

Working paper

2014-12

NOVELTY, HYSTERESIS, AND GROWTH

Mario Amendola

Università degli Studi di Roma "La Sapienza"

Jean-Luc Gaffard

*OFCE Sciences Po, Skema Business School
and University of Nice Sophia Antipolis*

May 2014

ofce

Novelty, hysteresis, and growth¹

Mario Amendola

Università degli Studi di Roma "La Sapienza"

Jean-Luc Gaffard

OFCE Sciences Po, Skema Business School and University of Nice Sophia
Antipolis

Abstract

Novelty and hysteresis are the main engines of economic evolution. However, they are also at the origin of co-ordination issues, as the consequences of any innovative choice can never be fully expected. Thus, there is no sense in analysing economic change as an intertemporal equilibrium with rational expectations. Not only growth and fluctuations cannot be dissociated, but there is no long-term trend that would be independent from what happens in the short-term. The explicit consideration of essential evolutionary phenomena like novelty and hysteresis help a clearer understanding of some important episodes of contemporaneous economic history. The periods considered are characterized by crises and structural changes, and it is exactly when important disturbances affect the functioning of the economies that the relevant features of their behaviour come to the surface and hence the right interpretations of the phenomena taking place, with the adequate policy implications, can be formulated.

¹ This paper has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 320278 (RASTANEWS).

INTRODUCTION

While focussing on themes like technologies and institutions evolutionary economists have often abstracted from rigorous economic analysis. When this is not the case they have turned mainly to orthodox economic theory, especially when the latter has apparently considered the above-mentioned issues, but actually deprived them of their essence by casting them into its analytical mould. This has certainly obscured the comprehension of the problems of economic change that are at the heart of the working of capitalist economies.

However, there are economists that have not fallen into this trap. Two of them need in particular to be mentioned, namely, John Richard Hicks and Nicholas Georgescu-Roegen, as they have been able to deal with typical evolutionary problems without giving up a rigorous analytical approach.

We are both of us evolutionists, but not straight-line, or ‘exponential’ evolutionists. It is the *new* things that humanity has discovered which makes its history exciting; and the new things that may found in the future, before humanity blows itself up, or settles down to some ghastly ‘equilibrium’, make a future worth praying for, and worth working for. (Hicks [1974], [1982] p. 300)

These authors might be labelled as heterodox when considering what has become today the dominant economic theory. But this is certainly not the case when we consider that they actually walk in the threads of the great economists that have traced out the evolution in time of economic theory. What is then the reason why their contributions have been put aside, when not completely made to disappear? The reason, we believe, is the emergence of a way of doing theory that has ended up abstracting from essential evolutionary problems like *novelty* and *hysteresis* that are instead at the heart of these contributions.

Modern economic analysis moves from the philosophic view that it is possible to clearly understand the functioning essentially rational of the world, and hence establish an order (of economic behaviours and institutions) as the result of this understanding. However, this view abstracts actually from phenomena like the emergence of novelties and the process of hysteresis, which imply that « however

large the number of observations, the effect of the last experiment can be known only after we observe what we wish to predict » (Georgescu-Roegen [1971] p. 126).

This consideration blurs the very method of contemporaneous @causality that is at the heart of the ‘equilibrium’ analytical framework: a method which allows to define a state of the economy as its natural way of being and functioning and that implies that a certain effect is automatically associated with a given signal (e.g., a greater revenue implies more consumption, higher costs imply higher prices...)

The natural reference of novelty and hysteresis to change and processes taking place step by step shifts in fact the focus from the logical time of the world of equilibrium states, an arbitrary accounting period whose length is not relevant, to the historical time, where different evolutions of the economy are possible. In the latter context, in particular, inputs are dissociated *in time* from outputs and costs from proceeds, thus casting heavy doubts on standard production and consumption theories. But, as we shall see in the next pages, other consequences follow from the consideration of novelty and hysteresis. The distinction between a ‘positive’ and a ‘normative’ approach takes on a different meaning. The co-ordination of economic activity, assured by assumption in an equilibrium context, becomes the crucial problem to be solved for the viability of the economies. Money can no longer be considered as neutral as it appears as a main actor of the co-ordination process. The very distinction between short and long term fades away, as the last appears just as the result of a related sequence of short terms, as well as the distinction between growth and fluctuations, where the latter become just the way of being of the former.

THEORY AND NOVELTY

It is for its dogmatism, not for its use of abstraction that standard economics is open to valid criticism. Casual observation of what happens in the sphere of economic organizations, or between these organizations and individuals, suffices to reveal phenomena that do not consist of *tâtonnement* with given means towards given ends according to given rules. They show beyond any doubt that in all societies the typical individual continually pursues also an end ignored by the standard framework: the increase of what he can claim as his income according to his current position and distribution norms. It is the pursuit of this

end that makes the individual a true agent of the economic process.

Two are the methods by which he can pursue this particular end. First, he may seek ways by which to improve *qualitatively* the means he already possesses. Secondly, he may seek to increase his personal share of the stock or flow of social means, which is tantamount to changing the prevailing distributive relations. It is because even in a socialist society the individual activity is in the long run directed towards these aims that new means are continually invented, new economic want created, and new distributive rules introduced. (Georgescu-Roegen [1966] p. 105, [1971] p. 320).

Thus the economic discipline, traditionally aimed at analyzing how given economic means can better pursue given economic ends, and what this implies in terms of the distribution of income and wealth, ought rather focus on the process by which new economic means are created in order to pursue new economic ends: it is in fact the emergence of novelty that actually determines the history both of individuals and the society. The reason is that “evolutionary elements predominate in every concrete economic phenomenon of some significance” (Georgescu-Roegen [1971] p. 320).

The novelty we are talking about is not a simple projection towards a future rationally anticipated moving from current data, though. It is instead the effect of the experience accumulated along the way: the effect of the hysteresis.

As a matter of fact, contrary to what the standard economic theory purports, the economic process is not a mechanical phenomenon, and as such it cannot be defined by the laws that make its variables to depend on a time measured by a mechanical watch.

The idea that the march of the entire economic process can be described by a system of differential equations with clock-time as the independent variable – an idea underlying many macro-dynamic models – is in all probability vitiated *ab ovo*. (Georgescu-Roegen [1971] p. 139).

Novelty, according to Georgescu-Roegen, has a precise meaning. It means that the economic process cannot be fully determined by its initial conditions or, let alone, by rationally anticipated future conditions. What happens along the way, the learning, the

articulation step by step of decisions and arising constraints, actually determines the evolution of the economy. The hysteresis cannot be dissociated from the novelty.

Novelty, on the other hand, is what allows to clearly understanding the difference between the concept of risk and that of uncertainty, introduced by Knight and elaborated by Keynes. While a risk is associated with a state characterized by a certain probability, the result of uncertainty is a radically new situation. While a result associated with a certain probability can be a reference to rely upon, the surprise deriving from novelty cannot be dealt with *ex-ante* but must be taken care of step by step.

The point bears upon Shackle's original idea ([1949], [1955]) of analyzing expectations in terms of the degree of surprise caused by their realization instead of the degree of belief in their outcome. In one respect the idea has a definite merit. While the occurrence of any event for which there is an *ex ante* degree of belief will cause a degree of surprise (the greater the smaller is the degree of belief), for a truly novel event there is an *ex post* surprise but no *ex ante* belief in it. (Georgescu-Roegen [1971] p. 123).

In this light, growth appears as a quantitative phenomenon distinct from development interpreted as a qualitative change.

In the literature, we (...) find the right starting point for a physiological analysis of economic change. It is a distinction upon which Schumpeter, with his characteristic flair for what is analytically relevant, repeatedly insisted. The idea is that any economic change consists of entirely distinct types of phenomena – *growth* and *development*. As Schumpeter defined it, development consists of a 'spontaneous and discontinuous' change that comes from *within* the economic process because of the very nature of that process. This change consists of some entirely new ways of combining the productive forces and materials, briefly, of new methods of production. Such a novelty changes the face of economic world forever, that is, in an irreversible and irrevocable manner (Georgescu-Roegen [1974], [1976] p. 243).

While it is always possible to define and measure growth by a quantitative index, it is the continuous emergence of novelty that determines the effective evolution of market capitalist economies.

NOVELTY AND CAUSALITY

The essence of modern economic analysis is to define causal relations, which is not possible singling out as those actually leading to given observed facts. And « with a bewildering variety of possible models to choose from, one can reasonably ask what could constitute the verification or the falsification of a particular model » (F. Fisher [1991] p. 211). The test of the relevance of a particular theory is then that « one can use it to tell a logical consistent story of what *might* have happened – a story consistent with the few facts that the theorist happens to know » (ibid.).

Contrary to this approach, the focus on qualitative changes, at all unforeseeable, does not allow referring to a given logical frame from which all sorts of propositions could be deduced and hence figuring out laws of evolution functions of clock-time.

This is why economics cannot be considered as a *theoretical* science (Georgescu-Roegen ([1966], [1971])). It is a *discipline* (Hicks [1983]). Its fundamental principles derive from the institutional setting. “Without this institutional content, the principles are nothing but ‘empty boxes’, from which we can only obtain empty generalities” (Georgescu-Roegen [1971] p. 324). In other words, there are not economic laws that only the existence of institutional imperfections hampers from being fully applicable. Outside a specific institutional content - and, we would add, without reference to the specific features that the economic phenomena each time considered take up in this context – the application of these laws is not only senseless but, as we shall see, also a threat to the viability of the economies and the societies concerned.

Laws of supposed general validity, where the variables involved are a function of clock-time, are based on a particular notion of causality: the *contemporaneous causality* as opposed to the *sequential causality* (Hicks [1979]).

Contemporaneous causality is the relation that characterizes the equilibrium analytical models, including intertemporal models: that is, models referred to economies which function in an established way. It comes directly from the relation between economic magnitudes that classical economists figured out to replicate the general and immutable character of the ‘ laws’ of physics and other sciences

Adam Smith (...) is saying that the relative cheapness of water transport is a cause of the relative wealth of some places that have good water communications. He is thus (in terms of our analysis of causality) comparing what was in his time with what *would have been* if, other things being equal, the relative costs of land and water carriage had been different. He must thus be thought of as

constructing a theoretical model, in which relative costs are changed but other things are not changed. What was in time is what was in his lifetime, or over the time his memory extends – quite a long period. The model must refer to the same period. But since it is only the things which in actual experience remain, more or less, unchanged over time which are relevant to the comparison, it would seem to follow that the model itself must be unchanging. Change over time, within its period, cannot enter into it, since such change is irrelevant to it. That is the first sense in which the model must be in equilibrium. (Hicks [1979] p. 45)

Such causality implies that it is always possible to deduce a given effect from a certain cause, so that they become analytically contemporaneous. This doesn't mean not to make reference to time but that in the perspective adopted the time dimension is not relevant. In this perspective in fact, with reference to the phenomenon of production, although differently dated, inputs do not come before output 'in an essential way'. That is, they are analytically, and from an accounting viewpoint, contemporaneous, in the sense that there are always proceeds against which costs can be set and a 'current' productive activity out of which they can be financed.

Sequential causality implies instead that a given effect is dissociated in time from a certain cause 'in an essential way', in the sense that it may or may not result from it according to what happens during the lapse of time between the two. It is the causal relation that characterizes evolutionary and sequential models, which are aimed at analysing the evolution of economies out of equilibrium, that is, while undergoing a process of change.

In the world of contemporaneous causality constant laws determine the relations between the events. An increase in income implies a greater consumption. Higher costs bring about higher prices. A given effect is always associated to a certain signal, with reference to a time that is an arbitrary accounting period whose length is not relevant.

Sequential causality, on the contrary, denies the existence of constant, reliable laws. Multiple and possibly different evolutions of the economies may come about depending on what happens along the way, namely, depending on the sequence of the decisions taken step by step, and the sequence of the constraints deriving from them.

These decisions appear then as the heritage of the past and the determinants of the future.

The time lags are essential in this sketching out of the evolution of the economy: the prior lag, which is the lag between the signals coming from the market, or the authorities, and the decisions taken as a result; the posterior lag, which is the lag between these decisions and their realization. These lags may be very different,. In particular, the prior lag is tricky. “For the objective cause does not necessarily compel a reaction; it is (as often been said) a ‘signal’, and the reaction to the signal may be fast or slow” (Hicks [1979] p. 90). Higher incomes do not necessarily imply a greater consumption, both because consumers wait to know more about the reliability of the signal received and because the goods that they would like to demand in greater quantities are not disposable at the moment. Higher costs may not mean higher prices, because before increasing their prices the producers could prefer to see what the competitors would do or because they are bound by long-term contracts with their clients and prefer to reduce their profit margins rather than risk to loose market shares. Reserves become an important ingredient of the decision process.

The absence of reserves, either in the form of liquid assets or of assured borrowing power, is a severe constraint on freedom; it must therefore be expected that the decision-maker will seek to remove it, if that can be done at reasonable sacrifice, so far as he can. So the characteristic form of a modern economy is one in which many of those who make decisions have some reserves. They are accordingly not bound to respond to the signals; even if the signal persists, they have time to react. So the signal is less imperative, and therefore less dependable. (Hicks [1979] p. 91)

Thus, stocks may act as buffers between physical inflows and outflows, and between financial income and expenditure flows (Leijonhufvud [1973]). In particular, stocks of liquid assets allow expenditures to be maintained when revenues fall off. Thus real world economies could be more robust than pure flow models would suggest. However, if disturbances are of an unanticipatedly large magnitude, buffer stocks may be exhausted and a tight income constraint takes over.

Moreover, the role of real and financial stocks is ambivalent. On one hand, they may effectively act as buffers. On the other hand, they may reinforce the multiplier effect. Debts may act as buffers as well as they may amplify demand constraints. Thus, deflation increases the real value of existing debt, and the price effects may

themselves be deviation amplifying. An increasing indebtedness of households, which may hide, for a while, the effects on output of large displacements of potential demand, will end by affecting current spending, when it appears that these households are insolvent.

Clearly, given technologies and/or preferences cannot univocally determine production and consumption paths, and hence the evolution of the economy, as standard economic models purport.

PRODUCTION

Production is a matter of organization rather than of technology. The commonplace representation of this phenomenon can be relied upon only in the particular contexts of general equilibrium or steady growth. In these contexts the production function is defined as the frontier of the set of possible productive combinations. This definition results from an efficiency axiom. The representation of production is in fact fully assimilated to the economic problem that it evokes, that is, the choice of the optimal allocation of productive resources. Production appears as a pure technical phenomenon; neither its time dimension nor its organizational one is taken into account.

The real story is a different one (Georgescu-Roegen [1971], [1976]). The production process is characterized not only by its inputs and outputs but also by the length of time over which it extends. The inputs and the outputs themselves are defined over time. According to Georgescu-Roegen, the elements that characterise an elementary production process are better divided into two categories: the flow elements (natural resources, intermediary products) that enter *or* leave the process (they are destroyed or created), and the funds elements (equipment, machines, human capital) that enter *and* leave the process. The main problem, in relation to any given elementary process is that the fund factors involved in may remain idle during a great part of the production time. When prevailing, this idleness prevents from investing in fund factors and taking advantage of a further division of labour, which slows down growth. Efficiency requires a specific arrangement of a number of elementary production processes, which is the way to reduce the idleness of fund factors. Thus, the industrial organization of production processes that consists in arranging production stages in such a way that all stages are simultaneously carried out

(production in line) allows to minimize the idleness of equipment, thus being the source of static efficiency. Introducing this organisational dimension in the analysis of production prevents from considering the production phenomenon as a purely technical one as it is the case with the production function.

The standard production function, in which any reference to the time dimension of the production process vanishes, is only relevant in the particular context of a complete synchronisation of the different stages of production. This, however, requires a large scale of production and hence a corresponding size of final demand. Only then the supply and demand conditions are met, costs and revenues are synchronised and labour productivity can be considered as reflecting the properties of technology. But this state is only a benchmark, which corresponds to a specific organisation of production and that calls for a specific institutional context.

One might maintain that this is the case of market capitalist economies. But it is not so. In the attempt to assure the maximum efficiency in the use of existing resources, which is never fully satisfied, the industrial organization continuously creates incentives to innovate, thus reducing static efficiency in order to promote dynamic efficiency.

What actually happens, then, is that inputs are dissociated from outputs and costs from receipts. These distortions are transmitted over time making the evolution of the economy to depend on what happens step by step.

Let us consider, for example, the case of a major innovation characterized by the fact that the construction cost of a new productive capacity exceeds the replacement cost of the existing one, more than counterbalanced, of course, by a reduction of its utilization cost and an increase of its efficiency (Hicks [1973]). With given resources, the investment measured in units of productive capacity is reduced due to the increase in the unit construction cost. If wages are fixed, at the end of the construction period of the new productive capacity there will be a lower productive capacity in general, which will result in a fall of gross output and then in unemployment. This, we may recall, is the case of Ricardo's machinery effect (Ricardo [1951]), which shows how the unemployment resulting from technical progress is not due to the specific features of the new technology introduced, superior by definition, but to the economic conditions of the transition process from the old to the new technology. With flexible

wages, and full employment, the increase in construction costs will nevertheless bring about a fall of gross output, associated now with a fall in labour productivity, which will no longer measure the efficiency of the technology but the difficulties of the transition.

Thus, while in a state of equilibrium the productivity of labour reflects that of the technology, under the axiom of efficiency, out of equilibrium it is dissociated from the latter and reflects rather the economic conditions of the transition between technologies, which depend mainly on the prevailing institutions.

CONSUMPTION DECISIONS

In the same way as production, consumption has a time dimension, which we cannot abstract from. As a matter of fact consumers' choices cannot be analysed simply by assuming that they obey axioms establishing the coherence of preferences, without taking into consideration the existence of effects of hysteresis.

The indifference map (the order of preferences) of the consumer changes when he experiments a combination of goods that does not belong to the combinations set already experimented in the past. It changes *a fortiori* when a new good is introduced. When his income goes up the consumer does not increase his consumption of all the existing goods in the same proportion: he extends his demand to a greater gamut of goods so as to satisfy new needs.

Preferences are not homothetic, which reveals an essential dimension of evolution.

According to this model, at a given position (M1), the consumer has a definite demand (D1) for X. if a change in price brings him to a new position (M2) capable of altering his indifference map, his demand for X will implicitly be changed in a new curve (D2). Save for a irrelevant coincidence, no new shift in prices alone could bring the consumer back to the former position (M1). This irreversibility (...) appears with this model to be the normal case, whereas reversibility is the exceptional one Georgescu-Roegen [1950], [1966] p.179).

And the fact that new experiences may push consumers to change their preferences hampers from calculating a general equilibrium assuring an optimal allocation of resources. A 'demon of Laplace' could not be able to do it because any answer given to him *ex ante* could reveal itself wrong *ex post*.

The equilibrium computed by our demon is (...) defeated not by interventions of exogenous factors but by endogenous causes. Consequently, our demon will have to keep on recomputing running away equilibria, unless by chance he possesses a divine mind capable of writing the whole history of the world before it actually happens. But then it would not longer to be a 'scientific' demon. (Georgescu-Roegen [1966] p. 119).

The phenomenon of hysteresis and the complementarity of successive utilities hampers the consumers from establishing an optimal level of savings and thus to maximize an intertemporal utility. Two hypotheses underlying this kind of calculation, in fact, are not verified: the hypothesis of stationarity of the intertemporal preferences and the hypothesis of independence of successive utilities implying that the utility function has the shape of a sum of separate utilities (Hicks [1965] pp.251-63).

Not being able to compare all possible alternatives, the consumer makes his choices each time comparing the utility of the good he intends to buy with the marginal utility of money as resulting from past experience. This solution, suggested by Marshall, is only valid in an essentially stable environment.

But when income is changing (or when many prices are changing) it becomes less reliable. It is based on the past; when the present is seriously unlike the past, it becomes a less reliable guide. The *lags* with which consumption responds to a change in real income, though they are partly a matter of constraints set by commitments (including as commitments the possession of durable goods), must also be a matter of the time which is taken for the marginal utility of money, as it appears to the consumer, to respond to change. To make fully rational decisions in fundamentally new conditions is by no mean easy (Hicks [1976], [1982] p. 286).

Novelty and hysteresis cast heavy doubts on the axioms on which the standard theory of the preferences is based. The choice made according to the latter are in fact no longer coherent once strong variations affect individual incomes and/or the structure and the level of prices.

NORMATIVE ECONOMICS AND POSITIVE ECONOMICS

The models of modern economic theory belong to the normative 'welfare economics' – whose task is exactly to define a measure of the welfare and to establish the

conditions of its maximization – rather than to positive economics. This branch of economic analysis is aimed in particular at identifying an equilibrium describing the position of the economy at all times

The equilibrium assumption is included in the way the theory is set up. This is certainly so if we define our social optimum by some sort of ‘social welfare function’; for if we do that, we are treating the economy *as if* it consisted of a single ‘individual’; it is the equilibrium choice of that single chooser which is the optimum choice. And the position does not seem to be radically different if we insist on pluralism, as for instance when we ‘reconcile’ the maximisation of utility by ‘distinct’ individuals by compensation devices, so long as the maximisation of utility by each individual is kept as one of the conditions of optimization. A static welfare optimum has to be an equilibrium (Hicks [1985] p. 13).

Focussing on a point or a path of equilibrium determined by the optimizing behaviour of a representative agent exempts from investigating the stability of this equilibrium, that is, the convergence towards it starting from a given disequilibrium state, since in the perspective adopted, the economy is by definition in equilibrium in each point of the trajectory followed: an equilibrium that corresponds to an individual optimum.

The facts that are observed are supposed to be the result of this behaviour. The evolution of the economy can be regular, or undergo fluctuations when the consumer reacts to exogenous stochastic shocks, as is the case with the real business cycles theory.

In positive economics, on the contrary, the equilibrium point or path is a particular position of the economy which may be attained or less starting from a given disequilibrium position.

It is necessary, if the equilibrium assumption is to be justified, that we should be able to assert the existence of a *tendency* to equilibrium; and indeed, if the assumption is to be usable, it must be a strong tendency. (Hicks [1985] p. 13).

This distinction between normative economics and positive economics fosters thinking about the very notion of equilibrium and its use in economic analysis. Equilibrium is about the rationality of economic agents (any one acts so as to attain his preferred position), the consistency of their actions, the compliance of their perceptions of the environment with its reality. Thus “an economy is in equilibrium when it generates messages which do not cause agents to change the theories which

they hold or the policies which they pursue” (Hahn [1973] p. 2). This is true of static equilibrium, of long run equilibrium, of intertemporal equilibrium; although the reference to intertemporal equilibrium radically modifies the nature of the concept of equilibrium, which is no longer an attractor – a stationary point (Dos Santos Ferreira [1989]).

The evolution of an economy is the result of what happens in a sequence of moments, along which the economy may be or may be not in equilibrium. The equilibrium at a given moment of time points to a rational behaviour. Every agent acts so as to reach a certain end given the constraints inherited from the past and the expectations as the future events. The absence of equilibrium over the whole sequence of moments means that the expectations have not come true, that some wrong decisions have been taken that cannot be instantaneously, and without cost, reversed. This is fossilized in the formation of non-desired stocks, whether real and/or monetary. At each moment new constraints emerge, and new opportunities appear whose exploration feeds a learning process. The economy sends messages that cause agents to change their perception of the environment. It is clear that such a kind of sequence has nothing to do with an intertemporal equilibrium.

In this light norms no longer obey axiomatic principles. They rather reflect behaviours or attitudes in relation to given events, having a contingent character and changing with the events themselves. They are the result of rules and institutions that evolve with the experience, as well as of political choices that reflect the pressure of lobbies or arbitrates that reconcile conflicting interests.

The aim that these norms pursue is no longer the definition of a social optimum, but the viability of the economy confronted with the distortion that its evolution necessarily implies. The relations between the economic agents – the social interactions – prevail over their individual utility functions (Coase [1978]). The construction of a viable interaction shapes the behaviours of the agents rather than the research of a maximal utility for each individual.

CO-ORDINATION PROBLEMS

The emergence of novelty brings about co-ordination problems typical of an economy out of equilibrium, different from the co-ordination problems arising from the

existence of multiple equilibria. In the first case the very viability of the economy is in doubt, while in the second case the only problem is the sub-optimality of the equilibrium chosen. The discussion on the relevance of endogenous growth models throws light on the point

Endogenous growth theory as it now exists is not well suited for dealing with the deepest adjustment and co-ordination problems raised by technological change, because the general equilibrium framework in which it has been cast assumes away all problems of disequilibrium co-ordination. Not all endogenous growth models are Walrasian competitive equilibrium models, but they are all rational expectations equilibrium models, and the assumption of rational expectations equilibrium implies either that people have no need to adjust to each other as in many representative agents models, or that they have already been provided, by some unspecified mechanism, with a pre-coordinated set of beliefs on which to base their actions. (Howitt [1994] p. 772).

Out-of-equilibrium co-ordination problems were already at the heart of Harrod's growth model [1939], whose principal aim, blurred in its standard interpretation, was to understand what happens when the current growth rate does not allow realizing the entrepreneurs' production and investment plans. When the actual capital stock differs from the desired one, an adjustment is required to take care of a disequilibrium that reflects a lack of co-ordination. The evolution of the economy will then be determined by this adjustment rather than by the properties of the production function. The result, according to Harrod, will then be a global instability. The fact that this result does not seem to go along with the observed facts has been generally imputed to the hypothesis of fixed coefficients of the production function, although in Harrod' model there is not a production function but an investment function, which is a behavioural function and not a technical one. Besides, the global instability is just one possible result out of many others. If, while considering an investment function, adjusting the effective capital stock to the desired one is a long and gradual process, the economy actually remains near an equilibrium path (Hahn et Matthews [1964]).

Whatever the shortcoming of Harrod' model, though, it remains the necessity of the representation of a growth process taking place in real time and stirred by innovation, in order to be able to single out the co-ordination problems arising out of equilibrium. This is what Hicks' model of the Traverse [1973] takes care of. In this model the

Austrian inspired articulation of the production process in real time allows to show the distortion of productive capacity - the fact that its construction phase is no longer consistent in time with its utilization phase – due to the introduction of an innovation, which implies the breaking of a regular growth process and the emergence of unemployment. True, in the specific analysis carried out by the author, an ad hoc hypothesis, that of *full performance* of the economy, allows a continuous matching of supply and demand and the necessary arrival to a new equilibrium where unemployment is fully reabsorbed, thus reducing the Traverse to a predetermined mechanical trajectory, as stressed by Solow.

The Austrian scheme is well adapted to the mechanical job of tracing out the route by which the new process replaces the old. It is possible to keep track of employment as old processes die off and new ones start. But that accounting does not take us very far (...) Professor Hicks is an illustrious addition to the ranks of those who have not go very far with non-steady state capital theory, even though he has some new things to say. The problem is, of course, terribly difficult. There may very well not be any general theorems to prove; even the qualitative results may depend sensitively on precise assumptions about the formation of expectations, the character of technological possibilities, the sociology and social institutions of business decision-making, the volume and composition of effective demand. (Solow [1974] p. 191).

However, this drawback hides the thorough analytical advance that this model implies. As a matter of fact the question is not to know whether it provides an analytical framework able to deal properly with all the features of qualitative changes. But whether it deals properly with one essential dimension of changes characterized by the phenomena of novelty and hysteresis. The crucial point, here, is that unemployment is not the consequence of the specific proprieties of the new technology, but rather a feature of the very process of change: as a matter of fact the result of the sequential interaction of decisions and constraints sketching out this process. The simplifying hypothesis adopted by Hicks, which amounts to make specific reference to a perfect barter economy, doesn't actually affect the basic structure of the model. The effects of a distortion of productive capacity on productivity and employment that the model allows to show emerge in all circumstances and not only in the case of a perfect barter economy. Moreover, the introduction of money into the model allows enriching considerably the understanding

of the essential features and of the viability conditions of processes of structural economic change.

THE MONETARY LINK

As just mentioned, Hicks [1973] has pointed out that fluctuations are possible in a barter economy as the effect of real distortions that affect the profile of production processes, even if full performance is assumed. In a monetary economy, when uncertainty results in a lack of coordination between supply and demand, these fluctuations can be amplified or dampened according to the role played by money and finance.

The introduction of money allows acquiring and diffusing the information, without which the exchanges wouldn't take place. With its coordination role it shapes the evolution of the economy out of equilibrium, and as such may make it viable, avoiding the danger of its collapse. The corollary is, of course, that there is not an attractor determined by technology or the preferences from which the economy cannot definitely deviate.

More specifically, innovation that implies diverting some resources from old to new uses, or simply an acceleration of growth, requires money creation.

Let us suppose that Industry seeks to expand production (...) Inputs come before outputs, so the first requirement is for additional money to pay for the inputs; and if the higher level of production is to be maintained, the money will need to be kept within the industrial sector, to circulate the increased output. ((Hicks [1979] pp. 97-8)

Monetary theory should then be conceived in a way that permits to identify how the financial sector interacts with the real sector in an economy out of equilibrium. It has instead most often been looked at as a portfolio choice, aimed at arbitrating between risk and revenue in the case of different possible events. In this kind of analysis the essence of the concept of liquidity, the most important attribute of money, disappears.

For liquidity is not a property of single choice; it is a matter of a sequence of choices, a related sequence. It is concerned with the passage from the known to the unknown – with the knowledge that if we wait we can have more knowledge. So it is not sufficient, in liquidity theory, to make a single dichotomy between the known and the unknown. There is a further category, of things, which are

unknown now, but will become known in time. These also must be fitted in (Hicks [1974] p. 38-9).

This definition of liquidity, that confers to money its specific attribute, points to the interest of economic agents to know whether today's choice implies or less a greater gamut of future choices. Liquidity, then, is what is provided by the acquisition of "assets more certainly realizable (*that is, convertible into money*) at short notice without loss" (Keynes, *The Treatise Vol II*, p.67)

A firm, which acquires a non-marketable asset – say a new factory, designed and equipped from its own particular purpose – has committed itself to a course of action, extending over a considerable time, which a fairly narrow band of subsequent choices attached to it. It has 'given hostages of fortune'. The acquisition of an easily marketable asset, on the other hand, can easily be revoked. There is not the same diminution of liquidity; the firm is in position that is almost as flexible, after the acquisition, as before it. That, I suggest, is precisely what we mean by saying that the marketable asset possesses liquidity. (Hicks [1974] p. 41-2).

What just stressed clearly implies that the traditional portfolio choice theory is relevant only in the case of a choice made once and for all or in the case in which there are not investment and/or disinvestment costs. This may be the case when financial investments are dissociated from the real economy, and investors abstract from the consideration of the passing of time; but certainly not in the case of innovation. In this case, the entrepreneurs have to make choices, whether concerning physical or financial assets, that take into account the consequences of their irreversibility.

These assets may, however, be cross-classified in what for our present purpose is a more meaningful way. First there are assets which are required for the normal running of the business; I call these *running assets*. Secondly, there are assets which are not normally used, but kept because they *may* be wanted. I call these (in a more general sense) *reserve assets*. (Hicks [1974] p. 46-7).

The running assets may be material or immaterial. They may also be financial assets. They have the specific property to be complementary assets, with the consequence that their efficiency when taken together cannot be imputed to any of them in isolation. The reserve assets are just in a minimal part physical assets, and more generally financial assets like securities or credit lines.

In this light the monetary analysis focuses on the co-ordination needed by the realization of irreversible investments. The monetary policy should then be aimed at influencing investment decisions of this kind rather than inflation rates. Its efficiency depends on the capacity of affecting the liquidity of the firms.

This analytical perspective follows a tradition that goes from Smith to Keynes

Enabling agents to cope with the passage of time and uncertainty about the future are central functions of the monetary system. Different agents have different attitudes towards risk, different capacities for assessing it, for valuing it, and so on, and because it is the monetary system that co-ordinates those agents' activities, it is also through its workings that they seek to overcome what Keynes called "the dark forces of time and ignorance" in whatever ways they deem best for themselves. Today's monetary system provides myriad possibilities, direct and indirect, for linking consumers with producers, savers with investors, and for coordinating their plans, and it is continuously evolving new means of dealing with these matters. (Laidler[2010] p. 5)

There cannot be a co-ordination brought about by the automatic and instantaneous interaction of the forces of supply and demand without a monetary intermediation.

The "as if" auctioneer-supervised "market" whose mechanisms co-ordinate these model economies is thus a metaphor for the actual economy's monetary system and, because its mechanisms are presumed always to work, these models can neither help us understand why real world monetary systems sometimes breakdown, or what might then happen as a consequence. Or to return to, and extend, Smith's much more famous metaphor, the invisible hand that guides the market economy has monetary fingers, and when these fail to function properly, so does the market economy. (Laidler[2010] p. 6).

Keeping the economy within a stability corridor depends on the agents' behaviours and the monetary policy. The existence of financial stocks acting as buffers helps much to the task (Leijonhufvud [1973]). Once again, the sequence of decisions and constraints is what matters.

SHORT AND LONG TERM

Mainstream economic theory maintains that the assumed proprieties of the long term determine what happens in the short term. Rational expectations, that is, the perfect knowledge of the functioning of the economy, univocally determine the current choices. The possible mistakes of the short term are imputed to the action of 'wrong'

institutions that must be modified. Re-establishing the 'right' rules and the 'right' practices, both monetary and budgetary, allows to get back in tune with the believed optimal long term. The actual taking place of the events is not relevant. It is then no use criticizing a budget austerity resulting in a fall in output and employment because there is the faith that all problems will be solved and the growth will come back.

The consideration of novelty and the hysteresis, on the contrary and apparently paradoxically, hints at the prevailing role of the short term, not because one should forget about the long term but because this will just be the result of the sequence of successive short terms.

The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is past the ocean is flat again. (Keynes [1923] p. 65).

In this light the business fluctuations appear as the natural way of being of the growth process, which implies the necessity to control their amplitude to make the growth itself viable.

Policies, institutional rules, and organisational capabilities are essential in the determination of the sequence of events both in the short term and in the long term. However, any tentative of applying simple rules has failed both to prevent and to solve an economic crisis. That was the case with the fine-tuning as promoted by standard Keynesianism in the sixties as well as with a policy strategy reduced to target a low or zero inflation rate during the two last decades.

Policies cannot be but discretionary. This means that, e.g., inflation pressures or trade deficits should be accepted if not promoted, when innovative choices create a divorce between costs and proceeds, between supply and demand. Public deficit and public debt should be accepted if not promoted, when the private sector has to be deleveraged. Institutional rules or structural policies should be aimed at creating viability conditions of an out-of-equilibrium process, which, without any doubt, require maintaining some rigidity in the reactions to market disequilibria, that is, some market imperfections.

INTERPRETING SOME SIGNIFICANT ECONOMIC EVENTS

The explicit consideration of essential evolutionary phenomena like novelty and hysteresis changes significantly the interpretation of the behaviour of economies undergoing processes of change and the figuring out of the policies suited to deal with the problems involved.

Let us briefly recall the main points of contrast between the standard equilibrium analytical approach, which abstracts essentially from the above phenomena, and the one stressed in this paper. The first and most important point concerns the method of contemporaneous causality, not suited to deal with qualitative processes implying structural changes. These processes call for an out-of-equilibrium step-by-step analysis of sequences of events, which require the coordination of their articulation over time. In this perspective, we have just seen, the long term no longer determines what happens in the short term, but is itself the result of a sequence of successive short terms.

This has relevant implications both for production and consumption theory. As regards in particular production it blurs the production function atemporal representation of production processes, based on the hypothesis of a coordination imposed by assumption, and calls for a sequential articulation of the production process, with particular focus on the required complementarity over time of the phases of construction and utilization of productive capacity.

Another important difference is the way we look at money. It plays an essential role for assuring the required coordination and hence the viability of the process of economic change. It may affect this process one-way or the other, but is never neutral and must be always be taken into account.

The above considerations help a clearer understanding of some important episodes of contemporaneous economic history. The periods considered are characterized by crises and structural changes, and it is exactly when important disturbances affect the functioning of the economies that the relevant features of their behaviour come to the surface and hence the right interpretations of the phenomena taking place, with the adequate policy implications, can be formulated.

The Great Depression and the Reconstruction after World War II, in particular, are examples of a failure and a success, respectively, of the policies implemented as a

result of different interpretations of the ongoing processes due to different analytical perspectives.

The Great Depression

The crisis of the 29th and the Great Depression following it appear as the result of disequilibria amplified by the economic policy followed: aimed, according to the dominating doctrine of the time, at maintaining an impossible neutrality of the government and characterized by a wrong appreciation of the effects of the monetary policy implemented. The volatility of investments, not well co-ordinated by the markets, was actually the main factor of the crisis. Heavy investments and abnormally high yields until 1928 were in fact followed by a sudden reduction of investments after that date, due to the unexpected reserve of lenders accustomed to uncommon revenues, and then by a similar attitude of borrowers worried by the perspective of falling prices. Excessive investments, then, made possible by easy borrowing facilitated by the abundance of capitals accruing to financial markets, are at the root of the problem. The policies pursued to deal with the problem itself, tight monetary conditions and falling public expenses, failed re-establishing the equilibrium of the economy and contributed instead bringing about an overall demand deficiency. The irreversibility of the distortions created could have not in fact been taken care by the simple market forces. Public intervention of a Keynesian type, as we know, was later able to alleviate the demand deficiency and to bring about a certain recovery, but not to re-establish a solid and stable growth process, as it didn't deal with the structural factors that caused the existing disequilibria but just with the resulting disequilibria themselves.

The Recovery after World War II

The problem to be faced by the Western economies after the end of World War II is different from the one that characterized the Great Depression: the reconstruction of a productive capacity shattered by the war rather than the injection of a demand required to bring back to life an existing idle capacity (Hicks [1947]). The clear perception of the causes of the disequilibria involved and of the time required to treat them properly accounts for the success of the reconstruction process carried on in the 50's. The focus on the time dimension of production processes, namely, the length of the phase of construction of productive capacity and its necessary completion before

its possible utilization, helps understanding the problems involved and the policy suited to deal properly with them.

After the war the capital equipment had suffered from heavy destruction. Moreover, its being starved of labour for years had contributed to greatly run it down. As a consequence the current production of consumption good was not sufficient to satisfy the existing domestic demand. As a matter of fact the additional supplies of labour made possible by the demobilization of the soldiers could not produce a significant addition to the supply of consumption goods at once, due both to the low productivity of a scarce capital equipment and the construction time required to increase it.

The potential demand fed by the wages of the newly employed labour had therefore to be kept down if inflation were not to develop affecting the reconstruction process. However, in this situation a rigid monetary policy to control the inflationary pressures, according to the standard doctrine, would have not been appropriate, as it would have put a brake on the resources hardly needed to finance the investments required by the 'construction' of capital and intermediate goods.

Rationing and taxes are the other ways in which the necessary restriction of consumption expenditure could be brought about. And, again, a (moderate) rise in the prices of consumption goods relatively to the wage-level. This latter measure, if people expect a future fall in prices as the result of the increases in productivity due to the completion of the ongoing investment processes, would on the other hand have the additional advantage of making investments with shorter construction periods, badly needed in the first reconstruction phases, more profitable than investments with longer construction periods, whose final output would fetch lower prices.

In open economies a powerful measure can be added: the imports of consumption goods, especially if not too costly, in order to dampen the inflationary pressure; but also and mainly imports of investments goods that allows reducing the time to build the new productive capacity, that is, "the length of time for which intense strain may be expected to continue" (Hicks [1947] p. 162). Thus the trade deficit appears as a necessary evil, and even a condition for removing it later on.

This is the gamut of policies that have been actually implemented, inspired by the principle of dealing with disequilibria interacting over time rather than aiming at an equilibrium growth path, and that have made a success of the reconstruction effort,

thanks in particular to a wise monetary policy and to the help of the well-known Marshall Plan and of an adequate trade policy.

The Years of High Inflation and after

According to the interpretation of the Keynesian doctrine which was the mainstream in the 60's (that is, the neo-classical synthesis), fluctuations are mainly due to changes that affect the global demand, and take place around a trend determined by technologies and preferences, i.e. by supply conditions. Macroeconomic policy is then reduced to an arbitrage between inflation and unemployment, the so-called fine-tuning, aimed at fostering or checking global activity by means of the budgetary weapon. In this light the short term is dissociated from the long term and Keynesian ideas go along with neoclassical ones. This policy has failed when the economies had to deal with a supply shock, like the huge increase of the price of oil and other primary resources in the beginning of the 70's; the economists were then confronted with a new theoretical challenge, the *stagflation*: that is, how explaining why inflation and unemployment increased simultaneously. According to the prevailing macroeconomics, inflation is a monetary phenomenon due to the expectations of rising prices and resulting from inappropriate government interventions, while unemployment is a medium-term real phenomenon, in the sense that it cannot deviate permanently from a *natural rate*, the higher the greater the market power of producers and/or workers. Any attempt to reduce unemployment below this natural level would feed inflationary pressures that would quickly grow out of control due to the expectations of rising prices. Only structural reforms aimed at making labour markets more flexible and products markets more competitive would then allow to actually reduce unemployment.

We have shown in this paper that another interpretation, focussing on a related sequence of the events, and hence with an interaction between short and long term and between monetary and real forces, is more adequate when dealing with important economic changes.

As a matter of fact, the supply shock (that followed a fiscal and monetary shock in the U.S.) was a novelty that generated a creative destruction process, the first consequence of which was a greater dispersion of excesses of demand and supply across markets. Consumption was no longer in harmony with investment, inducing

sector discrepancies: and transmuted the capital embodied in the late stages of old processes into capital embodied in the early stage of new processes was bound to be a strain. If we add the fact that downward adjustments of wages in excess supply markets are slower than upward adjustments in excess demand markets, stagflation was inevitable.

This resulting situation could neither be taken care by stimulating final demand, nor by applying a tight monetary policy, the tools suggested by the mainstream theory. In presence of a resource constraint, accommodating fiscal and monetary policy brought about an increase in wages rates, final demand, and prices at the detriment of investment, which resulted in the aggravation of inflation and unemployment. This reflects a mistake in interpreting the crisis as a problem of lack of demand, along a Keynesian line that considers consumption and investment on a par, rather than as a problem of insufficient accumulation of capital. Only an increase in investment associated with a stable money supply and only moderately flexible prices and wages would have brought about a re-absorption of unemployment as the result of the successful adoption of new and more productive technologies.

But, as a high inflation prevailed for many years, policy makers had no other choice than fighting it by strongly increasing the interest rates. This policy was successful in the U.S., in bringing about, very rapidly, a lower rate of inflation, and because an acceleration of the process of accumulation of capital was made possible. Just the opposite of what happened in the main European countries, where a restrictive monetary policy during too long a time has had perverse effects on growth (reduced) and unemployment (augmented) with the result of constraining more and more productive investment.

The return of financial crises: the emblematic case of Argentina

The focus on an equilibrium long term believed substantially immune from current perturbation, a pillar of the dominating theoretical and policy approach, also helps to understand the financial crises that have hit Asiatic and South American economies in the past and seem to be coming back to day, e.g., in Argentina. The macroeconomic restrictions imposed to face the current difficulties have in fact negatively affected the long-term performance of the economies concerned rather than appearing, as expected, the natural complement of the structural reforms required to overcome the

crises and the guarantees of the expected results (Krugman [1999]).

The experience of Argentina, an economy characterized by important structural shocks and frequent changes in the policies pursued, allows to stress this point.

After the hyperinflation of the end of the 80's strict monetary rules rather than discretionary behaviours have been introduced to stabilize prices expectations. A monetary system based on a fix rate of exchange of the peso with the U.S. dollar has been associated with a liberalization of the external trade. This has actually slowed down inflation and increased both domestic credit and the inflow of foreign capitals, with the result of an initial increase of both consumption and investments. However, things have quickly changed. The fixed rate of exchange has penalized exports, and, together with increasing interest rates in the U.S., fostered a massive outflow of capitals, thus leading to an increasing external deficit. This is a pattern that recurrently affects Argentina, casting doubts on the solvability of debtors and the expected state of the economy. The standard policies based on fixed rules may temporarily help but the severe restrictions involved inevitably lead to a collapse of the economy when the engagements taken can no longer be maintained, while they have fed final consumption and non-productive investments. This renders the economy potentially unstable and explains the recurrent crises.

The ongoing crisis

The crisis officially started in 2008 and still ongoing is a clear confirmation of the analytical and policy relevance of all the points raised in this paper: the importance of the specific institutional contexts where the events take place, the sequential causality of the events themselves, the hysteresis of production and consumption processes, the interaction of real and monetary phenomena.

We know enough now not to attribute the origin of the crisis simply to the financial sector, and hence calling just for new kinds of regulation of the banking and the financial systems, as it was believed at the beginning. A deeper scrutiny allows to see it as the result of a perverse relation that has its roots in the real economy: namely, in the strong increase in incomes inequality that, following fiscal, deregulation and privatization policies, has been taking place in the Western world in the last thirty years or so (Amendola, Gaffard and Patriarca [2013]).

This increase in incomes inequality, with the resulting negative effect on final demand, has stirred a process of interacting disequilibria over time, continuously widening the original inequality.

In particular the redistribution in favour of the higher incomes has brought about an excess of savings that, rather than financing investments in production technologies, whose prospects and opportunities had been reduced by the all around aggregate demand deficiency, have fed an increasing demand of assets and commodities that can be considered, and exchanged, as stores of value (like residential houses, real estates, art objects, precious materials, oil, and so forth) and of financial speculative assets, made more and more attractive by the resulting increase in their prices.

On the other hand, the hysteresis effects on consumption and credit facilities provided to sustain in particular the housing sector have slowed down the negative effects on final demand of the corresponding decrease in the average incomes. However, the option of indebtedness, although alleviating the effects of the crisis in the short run, has had a permanent negative effect due to the implicit further redistribution of incomes represented by the interest to be paid on the debts, the stronger the higher the interest rate. An out-of-equilibrium process has then been taking place, whose path-dependence depends on the emergence of involuntary stocks, both real and financial (including unsustainable leverage), which allows fossilizing and transmitting the economic disequilibria over the successive steps of the process itself. Transforming the private indebtedness into a public indebtedness to avoid the collapse of the economy has just added other dimensions to the crisis, as is well known, but likewise not been able to deal with its roots.

The policies followed to deal with the resulting stagnation of the economies and the increasing levels of unemployment, in a context characterized by a self-feeding process of increasing incomes inequality and a continuous shrinking of final demand, and where deflation rather than inflationary pressures appears as the main problem to be faced, have proved to be not adequate to deal with these problems, but rather have the opposite effect of feeding their perpetuation and in some cases rendering the crisis more acute.

These policies, and the structural reforms advocated, have in particular been aimed at correcting supposed financially unwise behaviours by cutting expenses, raising taxes

and imposing balanced budgets, with the focus on a long term where the expected results are automatically associated with the measures taken and the incentives provided. This conviction, reflecting the hypothesis of contemporaneous causality of the equilibrium analytical approach, abstracts from the consideration that the processes of economic change are characterized by an out-of-equilibrium sequence of interacting short terms where the costs of the decision taken come necessary before their expected results, and that for the ones to actually get to the others one must necessarily go through a process that has to be made viable under the threat of a collapse of the whole process.

This is the reason why, especially in the experience of the majority of the countries of the euro area, the ‘austerity’ policy pursued has not brought about the growth supposedly associated with the latter but has fed a disequilibrium process leading to ever more austerity, stagnation and unemployment.

A certain relaxing of the austerity that seems to be the consequence of the perception gradually gaining consensus that things are not after all going as expected, is certainly to be welcome, but it would take care of the effects of the crisis, the deficiency of demand and its leading to deflation, but not of its cause, the increasing inequality of incomes. In the same way as Keynesian policies, as already stressed, did bring about a certain recovery, but could not re-establish a solid and stable growth process, as didn’t actually deal with the structural factors that caused the existing disequilibria.

The sequence of wrong or insufficient steps taken: first the focus only on the banking and the financial system on the wrong assumption of its self containedness, then the acceptance of the relation between the financial sector and the real economy but the interpretation of its character in a long term equilibrium perspective, and finally focussing on the right problem but just scratching its surface, all reflect a way of doing theory that abstracts from essential evolutionary problems like *novelty* and *hysteresis* that are instead at the heart of the processes of economic change..

REFERENCES

AMENDOLA M. and J-L GAFFARD [2009]: ‘Revisiting the ‘machinery effect’: a more general view’, Working Paper OFCE 2009-13.

AMENDOLA M., GAFFARD J.L. and PATRIARCA F. (2013): 'Inequality, debt and taxation: the perverse relation between the productive and the non-productive assets of the economy, Working Paper OFCE 2013-21.

COASE R. H. [1978]: 'Economics and Contiguous Disciplines', *The Journal of Legal Studies*: 201-211.

DOS SANTOS FERREIRA R. [1989]: 'Equilibre Marshallien et Equilibre Walrasien', *Recherches Economiques de Louvain* 4: 399-424.

FISHER F.M. [1991]: 'Organizing Industrial Organization: Reflections on the Handbook of Industrial Organization', *Brookings Papers on Economic Activity: Microeconomics* : 201-40.

GEORGESCU-ROEGEN N. [1950]: 'The Theory of Choice and the Constancy of Economic Laws', *Quarterly Journal of Economics* LXIV: 125-138. Reprinted in GEORGESCU-ROEGEN N. [1966].

GEORGESCU-ROEGEN N. [1966]: *Analytical Economics: Issues and Problems*, Cambridge Mass., Harvard University Press.

GEORGESCU-ROEGEN N. [1968]: 'Structural Inflation Lock and Balanced Growth', *Economies et Sociétés* IV (3) : 557-605. Reprinted in GEORGESCU-ROEGEN N. [1976].

GEORGESCU-ROEGEN N. [1970]: *La science économique, ses problèmes et ses difficultés*, Paris, Dunod.

GEORGESCU-ROEGEN N. [1971]: *The Entropy Law and the Economic Process*, Cambridge Mass., Harvard University Press.

GEORGESCU-ROEGEN N. [1974]: 'Dynamic Models and Economic Growth', in G. Schwodiauer ed., *Equilibrium and Disequilibrium in Economic Theory*, Dordrecht: D. Reidel Publishing Company Reprinted in GEORGESCU-ROEGEN N. [1976].

GEORGESCU-ROEGEN N. [1976]: *Energy and the Economic Myths: Institutional and Analytical Economic Essays*, New York, Pergamon Press.

HAHN F.H. [1973]: *On the Notion of Equilibrium in Economics*, Cambridge: Cambridge University Press.

HAHN F.H AND R.C.O. MATTHEWS [1964]: 'The Theory of Economic Growth: a Survey', *The Economic Journal* 74 : 779-902.

- HARROD R. [1939]: 'An Essay on Dynamic Theory', *The Economic Journal* 49: 14-33.
- HICKS J.R. [1947]: 'World Recovery After War', *The Economic Journal* 57: 151-164.
Reprinted in HICKS J.R. [1982]
- HICKS J.R. [1965]: *Capital and Growth*, Oxford, Clarendon Press.
- HICKS J.R. [1973]: *Capital and Time*, Oxford, Clarendon Press.
- HICKS J.R. [1974]: *The Crisis in Keynesian Economics*, Oxford, Basil Blackwell.
- HICKS J.R. [1976]: 'Time in Economics' in A.M. Tang et alii, *Evolution, Welfare and Time in Economics: Essays in Honour of Nicholas Georgescu-Roegen*, Lexington Mass. : Health Lexington Books. Reprinted in HICKS J.R. [1982]
- HICKS J.R. [1979]: *Causality in Economics*, Oxford, Clarendon Press.
- HICKS J.R. [1982]: *Money, Interest, and Wages. Collected Essays on Economic Theory, vol. II*, Oxford, Basil Blackwell.
- HICKS J.R. [1983]: 'A Discipline not a Science' in *Classics and Moderns. Collected Essays on Economic Theory, vol. III*, Oxford, Basil Blackwell.
- HICKS J.R. [1985]: *Methods in Dynamic Economics*, Oxford, Clarendon Press.
- HOWITT P. [1994]: 'Adjusting to Technological Change', *Canadian Journal of Economics*, 27 (4): 763-75.
- KEYNES J.M. [1923]: *A Tract on Monetary Reform*, London: Macmillan Press. Reed. *The Collected Writings* Vol. 6 [1971]
- KEYNES J.M. [1931]: *A Treatise on Money*, London: Macmillan Press. Reed. *The Collected Writings* Vol. X [1971]
- LAIDLER D. []: 'The Monetary Economy and the Economic Crisis', Working Paper 2010-1 Economic Policy Research Institute EPRI Working Paper Series, The University of Western Ontario.
- LEIJONHUFVUD A. [1968]: *On Keynesian Economics and the Economics of Keynes*, Oxford : Oxford University Press.
- LEIJONHUFVUD A. [1973]: 'Effective demand failures', *Swedish Journal of Economics* (repr. in A. LEIJONHUFVUD [1981])
- LEIJONHUFVUD A. [1981]: *Information and Coordination*, Oxford: Oxford University Press.

Novelty, hysteresis, and growth

LEIJONHUFVUD A. [2000]: *Macroeconomic Instability and Coordination*, Cheltenham: Edward Elgar.

LEIJONHUFVUD A. [2011]: 'Nature of an Economy', CEPR Policy Insight No 53

RICARDO D. [1951]: *Principles of Political Economy and Taxation* in *The Works and Correspondence of David Ricardo* (11 vol.) ed. P. Sraffa, Cambridge: Cambridge University Press

SHACKLE G.L.S. [1949]: *Expectations in Economics*, Cambridge Eng. : Cambridge University Press.

SHACKLE G.L.S. [1955]: *Uncertainty in Economics and Other Reflections*, Cambridge Eng. : Cambridge University Press.

SOLOW R.M. [1974]: 'Review: Capital and Time', *Economic Journal* : 189-192.

TOBIN J. [1972]: 'Inflation and Unemployment', *American Economic Review* 62(1): 1-18.