials interfere with each other resulting in further effects that become systematic and make prices even more volatile and the impacts even more unpredictable (Fig. 1; source Chang, 2004). The example handheld is that of the known interference between the price of oil and that of corn and wheat (Fig. 2; source CLAL, 2017). The expected increase in oil prices will create positive expectations for the alternative energy so that more land is used for energy crops. E.g. as a result, the EU harvested production of oilseed has grown considerably in recent years, namely 30 % from 2008 to 2014. Oilseed production in the EU-28 reached over 35 million tonnes in 2014 (Eurostat, 2015).

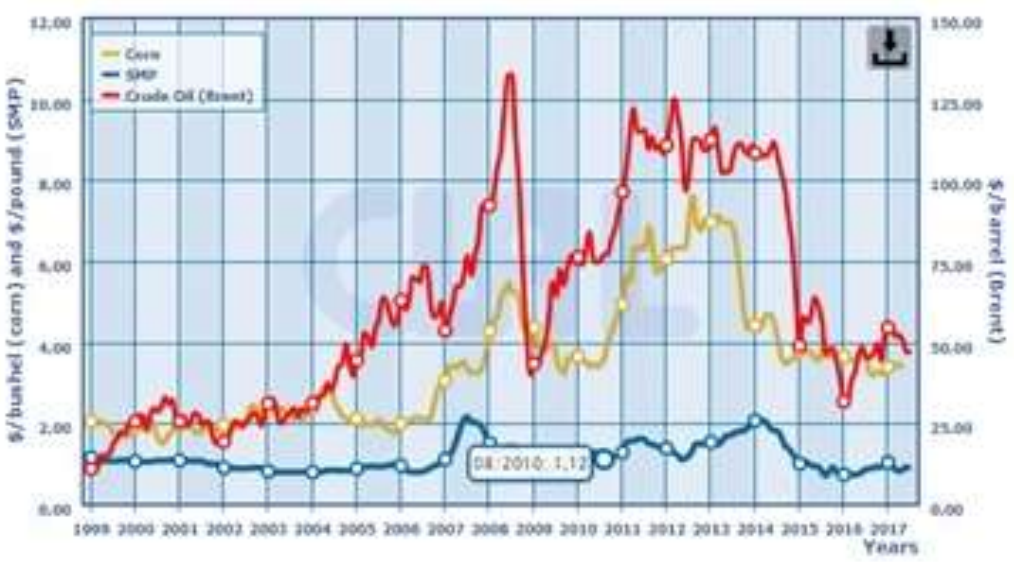

Figure 2. **USA - Comparative historical overview of the prices of Corn, SMP and Crude oil**

This results in an increase of agricultural commodity prices. The alternative use of land has caused the price of wheat and maize to increase in the period, creating as impact the difficulty of access to food to poorer world populations whose survival depends on these cereals, as well as of farmers due to the increase of feed prices. Thus the impact of oil price growth has the consequence to favour the impoverishment of the poorest populations for the above interference between oil and agricultural markets.

These trends have now become cyclical, and their beginning, end, extension, and intensity are unpredictable, and affect the landscape-environmental mosaic of many countries with a trend that the external observer considers erratic. The primary causes of these trends have not yet been identified. The formulating hypothesis can be traced back to the expectations of optimism or pessimism about the price trend of raw materials that trigger long-term decision-makers.

Last not least, in addition to market interference, unpredictable events have occurred due to weather and climate trends. From 1980 to 2015, only in the United States there were 188 meteorological and climatic disasters: 23 droughts, 22 floods, 7 frosts, 75 tropical storms, 34 cyclones, 11 violent fires, and 14 winter storms. Direct damage has exceeded $ 1 billion, but the total cost of these 188 events is more than $ 1 trillion for the United States alone (Smith, Matthews).

A tripartite Lotka-Volterra Model, and the antagonistic forces on the market

The global market is dominated by antagonistic forces or actors: Multinational corporations, Ecological movements, and national or supranational Governments.

Figures 3 and 4 represent the two stages or phases of the interpretation of the Lotka-Volterra antagonist tripartite model: the first is characterized by the dominance of market forces and the second by the claims of the ecological movement (Piccinini et al., 2015). In the Phase I, the Market is the predator and pushes the Government to alleviate environmental rules and behaves itself as free rider while Ecologists are the Prey, which as a reaction protests and creates environmental protest movements (Fig. 3).

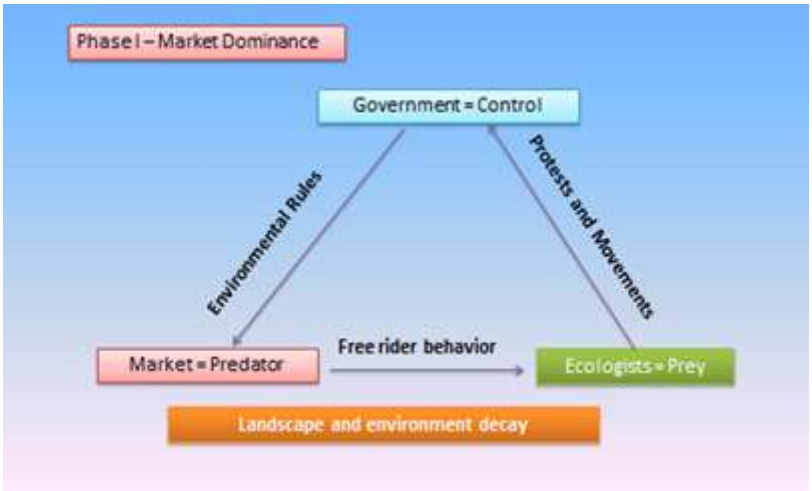

Figure 3. **Examples of interpretation of the tripartite Lotka-Volterra antagonist model – Phase I**

As a result of this loosening of ecological controls, the landscape and the environment undergo a decay. Afterwards their activity creates instability and chaotic fluctuations in the markets of natural resources and raw materials with uncertain indirect effects on the landscape-cultural mosaic.
In Phase II, there is on the contrary the predominance of ecologists that become the predator on the market. They make electoral pressure on the government to tighten environmental rules and make them unsustainable from an economic point of view. The market thus becomes prey and the ecological degrowth campaigns lead to market crises and under-employment (Figure 4). The possibility of obtaining "ecofriendly" fuel from agricultural commodities has been made possible by technological advances which in turn have been considered economically advantageous by the market. In fact, the price of oil represents and has always been a benchmark for assessing the economic viability of maize or other vegetable oils. Additionally, national, European and

international policies have promoted the use of traditional fuels for biofuel increasing quotas. Inevitably, the combination of these effects has been affected and will increasingly be affected by land use and landscaping in feedback. On consequence, it is not possible to determine which scenarios will most likely be affected by production choices that are ultimately based on global market conditions and ecological movements through government policies. This latter seems the tool able to reconcile market with ecological instances.

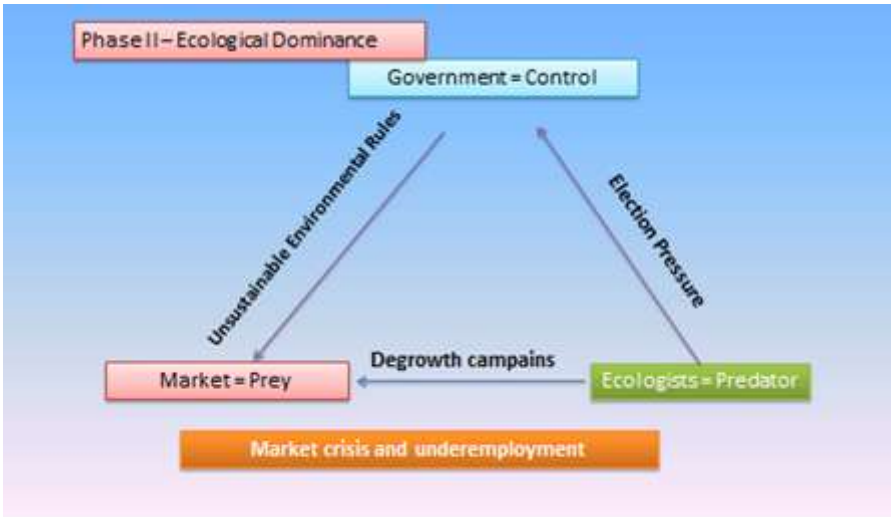

Figure 4. **Examples of interpretation of the tripartite Lotka-Volterra antagonist model – Phase II**

If the actors were two (predator and prey), there would be the assurance that the model would lead to an equilibrium (Piccinini et al., 2016). In the case of three or more actors, with the addition of the government, large deterministic chaos is determined, as the Games Theory (Volterra 1931; Lotka, 1925; Von Neumann and Morgestern, 1944; Predetti, 1967) also supports.

The horn of the dilemma is that the speed of action of the two main actors is very different. There is a contrast between the speed of financial and ecological actions. Financial operations are very fast and work quickly, creating immediate repercussions, while ecological actions are only effective in the long run, and their impact on the landscaping mosaic is very slow and delayed with respect to the cause. The role of the government is initially to follow the claims of an actor and, at a later stage, those of another actor, thus creating a further factor of instability. At the end of the two phases, the phase I begins again, followed by phase II to infinity without the vicious circle being able to stop. It follows that the overlap of the three actions, with different times, creates a system that even in the simplest cases leads to chaotic situations, unless some particular combination of factors.

Some final considerations

The landscape-environmental mosaic is inevitably the victim of forces that tend to modify it. These forces derive mainly from the combined effect of the market perturbed by the multinational corporations and technologic progress, of the ecologist movement claims, and of government policies, adopted at national and international level. The impacts of this combination may be both local and pervasive, and thus not strictly localized to specific areas; moreover they can expand assuming the erratic character both temporally and spatially.
The structure and composition of landscape-environmental and cultural mosaics depend on a series of events including:
- weather and climatic disasters;
- the performance of commodity and/or agricultural markets (fruit, wine, etc.) and the interference with the energy market;
- the climate footprint which affects agricultural prices and yields, and in the medium term also land use and soil sealing;
- the impact of multinationals' operations, ecological movements and governmental action depending on the varying speed with which they move.

These are therefore highly complex systems whose evolution is almost completely unpredictable and erratic. Even long-term trends may suddenly be abandoned and replaced by new trends, but it is difficult to determine when and how this will happen.

Summary

Natural resource market is not predictable through standard economic models, and its randomness creates astonishment among operators. Recent example is the oil market whose prices from June 2014 to December 2015 have drastically plummeted and from March to May 2016 suddenly strongly increased. This research approach is mainly theoretical and aims to shed light on: I) the remuneration of natural resources, a neglected topic in the economic thinking; (II) the concept of absolute and relative rent, introduced by Ricardo (omitted in this work); III) how the global market for natural resources is dominated by antagonist forces or actors as a Lotka-Volterra antagonist tripartite model attempts to explain.
The landscape-environmental mosaic is inevitably the victim of those forces that tend to modify it. Their impacts may be both local and pervasive, and thus not strictly localized to specific areas; moreover they can expand assuming the erratic character both temporally and spatially. The structure and composition of landscape-environmental and cultural mosaics depend on a series of events including: a) climatic phenomena; b) the performance of commodity and/or agricultural markets, and the interference of the energy market; c) the climate footprint which affects agricultural prices and yields, and in the medium term also land use and soil sealing; d) the impact of multinationals, ecological movements and governments. This suggests that any predictive model used is extremely complex and provides no certainty about the evolution over time that thus appears unpredictable and erratic.

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