The future of modernized agriculture and the return of traditional techniques

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Abstract

The industrialization of the agricultural sector has resolved, at least in Europe and in the United States, the thousand year-old problem of the lack of food. Unfortunately, during the last years the limits of such an agriculture clearly exploded. The modernized agriculture, in fact, produces negative externalities and it does not assure food safety.

Through our contribution we hypothesize three future scenarios for modernized agriculture. We shall study in particular the one that foresees the conversion to sustainability through the return of traditional techniques. In order to analyze the problem, we shall introduce the Sraffian framework of the "re-switching of techniques". Finally we shall build an original and new model of "re-switching" for the short period.

The aim of our work is to show that, at least theoretically, it is possible that a traditional agricultural technique could be convenient in a context of both low and high profit level.

Key Words: Re-switching of techniques, modernized agriculture, sustainable development

1. The crisis of the modernization paradigm in the agricultural sector

1.1 As is commonly known, economic development has determined a sequence of different societies: the rural one before, the industrial one later and the post-modern one today. Those different societies were modified according to the dominant economic sector (in temporal order: agricultural, industrial and tertiary sectors). The social transformations, produced by the passage from a dominant sector to another one, do not concern only production and exchange relations but the whole society: personal relationships, languages, shared values, aesthetics, *etc.* The centrality of an economic sector is therefore evident in its ability to transform and to make itself similar to its surroundings (Sortino, Chang 2007). When the modernization of the whole society took place, the agricultural sector, although fundamentally different from the industrial one, gradually managed to

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assimilate its principal resources and values. The agricultural modernization model is based on characteristics that belong to the industrial sector: concentration, intensification and specialization (Arnalte *et al.* 2006). At the same time, the agricultural sector has substantially become dependent on modern inputs, external elements and industrial values.

The evaluation of the positive aspects of the industrialization of the agricultural sector is a fairly controversial one. However, we cannot disregard that it has resolved, at least in Europe and in the United States, the thousand year-old problem of the lack of food and the reality of famines. Moreover, the modernization of the agricultural sector has also created a huge agricultural *surplus.*

However, during the last decades the limits of such an agriculture clearly exploded and the modernization model of agriculture has therefore met a crisis point. It produces, in fact, negative externalities, *i.e.* pollution or biodiversity losses. At the same time, modernized agriculture does not assure food safety. This has been proven by a succession of food crisis in the last 20 years (*i.e.* bovine spongiform encephalopathy). It is evident that farmers, in view of the CAP distortions, produce more than required by citizens. The overproduction could be destroyed (with a further waste of energy) or undersold on the international market with unfair dumping policies.

1.2 The modernized agriculture, despite its overproduction and negative externalities, is particularly supported by EU and US agricultural policies. It is well known that in EU more than ¾ of CAP support goes to the biggest 10% of significant beneficiaries of subsidy recipients. In US the distribution model is even more distorted: only 40% of farmers receive any subsidy. Within this group, the richest 5% get over half. The Gini coefficient for government support shows that EU and US subsidy distribution is more unequal than income distribution in the world's most unequal countries, calling into question the idea that subsidies play an important social welfare role (UNDP 2005).The CAP support of European citizens has therefore been reduced since they pay twice the agricultural support: as contributors and as consumers (CAP causes the increase of consumption prices). Last but not least, modernized agriculture is in crisis in view of the so-called *agricultural squeeze* (compression of the agricultural profits) connected essentially to the structural increase of the variable costs and in particular to energetic input costs. As a result, the agricultural modernization model is in crisis and there will be an in-depth change in the agricultural sector.

Through our contribution we hypothesize three future scenarios for modernized agriculture. We shall study in particular the one that foresees the conversion to sustainability through the return of traditional elements and techniques. In order to analyze the problem, we shall introduce the theoretical framework of the "re-switching of techniques" from the *neo-ricardian* theory. Finally, after we have shown two examples of economic models of "re-switching of techniques", we shall

build an original example of “re-switching” for the short period not yet present in the economic literature.

2. The future of modernized agriculture, unsustainability or return to the past?

2.1 In this section we examine three probable future scenarios for modernized agriculture. We connect them to one of the definitions of sustainable development which are present in the economic literature (Tab. 1). The definition we choose foresees a level of both strong sustainability (eco-centered development) and weak sustainability (techno-centered development), as well as endless intermediary levels. Each level is defined by different assumptions as to the replaceability level between the natural capital and the artificial material and immaterial capital (Turner *et al.* 1996 p. 75, Sortino 2007).

A) The first future scenario concerns the “continuing modernization”. Agriculture which is already modernized, through the further incorporation of innovative material and immaterial capital (i.e. new technologies, GMO and scientific knowledge), crosses over to a system which is based on a further specialization and an intensification of agricultural processes. Such a scenario is strongly supported by the agricultural *lobbies* and particularly by the agro-industry system. The agro-industry system is a very involved one. In fact, it receives low-cost commodities from farmers and it sells them the innovative technology (Van der Ploeg 2006). This scenario does not contemplate the reduction of externalities. This could guarantee the increase in technical efficiency and the economic growth of the agricultural sector. The problem though is that rural development is absent.

B) The second future scenario concerns the “balanced modernization”. It is characterized by the prosecution of the modernization processes. This is emphasized by the introduction of innovative technology which is useful in order to decrease the negative externalities and to transform them into resources. Such a scenario fits into the paradigm of the weak sustainable development (or techno-centered development). The most evident example is the case of *biogas* production from animal wastes. It consists of the conversion of externalities (animal wastes) into an energetic resource.

C) The last scenario which has been hypothesized is mostly discussed in this paper. We have called it the “return of techniques”. It implicates the conversion towards the sustainability of the productive activities in agriculture through the return of virtuous elements, techniques and knowledge of the tradition. The traditional elements are suitably readapted to the new productive context (Sortino, Chang 2007). In the §3 we analyze in depth this scenario. We believe that it is the most appropriate to represent the (European) model of multifunctional agriculture, which should be based on both production (*i.e.* safe food or landscape) and reproduction (of fertility or biodiversity).

2.2 The causes that force modernized agriculture to return to the past are linked to the elements of crisis that we have already discussed (agricultural squeeze, pollution, overproductions). In any case, other factors do exist, in particular the change of food consumption models: it depends on: 1) the increase in *per capita* incomes; 2) the increase in education level; 3) the precautionary principle adopted by consumers because of the food crisis during the last decades. Last but not least, the CAP reform is another cause that forces modernized agriculture to accept past techniques, through the financial resource relocation towards the second pillar (rural policies). The "return of techniques" scenario could be inserted in a theoretical context of strong sustainable development (or eco-centered development) which is connected to production de-growth. Obviously, the quantitative de-growth is not always linked with worse economic performances. In fact, products from *tradition* generally have, in post-industrial economies, more elevated prices. Therefore, within this context of rural development that is without quantitative growth the term "post-productivism" is the perfect synonym of "post-industrial".

Future of modernized agriculture	**Sustainability of development**
Continuing modernization	Economic growth without rural development
Balanced modernization	Techno-centered development
Return of techniques	Eco-centered development, quantitative de-growth

Tab. 1 Future scenarios of modernized agriculture

For a clearer presentation we have considered the three future scenarios of modernized agriculture as though they were clearly distinguished. Realistically speaking, we can find typologies of agriculture where modern unsustainable elements, modern sustainable elements and virtuous elements of the past are contemporarily present but with a different intensity that above-all characterizes a background tendency for rural development.

3. Return of techniques: searching for an economic framework

3.1 The phenomenon of the return of techniques in modernized agriculture is immediately perceived both in agricultural censuses and in qualitative analysis (*i.e.* farm visits, interviews *etc.*). In a preceding paper by the authors (Sortino, Chang 2007a) some indicators of the return of techniques have been underlined. For example: a reduction of synthesis products which are used in agriculture, expansion of organic agriculture; increasing the demand of traditional/typical products.

The attempt to frame the return of techniques within economic science has allowed us to analyze three examples which are present in the economic literature and which derive from the framework

of "*re-switching of techniques*" (Sraffa 1960). We believe that this framework has an important heuristic potential in explaining the processes of re-conversion of modernized agriculture through the return to sustainable elements of the past. Such a *framework* originates from the challenge of Sraffa to disprove the validity of the marginalist approach in the explanation of some anomalous phenomenon regarding capital and production (Marzano 1975).

3.2 Sraffa pointed out that a production technique may be competitive both at a relatively low and high rate of profit, but may be dominated by another technique for intermediary rates of profit. It is not reasonable, as the marginalist economists affirm, that by decreasing the profit rate the system will move towards more mechanized techniques with a higher proportion of capital on labour.

As is commonly known, traditional and sustainable agricultural techniques (*i.e.* crop rotation) are often profitable in weak and marginal typologies of agriculture. These techniques have been abandoned in the typologies of modernized agriculture in order to obtain greater profits. The following examples of "re-switching" intend to show that, at least theoretically, it is possible that traditional techniques can once again be found to be convenient in modernized agriculture for the expectation of obtaining higher profits. The first example of the re-switching of techniques (Fig. 1) was proposed by Samuelson (Samuelson 1966). He hypothesizes two different investments in order to produce the same product. The first investment produces 18 units of product in the first period, 0 units in the second period and 54 units in the third period. The second investment produces 63 units in the second period and 0 units in the first and in the third period. As can be deduced from Fig. 1, the first investment (continuous line) is more convenient up to *i=0.5*, the second investment (dotted line) subsequently becomes more convenient. From *i=1* the first investment again becomes preferable.

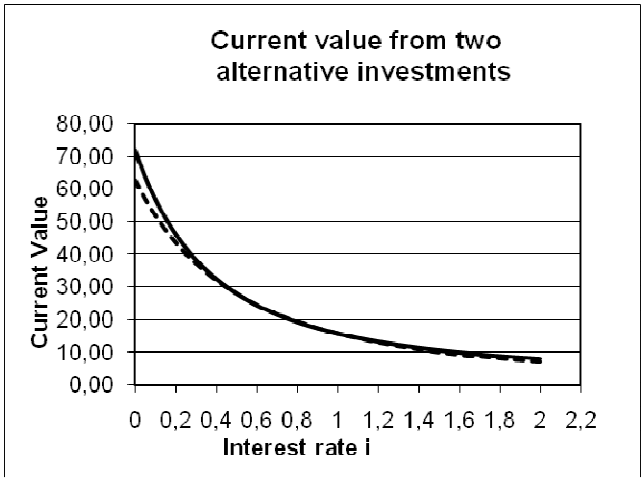

Fig. 1 Re-switching of techniques: Samuelson's example

This example is not very realistic if we consider the length of the period which is equal to one year. The interest rates when the techniques switch (50% and 100%) appear, in fact, not realistic during the short period. Samuelson's example is consistent if we adopt a longer temporal horizon, i.e. a ten or twenty-year period.

An example of the re-switching of techniques during a short period is present in literature: Ricossa's example (Ricossa 1982). Ricossa considers (Fig. 2) two different flows of income, indifferently positive or negative for three years (first year: 6, -10 e 0 and second year: -25/3, 100 e -500/3). He does not consider a generic period as Samuelson did. The interest rates when the techniques switch, as noted by Ricossa, correspond to i=100% and i=500%. During the short period, such interest rates appear to be unrealistic.

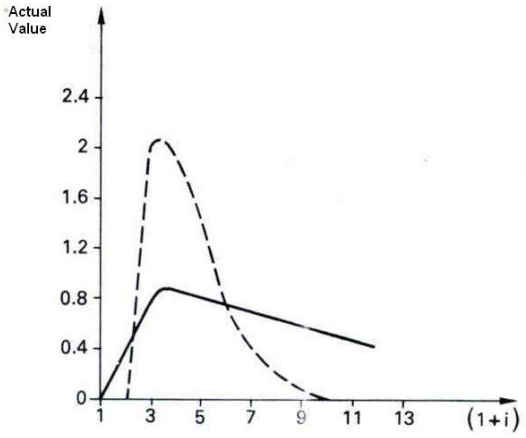

Fig. 2 Re-switching of techniques: Ricossa's example

4. The solution of Samuelson's example for the short period

It is however possible to construct examples that are meaningful also in the short period, as Piccinini's example shows us: we consider two alternative investments for three periods (years). The two production functions have a common *plafond* with values R_1, R_2, R_3 with the differential outputs U_1, U_2, U_3; V_1, V_2, V_3 which have been added. The first outputs are therefore: $R_1+ U_1$ (first year), $R_2+ U_2$ (second year), $R_3+ U_3$ (third year); the second outputs are instead: $R_1+ V_1$ (first year), $R_2+ V_2$ (second year), $R_3+ V_3$ (third year). The example is built with $U_1>0$, $U_2=0$; $U_3>0$ and $V_1=0$, $V_2>0$; $V_3=0$. For every parameter $\varepsilon>0$ we can determine U_1, V_2 and U_3 so that the inversion of the techniques happens when the interest rate is 100ε and $3*100\varepsilon$. We mean that the first project is more convenient for r between 0 and 100ε the second for i between 100ε and 300ε, and the first one once again for i greater than 300ε. We can see the following in Piccinini's example:

$$\begin{cases} U_1=1 \\ V_2=2+4\varepsilon \\ U_3=1+4\varepsilon+3\varepsilon^2 \end{cases} \qquad (1)$$

If ε=0.05 we have: U_1= 1; V_2= 2.2; U_3=1.2075 and the interest rates when the techniques switch are equal to 5% and 15%. Taking $R_1=R_3=0$; $R_2=0.9$ we will find that the first investment produces 1 units in the first period, 0.9 units in the second period and 1.2075 units in the third period. The second investment produces 3.1 units in the second period and 0 units in the first one and in the third period. As one can deduce from Fig. 3, we have built the curve of relative actual value (Investment 2/ investment 1). When the relative actual value is equal to 1, it will be the point where techniques switch. It is clear that in this case the switch-points are equal to *i*=5% and *i*=15%. The first investment in fact is more convenient up to nearly *i*=5% and it becomes preferable after *i*=15%.

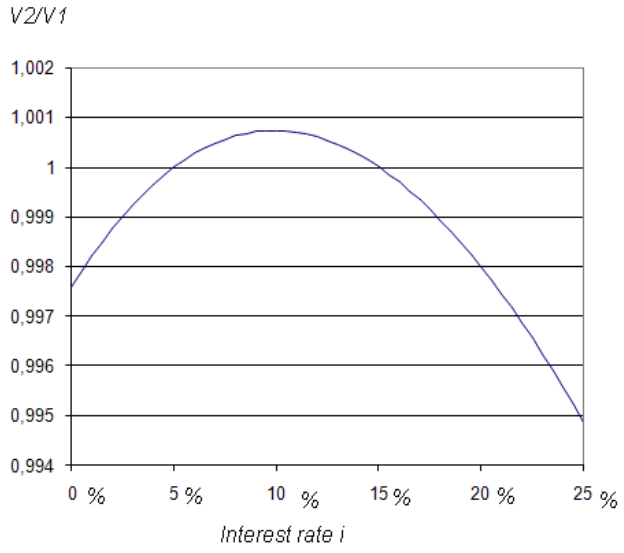

Fig. 3 The curve of relative actual value (Investment 2/Investment 1) in Piccinini's example

5. Some concluding remarks for the debate

Generally speaking, our opinion is that the "continuing modernization" and the "balanced modernization" future scenarios may not have a long term economic and environmental sustainability. The return of traditional techniques may help the modernized agriculture to find the "lost virtuosity" and the environmental sustainability. The principal conclusions of our study are the following: a) the Sraffian model of the re-switching of techniques is based on a coherent and logical theoretical structure. B) Samuelson's example (long period) and Piccinini's one (short period) have realistic values and are in line with real investment choices. Finally, we have demonstrated that, at least theoretically, traditional and sustainable techniques could be convenient in a context of both

low and high profit level. The crisis elements of modernized agriculture, the new agricultural policies and the new consumption models, that have been hereby discussed, could provoke re-distribution effects of profits which are capable of encouraging the return of traditional techniques. The discovered tools will be used in the continuation of this research in order to ascertain the entity and the importance of the return of techniques in the future of modernized agriculture.

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