

This Time Is... Complex. Keynes on Time

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Introduction

A fundamental dimension, in economics, time is rarely portrayed as a prominent theme, because of the sharp contrasts that have historically divided economists using alternative conceptions of time, but also of the conundrums brought about by its incorporation into economic models. Should we care about the nature of time, in doing economics? To put it differently, can we content ourselves with the "rather ordinary, workaday conception of the ultimate nature of time" usually implicit in social analysis, as Winston (1988: 31) writes? Or should we be anxious about the potentially dangerous effects of neglecting problems related to the metaphysics of time? Or, alternatively, should we concern ourselves with the both theoretical and practical issues raised by the measurement of a somehow elusive magnitude?

An easy answer to this question comes from the history of economics as discipline: the dominant neoclassical approach has opted for "the poverty of simplicity" (Louça 1997). Not only was any reflection on the metaphysics of time ruled out from the beginning, since Walras's general equilibrium theory, but the positivist-in-character reductionism of this latter fostered a static approach to economic systems, amounting to consider time as meaningless or at best irrelevant (ibid.). With the result that economics ended up with leaving aside the issue of time irreversibility. Zamagni and Agliardi's (2004) collection of articles about time in economic theory demonstrates, according to Boland (2005: 122), that economists are interested in the problem of how to incorporate time in their models, but much less so in the difficulty to build models "where time matters *because* it is irreversible".

Yet a history-of-economic-thought perspective can easily show that despite substantial general neglect in the mainstream of the discipline for such philosophical considerations, some leading figures of yesterday's economics have addressed the issue of time in a non-trivial manner, and rather brought time into the forefront of economic theory. Unsurprisingly, given both the methodological concerns time straightforwardly raises and the criticality of expectations in his economics, John Maynard Keynes devoted considerable attention to the concept of time. This paper wants to shed light on two usually

neglected aspects of Keynes's reflections on time. Section 1 explores Keynes's very early (1903) but usually ignored characterization of time as relative rather than absolute, intimately connected with the notion of change, and using, in practice, conventional measurement. Sections 2 to 4 examine Keynes's methodological reflections on time. We thus illustrate Keynes's logical approach to economic theory in Section 2, and discuss the criticality of time in the *General Theory* in Section 3. We then insist, in Section 4, on Keynes's treatment of time as one of those complex, manifold magnitudes which – perplexing the choice of units for macroeconomics – requires economists to carefully avoid unsafe logical reasoning about its characteristics and, more in general, the non-homogeneity of the economic material over time. Section 5 concludes by showing the limits of the now traditional history vs. equilibrium approach and the possibilities allowed by Keynes's alternative way of conceiving economics in time.

1. Keynes's early reflections on time

Keynes's conception of economics is anti-positivist (see Carabelli 1988). Not surprisingly, since his approach to the economic problem is mediated, so to speak, by a more general view of human conduct founded on the concept of probability. It is to probability, rather than perfect knowledge and the demonstrative truth of deductivism, as well as to the related notion of reasonableness – having some grounds or reasons for belief –, as opposed to pure rationality, that Keynes assigns the role of guide for human decision and action. The importance of *A Treatise on Probability* – with the logical conception of probability there exposed – to Keynes's economics is therefore paramount. The economic problem is but “a particular department of the general principles of conduct” (CW 29: 289): it makes use of arguments that have the same non-demonstrative and non-conclusive character qualifying also the logic of probability, which is contingent upon contexts of shifting cognitive circumstances. which normally occurs under conditions of limited, partial knowledge.

He considered economics as a “branch of logic, a way of thinking” (CW 14: 296), to borrow words from a famous exchange on the “method” of economic theory he had with Harrod in 1938. Economics is an apparatus of probable reasoning, in the terms of *A Treatise on Probability*. “A method rather than a doctrine” (CW 12: 851), that is a technique of thinking which “helps its possessor to draw correct conclusion” (ibid.), Keynes stated in introducing the *Series of Cambridge Economic Handbooks* of 1922-23. Keynes's economics consists thus of “strictly logical” analyses like the one (it is he himself who defined it as such, CW 29: 73), destined to create the field of macroeconomics, namely *The General Theory of Employment, Interest and Money* (see Carabelli and Cedrini 2014a). Economics has to be so, for the assumptions that validate positivist approaches to economic systems are much too demanding

if compared to a complex economic material made up, essentially, of “motives, expectations, psychological uncertainty” (CW 14: 300). Keynes’s economics is thus a way of reasoning about the fundamental forces at work in a socio-economic environment – reasons, beliefs, and opinions, all of them necessarily related to the dimension of time.

Now, this way of conceiving economics may raise problems exactly as concerns the treatment of time. On one side, representing a fundamental escape from the walls of the classical citadel, Keynes’s revolution is also one against a theory, neoclassical economics, which in denying any role to money, precludes time as well (Verdon 1996). “One of the most striking changes in economic thinking which comes primarily with John Maynard Keynes is his explicit focus on time”, writes Madsen (2014: 2). On the other, Keynes deliberately and explicitly chose to adopt a logical perspective in treating the economic material: he thus exposed himself to the accusation – advanced by Shackle (1972), among others – of sacrificing the historical dimension of time on the altar of equilibrium, if we are to follow Joan Robinson’s famous reasoning (on which see Dutt 2005). Limiting ourselves to contributions specifically dealing with Keynes’s treatment of time, a number of interpretations of *The General Theory* have been advanced to reinforce the case that Keynes did allow historical time to inform his economics (e.g. Chick 1985, 2002, Asimakopulos 1991, Hayes 2006, Fontana 2009), despite the general logical character of his analysis and references to equilibrium. It is to be noted that Robinson herself admitted that by focusing on expectations and uncertainty, Keynes took into account the historical dimension of time (Dutt 2005). But for this very reason, she has been criticized for instance by Termini (1981), who notes that the dichotomy logical/historical times is a simplistic one, which derives from equating “logical” with the notion of equilibrium and “historical” with the one of disequilibrium.

The possible frictions between Keynes’s logical approach and historical time provides an access point to a more general assessment of Keynes’s views on time itself. For in analyzing such tensions, one should not overlook that in Keynes’s economics, the concepts of time is strictly related to the notion of change, a crucial one in Keynes’s struggle against both laissez-faire and the determinism of general equilibrium theories winking at hard sciences as ideal. Although the time-change connection may appear a motif of the mature Keynes, it is not so. The idea dates back, in fact, to 1903, when Keynes read a paper titled “Time” (Keynes 1903) for an undergraduate Cambridge society, The Parrhesiasts Society. The paper was read on May 8, 1903, while Keynes was studying mathematics and attending John Ellis McTaggart’s lectures in Cambridge and after reading great philosophers’ contributions on the issue (see Harrod 1951, Dostaler 2007, Madsen 2014, 2012). Still, Keynes did not adopt McTaggart’s metaphysical perspective, nor addressed time from a “common sense” point of view. Rather, he mainly concerned himself with the issue of the measurement of time, thereby beginning a theoretical journey in the philosophy of measurement, and inaugurating a line of reasoning he will later apply to the

measurement of probability, of the general price level, and finally (in the *Treatise on Money* and then in the *General Theory*) of aggregate – manifold, or complex – magnitudes.

In his juvenile essay, Keynes wrote that the problem of time was “one of the stumbling blocks in every metaphysical system which the wit of man or devil has contrived” (all quotes that follow are from Keynes 1903), and that the “insoluble” has no solution. Suffering “the plunge from ordinary life into metaphysics” as “a very violent one”, Keynes decided to “approach the subject gently, by way of the mathematical aspects of time and especially of its measurement”. He thus focused on the “essential interconnection of the ideas of time and change”: it was “impossible to arrive at any conception of time which should be independent of the conception of change”, he observed, and – as against the “common-sense view of time” – likened a “changeless state” with a “timeless state”. Measuring change is however a difficult, perhaps intrinsically impossible task. He claimed that the “measure of time is no more than a measure of change”: “our perception of time means ... simply our awareness of change”. This meant that there existed “no absolute measure of time that is intrinsically more correct than any other measurement”. This owes to the impossibility of treating “motion” as if it could ever be “absolute”: motion is relative – “it is impossible to describe the position of anything, except by stating relations between this position and certain other selected positions. So that the notion of absolute motion, that is absolute change of position, is an absurdity” –, and in a conception of time as change, its measurement as well cannot but be relative.

Remarkably, Keynes’s interest in the “philosophy of magnitude” led him to devote attention to Russell’s *Principles of Mathematics*, of 1903, from which he borrowed the notion of “relation” later applied to (the relation of) probability, price (relations) and the general price level. Russell believed that the only relation having magnitude was one of distance, a term he used to qualify relations between different shades of colour or moments in time, or points of space. Keynes was persuaded that probability (being, in his logical conception, an objective relation between propositions) was similar to Russell’s relation of distance – which cannot be absolute, and is always relative to a standard. “Just as we speak of a place as being three miles distant, when we mean three miles distant from where we are situated, or from some starting-point to which we tacitly refer. No proposition is itself either probable or improbable, just as no place can be intrinsically distant; and the probability of the same statement varies with the evidence presented, which is, as it were, its origin of reference” (CW 8: 7). Relations of probability could thus be described as “magnitudes”. However, probability is seen by Keynes, already in his first version of his *Principles of Probability* (of 1907), as an “intensive” rather than “extensive” (as on the contrary is distance) magnitude *à la* Russell. That is, a magnitude that is not, in the general case, amenable to numerical measures, given that there are many “kinds” of magnitude of probability. Keynes wrote that there are no “any *prima facie* indications of the existence of a common

unit to which the magnitudes of all probabilities are naturally referable. A degree of probability is not composed of some homogeneous material, and is not apparently divisible into parts of like character with one another" (CW 8: 32). He believed that homogeneity of magnitudes of probability relations is a necessary condition for their comparability.

While discussing time in his early essay, Keynes adopts this same framework, the argument involving the problem of finding standards of measurement that allow the establishment of relations. Keynes however reminds that time is usually subject to practical measurement: hour, day, month and year. One could "lay down the rule that, whenever the King's pulse beat, one second had passed, and that the intervals between the pulsations of the King's pulse can be considered equal intervals", he observed. "For practical purposes ... we select certain bodies which we then choose to regard as fixed; we next select some phenomenon of continued change with respect to these bodies, and lay down the laws that equal amount of change take place in equal intervals of time. We have thus arrived at a standard – but purely conventional – measure of time". The rate of change can thus be thought of as "uniform or constant", but this judgment necessarily depends on the selected standard.

Keynes first illustrates the problem of "the essential relativity of all time measurement" by making use of the geocentrism/heliocentrism dispute. Here is how Harrod (1956: 61) summarizes Keynes's reflections: the measurement of time depends on the "unsupported assumption that the time intervals between recurring events of a certain character, e.g. the complete rotation of the earth, were equal. The scientists might allege that the tides were retarding the earth's spin to the extent of one second in a hundred thousand years; this proportion could only have meaning if there were other recurring events arbitrarily assumed by definition to be equidistant in time. If one wanted to criticise the regularity of these other events, then one must have some other standard which in its turn would be equally arbitrary. There was no absolute". Then, Keynes adds something on the convenience of the practical repudiation, so to speak, of the relativity of time, allowing us to take the earth's revolution as unit (that is, to assume that it rotates uniformly) and use the terms hour, day.

If the convention that leads us to regard physical phenomena as uniform or constant over time is convenient, he writes, it is because "a large number of the change-processes, which are of most immediate importance to us, are, referred to this standard, approximately – only approximately – uniform". It is the case of bodily needs, the length of life, the periodicity of certain functions, and "the majority of observed physical phenomena", "all recurring at certain intervals which ... appear approximately constant". Still, perhaps anticipating, somehow, the distinction made in his 1926 "Essay on Edgeworth" between "physics" (hard sciences, with the related "atomic hypothesis" on the material under investigation) and "psychics" (social sciences, investigating the complexity of human behavior in society, CW 10: 262), Keynes noted that "our thought-processes ... do not coincide with the standard,

nearly so closely; we have no method of determining the length of an interval by any sensation left behind by them”.

In “Time”, Keynes attacks Newton’s dualism between relative and absolute time, and his belief that despite the relativity of time measurement, there exists “a background of absolute time”, as Newton remarked in *General Scholium* of 1713. Newton, Keynes wrote, assumed that “Relative Time, of appearance and common sense, is some perceptible and external measure of Duration (whether accurate or variable) which is used in place of True Time, such as Hour, Day, Months, and Year. While admitting, therefore, the relativity of all time measurement, and the sole perception of time as being through change, he [Newton] nevertheless assumes an Absolute Time in the background unperceived and unperceivable, out of all relation with all other reality, and perfectly useless for purposes of explanation or description. There is no object in supposing the existence of this absolute time, there is no reason whatever for supposing it to exist. In addition he breaks his own first rule of philosophical thought, that no more should be postulated than suffice for the explanation of the data. He gives us two separate series - time and events – parallel but completely independent”.

In sum, Keynes believed that time is interconnected with change, and rather, since there cannot be time without change, time is, essentially, change. Its measurement cannot but be relative; when used for practical purposes to represent homogeneous intervals, it becomes conventional. In “Time”, he posed the stress on units of measurement, on their representing relations between positions, that is distances (in Russell’s terms), or intervals between different positions, with motion in between them (note that eight months later, Keynes wrote “Ethics in Relation to Conduct”, of January 23, 1904, describing probability as relative logical relation). And, again in “Time”, he noticed that, in practice, we measure such distances by employing the purely conventional “hours”, “days”, and so on. Relative and conventional, units of time are therefore arbitrary. “An astonishingly mature work for a freshman, not even a specialist in philosophy” (Harrod 1956: 61), “Time” may also represent Keynes’s early, fundamental recognition of the difficulties inherent to psychics and consequently the analysis of economic behavior. Troubles derive from the peculiar nature of a material (like the economic material) that is not, and cannot be, homogeneous through time, but also from the dimension itself of time, that is from the necessity of adopting arbitrary units of measure, despite awareness of their conventional character in practice.

2. Keynes's logical approach to the economic material

It is Keynes's definition itself of economics as logical way of reasoning about the economic material to illustrate why change occupies such a prominent place in Keynes's work. If Keynes rejects positivism, this is because of the intrinsic complexity of the economic material: economic reasoning cannot rest upon hypotheses that explicitly contradict the essence of this material. The "atomic hypothesis" which justifies inductive reasoning and mathematical calculus is invalidated, Keynes famously wrote in his 1926 *Essay on Edgeworth*, by problems "of organic unity, of discreteness, of discontinuity – the whole is not equal to the sum of the parts, comparison of quantity fails us, small changes produce large effects, the assumptions of a uniform and homogeneous continuum are not satisfied" (CW 10: 262). A condition of non-homogeneity affects time: the economic material is in fact "open to change" (O'Donnell 1989: 163), it is "shifting as well as complex" (CW 10: 127), as Keynes wrote in opposition to Jevons's attempt to carry economics "a long stride from the *a priori* moral sciences towards the natural sciences built on a firm foundation of experience" (ibid.). If economics is "a science of thinking in terms of models joined to the art of choosing models which are relevant to the contemporary world", this is because it has to face a material that, "unlike the typical natural science", is "in too many respects, not homogeneous through time".

As known, these are also the bases of Keynes's criticism of Tinbergen's work in econometrics. Tacitly assuming both the existence of "numerically measurable, independent forces" and the possibility of treating them as "independent atomic factors and between them completely comprehensive" (286), Tinbergen applied "the method of multiple correlation to unanalysed economic material, which we know to be non-homogeneous through time" (285). Keynes wanted economists to be "constantly on guard against treating the material as constant and homogeneous" (300): in economics, the Newtonian apple's motives for falling to the ground do matter. But then, how can model-builders avoid the paralyzing effects of non-homogeneity through time and other more general attributes of "complexity and interdependence" (the formula used in both *Indian Currency of Finance* of 1913 and in the *General Theory*)? "The object of a model", Keynes argues in his exchange with Harrod, "is to segregate the semi-permanent or relatively constant factors from those which are transitory or fluctuating so as to develop a logical way of thinking about the latter, and of understanding the time sequences to which they give rise in particular cases" (CW 14: 296).

The abovementioned illustration of the "object of a model" applies to the *General Theory* as well. Keynes's revolution lies in defeating the classical theory by showing the flimsy foundations on which this latter rests. What Keynes showed is that the want and ambition to confer generality to the "settled conclusions" (CW 12: 856) of their theory had compelled the classics to introduce tacit assumptions of

independence between variables. Once the limits of such hypotheses (“seldom or never satisfied”, CW 7: 378) are revealed, the resulting evidence of “lack of clearness and of generality in the premisses” (22) undermines also confidence in the generality of the conclusions. The generality of economic theory – and theories *have to* be general, in Keynes’s view – depends therefore on a correct use of logical reasoning about the economic material. Whereas the classical money-wages argument is de facto invalidated by the logical fallacy of “ignoratio elenchi” (259; the premises of the argument are irrelevant to, and incapable of, establishing the truth of the conclusion of the argument). The transposition of demand-and-supply schedules for different products of a given industry to industry as a whole’ depends in fact on the tacit assumption that the aggregate effective demand is fixed.

Unlike the classical theory, Keynes’s “own method” (257) of economic analysis does depend on those “roundabout repercussions” between variables that the classics, for want of a “simple” (ibid.) but fictitious generality, literally neglected. The idea is exactly to “segregate the semi-permanent or relatively constant factors from those which are transitory or fluctuating”: among the former, Keynes enumerates “given factors”, such as the quantity of available labour or institutional factors, and “independent variables”, namely the psychological propensity to consume, the marginal efficiency of capital and the rate of interest. But Keynes warns readers that “independent variables” are not so in virtue of any absolute criterion: rather, the selection depends upon the “quaesitum” of the analysis. Factors labelled “independent” are those “whose changes mainly determine our quaesitum” (247), and readers must be aware that the economist inclines towards “those variables which can be deliberately controlled or managed by central authority in the kind of system in which we actually live’ (ibid.).

Nor are “independent variables” truly independent: independence, in Keynes’s logical theory of economics, is “independence for knowledge”, in the jargon of *A Treatise on Probability*. It concerns logical connections between arguments, not material connections between events. The “roundabout repercussions” Keynes refers to when discussing the classical money-wages argument are those that – say – a reduction in money-wages has on the three determinants of the system, propensity to consume, marginal efficiency of capital and rate of interest, which in their turn, are capable of affecting employment directly. This is Keynes’s “two-stages methodology” (see Carabelli and Cedrini 2014a), whereby assumptions of (logical) independence, temporarily required to make science with a complex world (for instance, independence of money-wages on the three system’s determinants, allowing the economist to focus first on the direct effects of reduced wages on employment) must be appropriately removed in the course of the analysis. “After we have reached a provisional conclusion by isolating the complicating factors one by one, we then have to go back on ourselves and allow, as well as we can, for the probable interactions of the factors amongst themselves” (297). Simplifying assumptions include hypotheses of atomism, homogeneity, proportionality; hypotheses that contradict the catalogue of

attributes of complexity listed by Keynes in the *Essay on Edgeworth*, and that must consequently be removed in order to allow the economist to address the complexity and interdependence of the economic material under consideration.

In the *General Theory*, independent variables are simply those whose “values cannot be inferred from one another”, while given factors are not constant. Simply, the economist is “not considering or taking into account the effects and consequences of changes in them” (245). As always, Keynes is concerned with change, even in the rare cases in which he is not placing it at the centre of the analysis; and – as the above quotes make clear – change enters his economics also at a more methodological level. If Keynes’s economics represents a fundamental breakthrough in our way of examining the functioning of an economic system, it is also, and mainly, because of the possibility it allows to take the complexity of the system itself into full account, by transcending the dichotomy between history and equilibrium. It is to be noted that Robinson’s insistence on equilibrium as an obstacle to history rests on awareness of, and impossibility to neglect, the complexity of the economic material. In *The Accumulation of Capital*, Robinson (1956) restricts the validity of the metaphor of equilibrium due to the hindrances it creates in treating systems where equilibrium are temporary and contain the seeds of change within themselves; where path-dependence transforms disturbances into persisting effects; where expectations about possible disturbances have an influence. In *Essays in the Theory of Economic Growth*, of 1962, she maintains that in this perspective, causal relationships have to be specified, whereas in equilibrium models the “closed circle of simultaneous equations” make the dimension of time irrelevant, and there is in truth no causation. The interpretation we have here proposed induces to consider Keynes’s logical analysis as a sort of precondition for an adequate study of a complex economic system evolving through time: Keynes’s theory does not offer “settled conclusions”, but a way of thinking, a method. A vademecum, we suggest, to be used by readers who are invited to emulate Keynes’s efforts to grasp the complexity and interdependence of the economic material in the analysis of possible “interesting cases which may occur” (CW 5: 292) to readers themselves, to borrow from Keynes’s exercise in the “pure theory of credit cycles” (*A Treatise on Money*, Chapter 20).

Keynes’s acceptance of the complexity of the economic material and his effort to let it inform his economics rests on the analytical possibilities disclosed by his own method. The “provisional closures” implied by what Chick (2004) calls the “open system” logics add to the path-dependent nature of Keynes’s analysis to make the study of the “complexities and interdependencies” of the economic material possible and meaningful. Short-period equilibrium itself is one of these (the most important) temporary closures. Asimakopulos (1991: 120) reminds us that short-period analysis was (also) “a starting point ... set in an actual interval of historical time that allowed him to bring into his analysis factors that he considered to be very important in the real world”. But “Keynes's vision and interest went

much beyond the short period of his formal model, and at many places in *The General Theory* there is reference to changes occurring over time. He treated these changes as the result of changes in the values of the factors determining short-period equilibrium positions, changes that can occur “without much warning, and sometimes substantially” (Keynes 1936: 249). His model could only be a starting point or guide for the consideration of movements in employment over time, whose further analysis depends on ‘our practical intuition’.

A final point deserves attention: historical conditions enter Keynes’s analysis through the selection of independent variables, which in their turn depend on the *quaesitum* of the analysis (see Carabelli and Cedrini 2014b). As Keynes himself argues, there is continuity between *A Treatise on Money* and the *General Theory*, despite “the outstanding fault of the theoretical parts” (CW 7: xxii) of the *Treatise*: the *General Theory* represented “a natural evolution in a line of thought which I have been pursuing for several years” (ibid.). The *quaesitum* of the analysis has changed: the book “has evolved into what is primarily a study of the forces which determine changes in the scale of output and employment as a whole” (ibid.). The *Treatise on Money* represented a shift in *quaesitum*, from purchasing power to credit cycles and resulting fluctuations in employment and output (monetary instability becomes endogenous). Then, the Great Depression persuaded Keynes that he had left aside the fundamental issue of changes in the level of output and of the influence of “changing views about the future” on “the quantity of employment and not merely its direction” (xxii). Methodological continuity allow theories to change: judgment of logical relevance vary according to times and circumstances, and changing judgements bring different *quaesita* to the economist’s attention; theories change accordingly.

3. Expectations, time and equilibrium in the *General Theory*

Time is one of the fundamental pillars of Keynes’s revolution in economics. Time is change, and Keynes’s economics is about change. By the famous dictum of the *Tract on Monetary Reform*, “in the long run we are all dead” (CW 4: 65), Keynes meant that economists should adopt, both practically and theoretically, the short run optic as a guide to current affairs. In the *Treatise on Money*, he drove attention towards factors of change in dealing with “temporary divergences between price levels which in the long run are likely to move together”, as against the classical theory of credit cycle, which “assumed away the very facts” which it was intended to investigate (CW 5: 66-67). Keynes came back retrospectively on the “disadvantage” of the long run as exposed in the *Monetary Reform* in 1937, observing that he “could have said equally well that it is a great advantage of the ‘short run’ that in the short run we are still alive. Life and history are made up of short runs” (CW 28: 62).

The economic material cannot be homogenous through time, since it is made up of beliefs, uncertainties, and expectations. The resulting need of a “monetary theory of production” for the analysis of capitalism is evidently dictated also by the criticality of time and change. “The theory which I desiderate”, Keynes observed in 1932, “would deal, in contradistinction to [a real-exchange economy], with an economy in which money plays a part of its own and affects motives and decisions and is, in short one of the operative factors in the situation, so that the course of events cannot be predicted, either in the long period or in the short, without a knowledge of the behaviour of money between the first state and the last” (CW 13: 408). Money is the vehicle of time in a capitalist economy. “Time is a device that prevents all things from happening at once”, writes Davidson (2006: 139), as on the contrary happens in general equilibrium theory. In Keynes’s economics, money (as store of value) is a “time machine”, or “a vehicle for moving purchasing power over time” (141). Money is, Keynes famously said, “a subtle device for linking the present to the future; and we cannot even begin to discuss the effects of changing expectations on current activities except in monetary terms” (CW 7: 294). As Togati (1998) observes, the existence of money is strictly connected with the existence of a finite number of (future) markets, which is another way of saying that a monetary economy cannot be equated with a barter economy. In this perspective, time matters: general equilibrium theory assumes that all transactions (and decisions) can be represented as instantaneous and simultaneous, while Keynes places unsurmountable limits on this conception of “absolute” time. The decision to save does not amount to the decision to postpone consumption, and rather it brings immediate (negative) effects on effective demand. “It is not a substitution of future consumption-demand for present consumption-demand, it is a net diminution of such demand (CW 7: 210).

Time, change, money, and expectations are critical words of the vocabulary of uncertainty, which permeates Keynes’s economics. As O’Donnell (2013) has recently made clear, two alternative perspectives currently coexist in the Post-Keynesian literature about Keynes’s uncertainty and contiguous issues. Davidson is the main proponent of the ontological reading, focusing on the state of reality as non-ergodic, whereas the Keynes-philosophy literature developed since the Eighties with the rediscovery of *A Treatise on Probability* directed attention towards the epistemological foundations of uncertainty in Keynes’s thought. Uncertainty does not concern ontology, and rather derives from ignorance, that is from absence of reasons or evidence for holding beliefs (when logical probabilities, simply, do not exist, we do not know), from intrinsic incommensurability of probabilities¹, or from low

¹ The issue of uncertainty and the measurement of probability in Keynes’s thought is more complicated than usually portrayed. Unfortunately, the recent debate between Davidson (2015) and O’Donnell (2014) is no exception. The issue is clearly connected with the discussion here proposed of units of measure. In his *Principles of Probabilities* (1907: 65), Keynes points out that probabilities “are ‘essentially’ indeterminate ... I say ‘essentially’, because this indeterminacy is not simply relative to our knowledge or to a particular set of premises, but is absolute. We have to do with different kinds of the same species of quantity, whose units are essentially indeterminate in terms of one another, but which are sometimes comparable within certain limits. ... In these

“weight of argument”, that is low confidence in probability assessment. Agents (should) know that they do not know: thus, in Keynes’s economics, the “desire to hold money as store of wealth is a barometer of the degree of our distrust or our own calculations and conventions concerning the future” (CW 14: 116). Likewise, “the possession of actual money lulls our disquietude”, while the interest rate – what “we require to make us part with money” – becomes a monetary and even conventional phenomenon, “the measure of the degree of our disquietude” (ibid.).

In Keynes’s epistemological approach to uncertainty, expectations are fundamental, and all decisions by individual agents “operating with varying mixtures of knowledge and ignorance are inevitably expectations-dependent” (O’Donnell 1996: 3). Keynes himself found in the insufficient clarity with which the *Treatise on Money* distinguished “between expected and realised results” a reason for writing the *General Theory*. One can easily argue that the revolution of the *General Theory* lies exactly in expectations, given the critical role they play in determining employment. This means that time as well participates in the revolution: “it is the nature of expectation that it takes into account of the time element” (CW 13: 512). Direct evidence of this line of reasoning can be found, for instance, in Keynes’s criticism of Kalecki’s article on three alternative taxes on employment in the light of both Keynes’s *General Theory* and Kalecki’s own reflections on the business cycle (see Carabelli and Cedrini forthcoming). Keynes accused the Polish economist of introducing tacit assumptions of independence (similar to those used by classical economists) with regard to entrepreneurs’ reactions, in terms of investment and consumption behavior in the short period, to income and capital taxation. Besides the purely methodological problem, Kalecki was, according to Keynes, neglecting the far from negligible effects of using adaptive expectations. “The mistake of regarding the marginal efficiency of capital primarily in terms of the current yield of capital equipment, which would be correct only in the static state where there is no changing future to influence the present, has had the result of breaking the theoretical link between to-day and to-morrow” (CW 7: 145), he observed in the *General Theory*.

probability scales a new conception of relative indeterminacy of units of magnitude must be introduced. For although we can always express one unit in terms of another to some degree of approximation, there are strict limits to this and we cannot increase at will the closeness of the approximation”. This intrinsic indeterminateness of probabilities is re-emphasised again in the final version of the *Treatise on Probabilities*: “It is not the case here that the method of calculation, prescribed by theory, is beyond our powers or too laborious for actual application. No method of calculation, however impracticable, has been suggested. Nor have we any *prima facie* indications of the existence of a common unit to which the magnitudes of all probabilities are naturally referable. A degree of probability is not composed of some homogeneous material, and is not apparently divisible into parts of like character with one another ... Probabilities do not all belong to a single set of magnitudes measurable in terms of a common unit” (CW 8: 32-3). In his 1909 “Essay on Index Numbers” (see also Section 4), Keynes applies his philosophy of measurement of probability to economic quantities (CW XI: 52-3, 135). He thus distinguishes between a class of quantities in economics that includes quantities that are perfectly definite and capable of measurement, but which we are incapable of measuring; and a (numerous) class that includes quantities which are intrinsically, in themselves, in their nature, incapable of measurement. There too, he points out that this difficulty of measurement is intrinsic and inherent in these magnitudes and does not depend on our inability to measure them (such difficulties “depend rather upon reasoning than upon calculation”, CW XI: 64).

Due to the link they establish between today and tomorrow, expectations cannot be adaptive in Keynes's economics. The use of expected values, Keynes observed, makes his theory "as true over short periods and positions of disequilibrium as it is in the long period and in equilibrium" (CW 29: 101). Coherently with his conviction that time is change, and a changeless state is a timeless state, Keynes is attracted not by the process that leads to the formation of expectations, but by their change – as also made clear by the passage "a *change* in expectations (whether short-term or long-term) will only produce its full effect on employment over a considerable period" (50; emphasis in the original). Still, Keynes's own explicit insistence on expectations, which Robinson considered, as said, as proof of the historical-time nature of the *General Theory*, has more often than not regarded as problematic. It is in fact reminded that the logical framework of the *General Theory* presupposes equilibrium, and leaves no room for disequilibrium as dealt with by sequence analysis in the *Treatise on Money* (Loasby 1998). The (presumed, as we will argue) impossibility of falsified short-run expectations in the short period – Keynes, according to the prevailing view, would assume that such expectations are always realised – adds to the difficulty of retracing historical time in the *General Theory* (Robinson claimed that the analysis of historical time requires "the analysis of disequilibrium states in which economic agents have expectations that can be falsified", Dutt 2005: 127; on this point, see also Skott 2007). The assumption presumably made of realised expectations could in fact be equated to a declaration of irrelevance of time. Still, most post-Keynesians reply negatively to the question. Following Keynes himself, Kregel (1976) accustomed to reason in terms of the distinction between static equilibrium – short-term expectations being always fulfilled –, stationary equilibrium – individual expectation can prove to be wrong, the "general" (long-term) state of expectations being however unaffected by such disappointments –, and shifting equilibrium – in Keynes's own words, "the theory of a system in which changing views about the future are capable of influencing the present situation" (CW 7: 293). The idea that Keynes tends to assume short-term expectations as fulfilled in the *General Theory* comes more precisely from Chick's (1983) interpretation of the "method" of the *General Theory* as the result of Keynes's doubts on both Marshall's method – which would not permit a full understanding of interactions and repercussions of economic decisions – and the one of general equilibrium theory – with its "freezing of time" (Chick 1983: 15). Keynes's "compromise" (ibid.), as Chick defines it, presupposes in truth, as seen, a double rejection, in view of the impossibility to cope with complexity by adopting Marshall's method or the approach of general equilibrium theory. As regards time, Chick observes that Keynes opted for a static method, to be however employed for a dynamic economy, history being put into the initial conditions, as Robinson (1952) would say. The compromise is here between the method of comparative statics and the concerns of process dynamics: "events are permitted", in the *General Theory*, "to create in their wake new initial conditions for subsequent periods, while conditions

in markets which changed less often were fixed for a longer time. In those markets which are affected by the initial event, decisions are altered on the basis of outcomes along the way” (Chick 1983: 16).

The idea that Keynes assumes short-term expectations to be fulfilled is a noble one, so to speak: after all, readers might (wrongly) infer from the analysis that unemployment derives from producers’ incorrect expectations (see Chick 2006). Whereas Keynes himself noted that “the theory of effective demand is substantially the same if we assume that short-period expectations are always fulfilled ... if I were writing the book again I should begin by setting forth my theory on the assumption that short-period expectations were always fulfilled; and then have a subsequent chapter showing what difference it makes when short-period expectations are disappointed” (CW 14: 181). There are in fact, according to Keynes, “more fundamental forces which determine what the equilibrium position is”, not to be confused with “the technique of trial and error by means of which the entrepreneur discovers where the position is” (182). Uncertainty and long-term expectations (the main factors in Keynes’s theory of “shifting equilibrium”) are the fundamental forces governing investment. Largely borrowing from the notion of probability as dealt with in his *Treatise* of 1921 (see Carabelli 1988, Carabelli and Cedrini 2013), Keynes described the state of long-term expectations as depending on the non-numerical estimation of probabilistic values, but also on the confidence with which such expectations are held. He claimed that agents tend to adopt a “practical theory of the future” (CW 14: 114) whereby they project the present state of affairs into the future, induced to do so by uncertainty – a most favorable environment for the development of habits and conventions – and the absence of “specific reasons to expect a change” (CW 7: 152).

Hayes (2006, 2012) has recently argued that there is no need to postulate that Keynes tacitly introduced the assumption that short-term expectations are always fulfilled in Chapter 3 of the *General Theory*. Rather, the hypothesis would prevent us from understanding on what bases Keynes could claim to be offering a theory explaining “why, in any given circumstances, employment is what it is” (CW 14: 121-122). In other words, and more in general, the opposition of history and equilibrium would need revision. The traditional idea (prevailing before Kregel’s 1976 famous article on expectations in the *General Theory*) that the process of adjustment required to bring the system into equilibrium is a dynamic process of convergence over time of previously disappointed expectations owes to Keynes’s use of a function of aggregate demand specified in terms of entrepreneurs’ expectations. Keynes was usually believed to conflate this function with the missing expenditure function, which becomes possible only if expectations are fulfilled (Hayes 2006). Short-term expectations (in part depending on the state of long-run expectations) determine employment. They are concerned “with the price which a manufacturer can expect to get for his ‘finished’ output at the time when he commits himself to starting the process which will produce it”. Whereas long-term expectations are concerned with “what the

entrepreneur can hope to earn in the shape of future returns if he purchases (or, perhaps, manufactures) 'finished' output as an addition to his capital equipment" (CW 7: 46-47). In stationary and shifting equilibrium models as defined by Kregel, Hayes argues, effective demand cannot determine employment "at any time" (50), "to-day's employment [being] correctly described as being governed by to-day's expectations taken in conjunction with to-day's capital equipment" (ibid.), unless it is assumed that short-term individual expectations converge (being stable enough to) towards the equilibrium position. But Keynes does not consider any distinction between individual and general expectations (as in Kregel's stationary equilibrium model), and rather refers uniquely to "the" state of expectation, encompassing both (Hayes 2006; see also O'Donnell 1989). As against Chick's observations on the lack of explanation, in the *General Theory*, of the dynamic process by which entrepreneurs can come to evaluate aggregate demand, Hayes notes that there is no need for such explanation, if employment is determined "at any time" by short-term expectations.

Hayes's reading confines (under-employment) equilibrium to the present moment. In this view, Keynes's is a (technically) static and instantaneous equilibrium model in which "the nature of time and money are taken seriously" (Hayes 2012: 35). Keynes radically innovates the Marshallian tradition, by changing the definition of equilibrium periods as well as by substituting states of expectation for physical parameters to characterize stationary states. The equilibrium is in fact "based on forward-looking expectation and capable of shifting discontinuously from day to day" (Hayes 2006: 14), whereas a process of dynamic convergence concerns long-period equilibrium. Keynes departs from the classical theory in positing irreversibility of time, manifesting itself in the impossibility to reverse investments if expectations prove to be mistaken. The state of long-term expectations "is a close cousin to the propensity to consume and the preference for liquidity, both of which also reflect the historical nature of time" (Hayes 2012: 45). Entrepreneurs' past short-term expectations are embodied in the present capital equipment, which therefore adds to today's expectations in determining today's employment. "Express reference to current long-term expectation can seldom be avoided" (CW 7: 50), since they may be "subject to sudden and violent changes" (315), new conventions abruptly reversing previous evaluations (as illustrated in Chapter 12). Whereas short-term expectations can be safely omitted, due partly to the process of gradual ("relative to the shortness of the day") and continuous revision of short-term expectations themselves, and partly because this revision overvalues recent realised results. Entrepreneurs will tend to believe that these latter can continue over time, in the absence of "definite reasons for expecting a change (51). Short-run expectations will show a tendency to be fulfilled, also because there is overlapping with past results (expectations about the future coexist with past expectations about what has become the previous and current present). In the case of long-term expectations, past results cannot replace them, and expectations themselves cannot be checked.

Hayes can thus conclude that demand and supply are in static equilibrium at all times, that is every “day”. “The equilibrium price of the output of each industry corresponding to *today’s* aggregate employment is determined *today* as the price which clears the supply offers by employers and the demand bids by dealers in the forward market for delivery at the end of the production period” (Hayes 2012: 44). The main advantage of this interpretation is that it allows omitting any reference to the “tacit” assumption of fulfilled expectations. As Hayes maintains, disappointments are evidently possible, but changes in the state of long-term expectations or of liquidity preference (with liquidity itself being defined in terms of expectations, as “the degree to which the value of an asset, measured in any given standard, is independent of changes in the state of expectation”, 47; see also Rivot 2013) are much more significant in the determination of employment.

4. On time and time-units in Keynes’s economic writings

As said, despite Robinson’s (1977) claim that the *General Theory* reintroduced history into economics, the static method of the *General Theory* has in general and traditionally been considered a “regression” (Chick 1985: 150) with respect to the “explicitly dynamic method of the *Treatise on Money*” (ibid.). The debate centres around the presumed similarity between the Swedish School of Ohlin and others and the analytical framework of the *General Theory*. The idea of adjustment (in the *General Theory*) by a dynamic process of convergence over time towards equilibrium (with consequent need of the tacit assumption of fulfilled expectation) is in fact generally associated with the Swedish *ex ante/ex post* approach. And the explanation generally employed to suggest that the *General Theory* has nothing to do with historical time contrasts the “strictly logical” analysis of Keynes’s work with the “historical time sequentiality” of Ohlin’s scheme. In a far-reaching study of logical, mechanical and historical time in economics, Termini (1981) attributes to the “logical time” method three specific characteristics: unidirectional causality, impossibility to cope with changing situations, and absence of temporal reference from the laws of the method itself. Following Shackle (1967), she claims that Keynes’s comparative statics illustrates the equality of saving and investment without considering the adjustment process, owing to its inability to cope with disequilibrium situations. Termini (1981: 64) also notes that “no significance is attributed to the speed of adjustment of the variables, nor to the actual development of the process. *The unit of time is irrelevant* for the analytical purpose of the logical time scheme”. In general, she argues that the *General Theory* “underlines many features that are linked to the problem of uncertainty and focuses on an object that is definitely ‘in time’”, but also that it lacks analytical relations to account for uncertainty, relations that “are framed in ‘historical time’” (74, n. 42).

Before examining Keynes's thoughts on the Swedish approach, it should be remembered that the *General Theory* devotes Chapter 4 to the problem of "the choice of the units of quantity appropriate to the problems of the economic system as a whole" (CW 7: 37). Keynes believed this issue to be of the utmost importance, to the point of recognizing it as "one of the three perplexities which most impeded my progress in writing this book" (ibid.). Such troubles derives from the intrinsic complexity of magnitudes at stake: the volume of real output or income, the volume of real net output, the stock of capital, and the general price level are all "incommensurable collections of miscellaneous objects" (39) which, as Keynes argues with respect to the "community's output of goods and services", simply "cannot be measured" (38).

This reasoning belongs to a tradition, in Keynes's thinking, which dates back to the *Treatise on Probability*, and rather to its earlier version of 1907, where Keynes, as already hinted at in examining Keynes's early reflections on time in 1903, treated probability as a complex magnitude raising problems of measurement. The existence of different kinds of magnitudes of probability prevented comparisons on a numerical basis; only probabilities of the same kind, and expressed in the same unity of quantity, are numerically measurable and comparable. Remarkably, Keynes asserted that one could not apply to probability, in view of its intrinsic (objective) quantitative indeterminateness, the same treatment allowed in the case of complex physical quantities, that is conventional measuring. Complex physical quantities can be approached by recurring to some quantity or ratio characterized (as Russell's extensive magnitudes, or divisibilities) by equal intervals, however arbitrary, among its magnitudes. In 1909, in the essay on "The Method of Index Numbers with Special Reference to the Measurement of General Exchange Value", Keynes presented his philosophy of measurement, clearly in line with that of *Principles of Probability*. He distinguished between two classes of economic quantities: those which are perfectly definite and capable of measurement but are, de facto, unmeasurable because of missing information or data; and quantities that are in themselves incapable of measurement. Prices are there described as relations, and therefore quantities, but of a non-numerical character. In the absence of a common unit of measure, price ratios are possible only by the introduction of conventional measures, useful but not fully representative. Measurements of the general price level, a non-numerical quantity characterized by intrinsic indeterminateness, easily bring forth problems connected to the fallacy of composition.

Complex magnitudes (on which see, in general, Carabelli 1992), Keynes writes in *A Treatise on Money* with respect to the value of money and the general price level, are indefinable in logical terms, owing to the impossibility to reduce them to simpler terms. More, they are multidimensional; they are "capable of variations of degree in more than one mutually incommensurable direction at the same time" (CW 5: 88). The important antecedent, in this regard, is once again probability: non-comparable

probabilities are in fact the general case (the classes of comparable, and – worst – numerically comparable probabilities are much less populated), according to Keynes, who consequently treats individual beliefs as complex. Complex magnitudes are vague concepts that do not raise problems from an “ordinary language” viewpoint or in business practice. The conundrums they engender are in truth not insurmountable: they are, Keynes later observed in the *General Theory*, “‘purely theoretical’ in the sense that they never perplex, or indeed enter in any way into, business decisions and have no relevance to the causal sequence of economic events, which are clear-cut and determinate in spite of the quantitative indeterminacy of these concepts” (CW 7: 39). Still, it is evident that these magnitudes are non-numerical quantitative concepts: the general price level, for instance, “is generally incapable of measurement” (CW 11: 95), since it is “false premise that the *ensemble* of particular price relations is numerically quantitative” (68). Such magnitudes simply cannot be said to exist as they are normally portrayed; with the far from negligible consequence that the attempt to “erect a quantitative science” (38) upon such concepts is doomed to failure. Economists have to renounce using “quantitatively vague expressions” (CW 7: 39) and opt for ordinary language.

Keynes had acute awareness, in particular, of the problem of (the conditions for) comparison in time and space; in general, he was very sceptical about the possibility to make comparisons of economic magnitudes in space – e.g. comparisons of wellbeing – and of dealing in precise terms with economic variations in time. In the *General Theory*, he declared that “the problem of comparing one real output with another ... presents conundrums ... of no solution” (CW VII: 39); while in *A Treatise on Money*, he had denied the possibility to make such comparison “for communities as a whole, unless the change in the purchasing power of money ... is uniform for all the different levels of real income” (CW V: 87). In Keynes’s view, variations and change in economic variables are never mechanical and always qualitative and organic. Owing to the non-homogeneity of the economic material over time, naïf attempts to measure and quantitatively compare economic magnitudes through time may lead to logical fallacies in reasoning; still, approximate comparisons through time are nevertheless possible. As happens in the case of non-comparable probabilities, allowing direct judgements of relevance and indifference, or even “caprice” (CW 8: 32) and practical rules or habits (those exposed in Chapter 12 of the *General Theory* on long-term expectations) to play equal roles, arbitrariness in choice as concern incomparable economic quantities does not imply total indeterminacy in practice. “The fact that two incommensurable collections of miscellaneous objects cannot in themselves provide the material for a quantitative analysis need not, of course, prevent us from making approximate statistical comparison, depending on some broad element of judgement rather than on strict calculation, which may possess significance and validity within certain limits” (CW VII: 39).

This is the very position adopted by Keynes in Chapter 8 of the *Treatise on Money*, clarifying “The meaning of comparisons of purchasing power”. There, Keynes discusses the possible practical methods of arriving at approximations of the relative purchasing power of incomes, distinguishing between the direct method of comparing the incomes of similar persons, and various indirect methods of comparing the prices of equivalent composite commodities. In Keynes’s view, it is possible to use the direct method of comparison, by applying the direct judgements of relevance and indifference dealt with in the *Treatise on Probability*: “This method ... is, in fact, the method which is most often employed by common sense. It depends on a commonsense judgement of degrees of well-being by persons who have a general acquaintance with the conditions of life in both of the two positions under comparison” (CW V: 89-90). “Our task ... is not to prove something, but to elucidate by means of reflection a precise definition which shall correspond as closely as possible to what we really mean by a term in common use” (86), he pointed out. All such methods have limits, however, which Keynes explains in typically piquant illustrations, underlying the impossibility of weighing and comparing satisfactions in time or among heterogeneous objects: “We are not in a position to weigh the satisfactions for similar persons of Pharaoh’s slaves against Fifth Avenue’s motor cars, or dear fuel and cheap ice to Laplanders against cheap fuel and dear ice to Hottentots ... We cannot hope to find a ratio of equivalent substitution for gladiators against cinemas, or for the conveniences of being able to buy motor cars against the conveniences of being able to buy slaves” (104-109). “To say that net output to-day is greater, but the price-level lower, than ten years ago or one year ago, is a proposition of a similar character to the statement that Queen Victoria was a better queen but not a happier woman than Queen Elizabeth — a proposition not without meaning and not without interest, but unsuitable as material for the differential calculus. Our precision will be a mock precision if we try to use such partly vague and non-quantitative concepts as the basis of a quantitative analysis”, Keynes famously remarked in the *General Theory* (CW 7: 40).

It is to be noted that the conundrums raised by the choice of the units of quantity in macroeconomics is purely logical. This signifies that the difficulties involved by the choice are intrinsic to magnitudes themselves, and do not only derive from limitations in human cognitive capacities, but from problems of intrinsic incommensurability of magnitudes (see note 1). In criticizing the mathematical statistician Walsh on the existence of an absolute measure of the general price level, Keynes states that “his false premise, that general exchange value must be numerically quantitative, is responsible [for his idea that units are equivalent over periods of time]. If only we are sufficiently ingenious, he thinks, we shall find a formula yielding us an absolute measure of it ... If there was a perfect measure of general exchange value, Mr Walsh would certainly have found it; but the method of exhaustion is barren, if the object of search has no real existence” (CW 11: 135).

Time as unit, however, deserves further attention. In general, Keynes could but agree with Marshall (in *Principles of Economics*) that the element of time “is the centre of the chief difficulty of almost every economic problem” (CW 10: 207) and believed that this, in the Marshall analysis, was the quarter “least complete and satisfactory, and where there remains most to do” (ibid.). During the transition between the *Treatise on Money* and the *General Theory*, Keynes had however told his students, in his 1932 lectures, that units of time “are in their nature homogeneous” (in Rymes 1989: 104 n.1). He had also discussed with Robertson at a certain length, while commenting on saving and hoarding in 1933 (Robertson was then developing the theory that will become known as the “loanable fund theory”, having antecedents in Wicksell’s thought and later developed by Robertson himself and Ohlin), the issue of time units. Keynes was curious about the precise definition Robertson might offer of, in particular, the “technical ‘day’” (“I cannot discover what you gain by your ‘days’, which seem to me to stand in the way of dealing with a period as a whole”, CW 29: 19; “Is the technical day the same for everyone? – e.g. for weekly wage-earners and salaried people paid quarterly? About how long do you believe it to be in practice?”, 26).

In 1933, in a typed fragment of a chapter of what later became the *General Theory* entitled “Definitions and ideas relating to capital: the concept of accounting period”, Keynes distinguished between “accounting” and “production” period, the former being defined as “equal to the time which must elapse between the decision which will lead [an entrepreneur] to incur variable cost and the date when he will recoup himself by selling the resultant output” (74). The notion entered the *General Theory* without its initial name, but was accompanied by a more precise definition of the “day” as shortest interval after which the entrepreneur could revise his demand of employment. Keynes adopts “the minimum effective unit of time” (CW 7: 47, n.1), the “day”, in analysing the employment decisions of firms. And he focuses on short-term expectations, writing that “the behaviour of each individual firm in deciding its daily output will be determined by its *short-term expectations*”, “daily” meaning “the shortest interval after which the firm is free to revise its decision as to how much employment to offer” (ibid.). “Day” is thus both the short and market period: with a view to maximizing profits, entrepreneurs daily decide about employment with a given capital equipment (short period), their supply of finished output being constrained by the available stock (market period). And the long period, as Hayes (2012: 43) notes, is defined “in a unique and strictly *short-term* technical sense, to define the equilibrium on which the employment of labour and capital-goods will in theory converge if a new state of expectation persist for the full length of the period of production”.

To recapitulate, between the *Treatise on Money* and the *General Theory* Keynes seems to employ conventional time measures to elaborate disequilibrium dynamics – those upon which the *Treatise on Money* should have insisted more, according to the Keynes of the *General Theory*. Sequential analyses

of the kind of those used in the *Treatise* but then abandoned, before the appearance of the *General Theory*, were employed for this purpose. But the *General Theory* does not spare readers details regarding the author's worries about problems of measurement of aggregate quantities, and his concerns about the complexity of the economic material, special attention being devoted for non-homogeneity through time. In Chapter 4 of the *General Theory*, Keynes's choice of units reflects precise worries. The main problem with complex aggregate magnitudes results from the impossibility to find a common unit in which all relations relative to the quantity under consideration can be expressed, so as to make numerical comparison possible. Before comparing numerically economic quantities, "it is essential that we should first measure them in terms of some common unit" (CW 11: 52). In the absence of such reliable common unit of measure, the magnitudes, though quantitative in essence, cannot have a numerical character. Chapter 4 includes a critique of Marshall's and Pigou's concept of national dividend, which forcedly neglects the difference between measures of physical change and measures of changes in money values (likewise, the measurement of net addition to capital equipment involves problems of heterogeneity through time). Does this mean that a truly macroeconomic analysis is de facto impossible? No, provided such problems of measurement are solved by the use of a homogeneous unit of quantity: the quantity of money, due probably (Keynes gives no reason for this) to its being an established convention, similar to ordinary language (or representing its economic component); and the quantity of employment.

In the *General Theory*, Keynes does not employ the general price level to deflate the value of the output as a whole, in reason of the theoretical difficulties raised by the magnitude itself. Rather, confronted with the problem of finding a proxy for real output, he opts for the quantity of employment, immediately reminding readers that the two quantities are only "presumed to increase and decrease together, though not in a definite numerical proportion" (41). Moreover, the quantity needs to be deflated by a monetary measure: thence the use of money-wages, which is not *the*, but only *one* of the specific values of money, the labour power of money. This is because, while money is "strictly homogeneous", money-wages "can be made so" (ibid.), exactly by weighting the labour-unit "in proportion to its remuneration", and by employing "the money-wage of a labour-unit", or "wage-unit", to define the quantity of employment. Thus, a physical magnitude, employment is derived from deflating money-income by the wage-unit – two monetary magnitudes. The use of this quantity – and only this one – is to be seen in conjunction with the substitution of the employment function for the ordinary supply curve, thus reflecting (thereby adapting itself to the quaesitum of the analysis) the "methods and objects" of the *General Theory*. As Keynes writes, the employment function "expresses the relevant facts in terms of the units to which we have decided to restrict ourselves, without introducing any of the units which have a dubious quantitative character. In the second place, it lends itself to the problems of industry and output as a whole" (281).

In the *General Theory*, Keynes used units of time. In Chapter 5, references are made to the “first”, “second”, “third” day, where the “day” is defined, as seen, as “the shortest interval after which the firm is free to revise its decision as to how much employment to offer” (CW 7: 47). Keynes refers to “to-day” and “to-morrow” (145). He also argues that “a product has a period of production n if n time-units of notice of changes in the demand for it have to be given if it is to offer its maximum elasticity of employment” (CW 7: 287). More, in Chapter 16 (exposing his “sundry” observations on the nature of capital) – Keynes defines employment as “the sole physical unit which we require in our economic system, apart from units of money and of time” (CW 7: 214). Noting the point, Bradford and Harcourt (1997: 120) argue that time measurement is conventional in nature, and ought to act as proxy, in Keynes’s own terms, for an underlying relation that however should evidently represent “the example *par excellence* of a non-numerical quantitative relation”. Bradford and Harcourt rightly remind us that differently from employment and money, units of time are not discussed (as they contrarily should, given the importance of the definition of the set of units in proposing an analysis of output and employment as a whole) in Chapter 4. They thus conclude that “it was not until after the publication of *The General Theory* that he systematically applied the reasoning of Chapter 4 to the question of time” (Bradford and Harcourt 1997: 119).

Yet it is clear, though implicit, that the definition of the unit of time in Chapter 16 relates to Keynes’s own definition of the “day” in Chapter 5, that is to an analysis of the unit of time that has definitely left behind his earlier sequential analysis. His peculiar definition of the “day” is also related to Keynes’s focus on short-run expectations as determinants of employment, to having redefined income and profits (Chapter 6), as well as to the leading role assigned to entrepreneurs’ (relatively to consumers’) decisions. All this explains why Keynes felt the need to actively participate in the debate raised by his own book, with the double aim of “defending and developing” the *General Theory*. The 1937 article on the *Quarterly Journal of Economics* is undoubtedly the most important and effective contribution Keynes could offer with this aim in mind. But the emphasis he posed (in his articles, that same year, on the rate of interest) on the ex ante/ex post approach as a potentially unsafe technique of reasoning about macroeconomics should not be overlooked, if only because it reinforces the core message of the QJE article: macroeconomics is about uncertainty and economic agents’ attempts to cope with its potentially paralyzing effects. But there is more. Keynes’s writings and correspondence on the Swedish approach mark the turning point, and codify his belief that time ought to be explicitly considered as one of those complex, manifold magnitudes illustrated in Chapter 4 of the GT. One that – perplexing the choice of units for macroeconomics – (should) oblige economists to carefully avoid unsafe logical reasoning about the characteristics of both time and the economic material under investigation, as well as to focus, as Keynes did, on change and transitions.

It is Keynes himself, as Gnos (2004) correctly argues, who dismisses the hypothesis of applying the *ex ante* / *ex post* analysis to the *General Theory*. Exploring in depth the issue of the incompatibility between Ohlin's and Keynes's approach would require a lengthy detour: we will nevertheless focus on those aspects involved in Keynes's rejection of the *ex ante*/*ex post* approach that may be of chief importance for understanding his own attitude towards time in economics. In his notes for the 1937 lectures, Keynes observed: "*ex ante* saving a very dubious concept – the decision don't have to be made" (CW 14: 182), meaning that individuals, uncertain about what their future incomes are going to be, do not make any *ex ante* decision concerning saving. Nor would they be subject, even if they have some reasonable expectation about incomes, to the necessity "to make a definite decision (as the investors have to do) ... [and] they do not make it at the same time". Finally, "they most undoubtedly do not, as a rule, deplete their existing cash well ahead of their receiving the incomes out of which they propose to save, so as to oblige the investors with 'finance' at the date when the latter require to be arranging it" (216-217). Rather, "*ex ante* is solely the domain of entrepreneurs' decisions" (Gnos 2004: 338).

Keynes is here defending his own theory from a fallacious interpretation: "other economists, I find, lay the whole emphasis, and find the whole explanation in the *differences* between effective demand and income; and they are so convinced that this is the right course that they do not notice that in my treatment this is *not so*" (CW 14: 181). What has been decidedly less emphasized is that this general argument rests also on Keynes's awareness of the importance of the effects of time, that is of the non-homogeneity of economic magnitudes over time. "Time relationship between effective demand and income", writes Keynes in his notes for the 1937 lectures, is "incapable of being made precise. In case of factors other than entrepreneurs and rentiers the two are more or less simultaneous. For the latter income becomes determinant and is transferred at varying subsequent dates" (179). There is "no definite relationship between aggregate effective demand at one time and aggregate income at some later time" (179-180). To the purely economic argument against the Swedish approach, one has to add the strictly methodological considerations already touched upon in Keynes's notes for his 1937 lectures, and plainly formulated in a letter to Ohlin of January 7, 1937.

In the notes, Keynes refers to the "contraption of formulas of process of all sorts of lengths depending on technical factors with income emerging at a given date corresponding to input at an earlier date" (180) Keynes himself used in the biennium 1931-1932. All this was "discarded it partly because it was frightfully complicated and really no sense in it, but mainly because there was no determinate time unit. I found I could get all that was required by the conceptions of effective demand and income which were identical for factors but income of entrepreneurs at any time depended on outcome of prediction undertaken at various previous periods under influence of effective demand" (*ibid.*).

Likewise, in his letter to Ohlin, Keynes admits having reasoned in terms of the Swedish approach in the early period of the transition from the *Treatise on Money* and the *General Theory*, but to have abandoned subsequently this line of reasoning. Remarkably, the problem of the lack of definite unit of time now becomes the only (not simply central) argument. “As regards the ex post and the ex ante method, I shall certainly give further thought to its advantages. This is in fact almost precisely on the lines that I was thinking and lecturing somewhere about 1931 and 1932, and subsequently abandoned. My reason for giving it up was owing to my failure to establish any definite unit of time, and I found that that made very artificial any attempt to state the theory precisely. So, after writing out many chapters on what were evidently the Swedish lines, I scrapped the lot and felt that my new treatment was much safer and sounder from a logical point of view”. Now, this argument is usually neglected or at most considered as secondary, the true problem at stake being, it is believed, that the Swedish approach would jeopardise the theory of effective demand. But Keynes devotes considerable attention to (this which may appear as not more than) the “practical difficulty” (Gnos 2004: 337) of the approach. After agreeing with Ohlin that his method could be useful for purposes of exposition, Keynes concluded the letter by observing: “when one comes to prove something truly logical and properly watertight, then I believe there are advantages in my method and that the ex post and ex ante device cannot be precisely stated without very cumbersome devices. I used to speak of the period between expectation and result as ‘funnels of process’, but the fact that the funnels are all of different lengths and overlap one another meant that at any given time there was no aggregate realized result capable of being compared with some aggregate expectation at some earlier date. You will be quite familiar with the difficulty I have in mind (CW 14: 184-185). Time adds to the difficulty of treating complex magnitudes and their irreducible heterogeneity: again in his notes for the 1937 lectures, Keynes observes: “when one is dealing with aggregates, aggregate effective demand at time A has no corresponding aggregate income at time B. All one can compare is the expected and actual income resulting to an entrepreneur from a particular decision” (CW 14: 180).

From what precedes, it seems evident that Keynes’s line of reasoning about time and the conundrums it raises in economic theory shows a high degree of internal consistency. Keynes never opted for a mechanistic approach to time. In Chapter 5 of the *General Theory*, Keynes referred to the first, the second and the third day as mere succession of short periods. Rather, one could observe that Keynes had evidently to face two different problems: that of detecting and devoting the required attention to situations of non-homogeneity through time, and the one of using time in economic analysis while treating it, at the same time, in a manner that does not contravene the philosophical nature of the concept as he conceived it. Though distinct, the two questions may sometimes conflate into one another, compelling Keynes to face potentially unsurmountable difficulties. The main issues raised in Keynes’s early paper “Time” come to help, for such issues are also those that shape Keynes’s use of time

in economic theory. First, time is relative – that is, Keynes does not believe in a “homogenous or absolute” conception of time, and also for this peculiar reason, he adopts a logical approach to economic theory. As Togati (1998: 60) aptly observes, to Keynes, “the comparison between pictures taken at different periods of time has no objective value”. Second, time is change: Keynes’s *definitions* and *use* of units of time in the *General Theory* serve the purpose of emphasizing the importance of entrepreneurs’ expectations in determining effective demand. As seen, Keynes’s rejection of the Swedish approach rests on the impossibility to detect logically safe units of time. After all, in the *General Theory*, the “day” is a – however small – device to separate (relatively) constant from changing factors. Since entrepreneurs have to formulate, each “day”, both short-term and long-term expectations, it is also a “theoretical link between to-day and to-morrow”. A link that cannot be established or represented by an “extensive” magnitude *à la* Russell: the measurement of time is in fact (third “legacy” of the 1903 paper) highly conventional, and conventional measurement must not obscure or, worse, hinder the non-homogeneity through time of economic magnitudes.

5. Conclusion. Keynes’s time and beyond

What about historical time in the *General Theory*, then? The question seems to have flimsy foundations. As Chick (1985: 150) remarks, historical time has become a Post-Keynesian slogan, and Robinson’s definition “is explicitly directed towards establishing *The General Theory* as an example of theory occupying the historical domain”. Robinson’s definition seems at the same time too large (see Skott 2007) and too rigid (as generally hinted at above) to allow replying to the question. Dow’s (1985) proposal to add “expectational time” to the list of the three approaches to time in economic theory is fascinating but also revealing of the probable inadequateness of the taxonomy. While the alternative history vs. equilibrium can scarcely be used with advantage in evaluating the history-friendliness (“despite” the use he makes of – underemployment – equilibrium) of Keynes’s work. In general, however, the more one comes toward precision in defining (technically) the three “times” (as in Termini 1981), the bigger is the risk of losing important specificities of individual approaches. Moreover, the process that leads to associate individual economists to one kind of analysis or the other is path-dependent: it depends also, so to speak, on initial conditions or assumptions, those related to the specific school of the “judge”. For instance, Kalecki lamented the absence, in the *General Theory*, of a sequential analysis (like his own) of the determination of investment, blaming Keynes for applying a static analysis to an intrinsically dynamic element (see Carabelli and Cedrini mimeo). Toporowski (2013), and Kaleckians in general, see here at work the tension between Keynes’s “logical” time and the “historical” time appearing in Kalecki’s model, which differently from Keynes’s, incorporated classes,

the issue of income distribution, finance (in an endogenous-money framework), imperfect competition. But Keynes, on his part, criticized Kalecki for the (tacit) introduction of an assumption of adaptive expectations (present profitability strictly depending on past profitability). Moreover, by framing the theoretical tensions between the two economists in terms of logical versus historical time, one easily neglects that Keynes could evidently not be satisfied with an approach to time (and economic theory) that in truth can more appropriately be defined as “mechanic”. Kalecki’s work on the business cycle accepts Frisch’s approach to dynamic economics, with its physicalism and continuous analogy with oscillation and harmonic motion in physics, with its substantial neglect for subjective factors, with the use it makes of time-lags, and no concern for changes in expectations. Mechanical time assumes “the mechanical extension through time of a set of unchanging relations” (Termini 1981: 64). The past, not the future, determines the present; “time is abolished” (Chick 2004: 11) – with the result, for instance, that by applying mechanical time and circular causality to the *General Theory*, Robertson ends up with adopting the “loanable funds” theory pioneered by Wicksell and further developed by Ohlin, in antithesis to Keynes. In the Sixties, after Kalecki had become sufficiently aware of the limitations of his models, he exposed reasonable doubts about the applicability of econometrics, but substantially failed to incorporate history (“past economic, social and technological developments rather than determined fully by the coefficients of our equations as is the case with the business cycle”, Kalecki 1968: 276) into his growth models (see Besomi 2006).

Consistency is all too evident in Keynes’s criticism of theories that make use of “mechanical time” approaches. In his view, there are two alternative (general) schools of thought in economics: some economists “believe that the existing economic system is, in the long-run, a self-adjusting system, though with creaks and groans and jerks, and interrupted by time lags, outside interference and mistakes. These authorities do not, of course, believe that the system is automatically or immediately self-adjusting. But they do believe that it has an inherent tendency towards self-adjustment, if it is not interfered with and if the action of change is not too rapid. On the other side of the gulf are those who reject the idea that the existing economic system is, in any significant sense, self-adjusting. They believe that the failure of effective demand to reach the full potentialities of supply, in spite of human psychological demand being immensely far from satisfied for the vast majority of individuals, is due to much more fundamental causes” (CW 13: 486–487).

Termini (1981) focuses on the multiplier (which Keynes plainly and explicitly illustrated, in the *general Theory*, in logical terms) and Keynes’s argument about the identity between saving and investment as the two principal elements of his logical-time approach, noting that Keynes does not concern himself with the dynamics of the adjustment. Still, as said, Keynes openly rejected the Swedish approach because of the logical difficulties that non-homogeneity through time necessarily raises as regards in

particular comparability of economic magnitudes. One way of coping with such difficulty is obviously to introduce a strong assumption about the economic material, as Tinbergen (tacitly) did, according to Keynes, in his econometric work. The problem is that in economics, as Keynes remarked on every relevant occasion, we are not “dealing with the action of numerically measurable, independent forces, adequately analyzed”, which would allow us to know that such forces can be treated as “independent atomic factors and between them completely comprehensive, acting with fluctuating relative strength on material constant and homogeneous through time”. This prevents economists, Keynes noted in commenting Tinbergen’s work, from using “the method of multiple correlation with some confidence for disentangling the laws of their action” (CW 14: 285-286). This does not mean, to Keynes, that in presence of “adequate degree of uniformity in the environment” (316), econometrics should be discarded as method of analysis. But this requires breaking up a statistical series into sub-periods, allowing the possibility to verify whether the results obtained for each sub-period taken separately are “reasonably” (ibid.) uniform. Holding in mind that the expected result of the analysis is, only, that of being able to suggest possibilities and probabilities as an aid to theoretical research. Keynes’s repeated attacks in the *General Theory* to the “pseudo-mathematical methods of formalizing a system of economic analysis” (CW 7: 297) also, perhaps most importantly rest on the problem of homogeneity through time: whereas economics deals with “the influence of expectations and of transitory experience” (CW 14: 2), with change through time, to paraphrase Keynes (in a 1936 letter to Shove). Which compels us to cross the boundaries of “the realm of the formally exact” (ibid.) and opt for ordinary language.

In the light of what precedes, it seems reasonable to conclude that the structural ambiguity of the terms and concepts used in the debate over logical, mechanical and historical time, precludes the appreciation of Keynes’s thoughtful reflections and qualified use of time in economic theory. Or, better, this paper provides further evidence, with respect to existing contributions in the literature (see below), that the opposition itself between history and equilibrium may in truth reveal to be a false one. Things are much more complex than they seem to be, or than their names suggest. It is clear that when Hicks, in 1976 (289-290), confessed to have “reduced” the *General Theory* to “equilibrium economics; it is not really *in time*”, he was simply neglecting the possibility to make “equilibrium” and “historical time” compatible. But, as Asimakopulos (1991: 7) put it: “Both equilibrium and change are ... compatible in Keynes’s work, because the determinants of short-period equilibrium are themselves constantly changing, so that the equilibrium position of rest is only a temporary resting place”. As to long-period equilibrium, Keynes used it only “for purposes of illustration and completeness”: in so doing, that is “in abstaining from long-period equilibrium analysis, Keynes was observing the limitations imposed by historical time” (122). The combination of logical analysis and historical time in Keynes’s economics might still represent a star to follow, in the quest for the appropriate way of

conducting research on phenomena denoted by their evolving through time (as most economic phenomena are). Providing “the outline of a method of analysis which attempts to use the concept of equilibrium within a more general, historical-time framework to provide an understanding of how uncertainty and the acquisition of new knowledge affects economic behavior and impacts on the actual course of events” (Fontana and Gerrard 1999: 323), Keynes’s theory of shifting (as distinct from stationary) equilibrium can provide a new starting point (Hayes 2012).

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