



# Cycles, Growth and Structural Change

Theories and empirical evidence

edited by Lionello F. Punzo

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**Edited by**  
**Lionello F. Punzo**

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# Preface

This volume presents contributions revolving around the general theme of the relationship, empirical as well as theoretical, between economic oscillations, growth and structural change. It is constructed upon a twofold hypothesis. A reunification of the analyses of the three phenomena may be obtained through a comparison and cross fertilisation of the existing specialised approaches. Moreover, the accomplishment of such a project is perhaps within reach, now. This preface will discuss such a hypothesis, outlying the structure of the book and the string connecting individual contributions.

Most chapters are revised versions of papers read at the International Summer School of the same title, held in Siena in July 1998. Some chapters have been added with the intent of broadening the view without however any attempt to reach exhaustiveness. The field, in fact, represents one of the most exciting frontiers in current economic research, calling for the individual as well as, more often, joint efforts of specialists from very diverse areas: economic theorists, real life applied economists, econometricians, of course, but also mathematicians and people working in information-theory related areas. Cross fertilisation is at one of its historical peaks, and it is taking place here more than elsewhere in the economic discipline. The School was concluded by a lively workshop dedicated to the works of the late Richard M. Goodwin, whose lifetime research has been dedicated to the themes of this book.

## **Convergence: the new impetus to growth theory and growth empirics**

Among the factors that brought about the present rich and stimulating, though still fluid, state of affairs, one should count the new impetus to growth theory and growth empirics coming from the debate on 'convergence' (further supported by recent quantitative advances in cross-national comparative databases). Indeed, growth has been traditionally an area where a division of labour between theoretical and applied economics (and economists) could not be enforced. Similarly, the actual experience of fluctuations along with growth was the background for the development of the classical macrodynamics (the set of theories of business fluctuations of the 1930s to the 1950s) and more recently of new classical

macrodynamics. So, the intersection between theoretical work and empirical evidence has been remarkably extensive for fluctuations as well as for growth. Perhaps it has been greater than in other parts of economics, and in a sense this very aspect makes these theories so appealing to academic economists, but more so to policy makers and the general public alike. The questions raised by the opening of the new millennium, in a scenario of uncertainties about the future developments of the world as well as the national economies, can only increase such general interest. Does economics now offer answers to such grand questions as: how to support long run, smooth (or relatively smooth) as well as even growth? This is an open question, at present. The recent developments expose a varied scenario, where high instability is coupled with equally highly, cross-country, diversified growth performance.

Thus, there is an issue of growth and convergence, but we are also still looking for a satisfactory answer to the age-old issue of explaining why growth seems to marry with fluctuations. This is the coupling of trend and oscillation that focussed the reflection of Schumpeter and inspired the more mathematically inclined thinkers of classical macrodynamics. This is one of the issues addressed in the chapters of this book. It is done with diverse approaches. They range from neo-Classical, to neo-Austrian, to Schumpeterian and Evolutionist, and they vary between macro and micro. The book shows as well a variety of styles or methodologies: from historical reconstruction to quantitative studies (cluster analysis-type of approach to real business cycle econometrics to information-theoretic model theory), to the modelling of large artificial economies (often of heterogeneous interacting agents/firms/sectors), and qualitative econometrics. Such twofold variety reflects the philosophy of the series of International Summer Schools at Siena since their operation.

The list of factors for the present situation is far from short. It should include the unending dispute between exogenous and endogenous explanations of long run growth and fluctuations; the discovery of the possibility, besides multiple equilibria, of endogenous fluctuations and of chaotic, or non-periodic, behaviours even in simplest theoretical models, constructed upon the conventional equilibrium ingredients; finally, the formalization of a non-mainstream tradition, along Evolutionary, neo-Schumpeterian, or else neo-Austrian lines, to name a few.

I believe all this can be traced back to the key issue anticipated above: the need for a coordination of the analysis and explanation of short run economic variability with that of growth as a long run phenomenon and of these two with the analysis of structural change. It may be useful to spend a few words on how this issue presents itself now against the background of the history of its conceptual evolution, and to indicate the *Goodwin connection*.

### **Cycles, growth and structural change**

The three 'wings' of cycles, growth and structural change became part of one and the same conceptual design, in this century, synthesised by the Schumpeterian vision of a market economy growing only through fluctuations. In the so-called

Schumpeterian clock, economic time is irregularly struck by the swarms of innovations, i.e. clusters of technological and economic shocks erratically but systematically administered to the markets. This vision proposed the irregular oscillation as the unifying concept for dynamics but this got lost in the process of formalization by Hicks, Samuelson, Harrod, Tinbergen, Kalecki and others which created modern mathematical dynamics. (It only survived in Goodwin's lifetime work.) Then, attention shifted towards more orderly dynamics, the existence and stability of point-equilibria and of regular oscillations (limit cycles and the like). The eventual pre-eminence of this quest went along with the separation of the two issues, the explanation of growth from the explanation of the oscillations. In place of the single exogenously initialised mechanism of fluctuating growth, a dualism emerged between oscillations and growth, and in parallel the former was identified with the short run and the latter with the long run. The products of such a separation were the neo-classical theory of growth and the Hicks–Goodwin theory of self-sustained oscillations. Such a separation took also the shape of a methodological (or *weltanschauung*'s) opposition of an exogenous versus an endogenous explanation of dynamics, the former associated with Solow's growth model, and the latter with the classical macrodynamics just mentioned (in particular, Goodwin's own version of it). There are many reasons for this divorce between two research lines that otherwise both descend from the same Harrod's model (Solow inserting a production function, Goodwin going non-linear). One is the shift in post-war theoretical interests towards equilibrium issues and hence the related stability. But, probably, a more profound conceptual reason lies in the historical failure of those who believed in the paradigm of the endogenously sustained oscillations, to accomplish the self-assigned task of building the grand theory of the trend *cum* oscillations. Perhaps, the task was simply overly ambitious for those times and the mathematics at hand. More realistically, neo-classical growth theory never played with such a 'dream', as acknowledged by Solow himself.

It is too well known how the exogenous theory of growth survived (though with alternating phases) while at the same time the endogenous theory of oscillations went out of fashion. From the 1960s till recently, the latter was superseded by a simpler account of oscillations, sometimes referred to as the linear econometric model. This rests upon the notion of a fundamentally stable equilibrium behavior for the economy subjected to exogenous and random disturbances. Thus, this new dynamic wisdom had both long and short run explained by fundamental forces that were not modelled by the economist himself: for growth they were deterministic in nature, while they were stochastic for oscillations, so that they did not exclude each other and on the contrary could be combined through a sort of division of labour. Such a mechanical view of the working of an economy producing short lived oscillations as a result of passive behaviours on the part of economic agents was eventually questioned by both the first and the second monetarist waves, the latter producing the new classical theory of business fluctuations. But, although enriching the representation of decision making processes by taking into account expectation-induced adjustments, the dynamics of oscillations remained the response to exogenous shocks of an

otherwise point-stable mechanism. In growth theory, on the other hand, Solow's paradigm was challenged by the blossoming of a body of models collectively going under the name of endogenous models. They are endogenous in the sense that they account for the possibility of a sustained long run growth on the basis of economic forces associated with the very basic mechanisms driving a market economy.

After the middle of the 1980s, (macro-)economists lived in a situation that can be depicted as the mirror image of the one at the beginning of the 1950s: growth theory had tendentially become endogenous, while business cycle theory (Monetarist version) was exogenous! Beyond this interchange of points of view, basically the two 'varieties of dynamics' were still being treated in different parts of economics; the explanation of one would not be the explanation of the other. The issue of conjugating trend and oscillation in a unified model was still there to be addressed. RBC theory, which bravely picked it up, can be seen as a provocative but forceful attempt at realising such unification. Likewise, in the same light, one can appraise the birth and diffusion of Evolutionary and Schumpeterian modelling, neo-Austrian modelling, and some of the non-label literature on endogenous fluctuations and chaos that has emerged from the mid-1980s to the present day. One of the chapters in this volume goes over the issue to recall the RBC proposal of a (re-)unification of growth and fluctuations dynamics centred upon the equilibrium theory of growth in a stochastic environment. Other contributions present alternative viewpoints, with an out-of-equilibrium approach yielding naturally long run, persistent fluctuations in growth rates (as well as levels, if needed). The complex dynamics thus obtained does not distinguish between fluctuations and growth, the latter being but one simple type of the former. Their proposal of re-unification centred upon a generalised notion of growth cycle in a fundamentally deterministic framework can be contrasted to the essentially stochastic equilibrium approach of RBC. Likewise, the chapter on the positiveness of long-run profits in a evolutionary and Schumpeterian framework, shows such a possibility (excluded by Schumpeter himself) to be strongly related with the issue at stake.

In a sense, all the chapters in this book address the same question: how can we have both sustained growth and sustained oscillations? If the answer is positive, they should rest upon the same mechanism. Searching for the answer, some theories and models redefine the very notion of growth and, more often, of oscillations to accommodate frontier phenomena belonging to so-called complex dynamics. To see where the common mechanism could be, one ingredient is missing, though.

### **Dynamics from structural change**

In fact, parallel to the theoretical divorce of growth from fluctuations, there was a separation of formal dynamics from structural change. Taking the economic structure as given, dynamics became basically a theory of adjustment processes. Structural dynamics, on the other hand, was left out of a style of modelling too aggregative to afford a notion of structure richer than the description of some

statistical regularity. Thus, the analysis of structural change migrated to development theory and it stayed there until recently. As remarked by some of the contributors to a previous volume in this series, structural change eventually has re-appeared under disguise in some of the models of the endogenous growth family where the line between monotonic growth and discontinuous development is never clearly marked. Even Lucas' critique can be read as a critique of a modelling approach that assumed structure and kept it outside theoretical consideration, treating it as exogenous in the diminutive sense that Hahn points out in this volume. As a result of the recent historical developments, structural change has re-appeared on the agenda of the dynamic theorist and empiricist of the First World economies, too.

The mechanism that may provide a unique explanation of self-sustained dynamics lies inside the structure of the economy. This hypothesis was present more than intuitively to the minds of the believers of the endogenous program when forging classical macrodynamics. This was naturally so. More recent theoretical developments have forced us to reconsider our understanding of what makes up an economic structure (to include expectations, decision rules, institutions and rules of game, etc.), but all the recent dynamic literature accepts the principle that it is the endogenous structure of the economy, a set of broadly defined interacting 'fundamentals' that determines the dynamics we observe. The increasing wealth of interesting results obtained in this area springs exactly from the re-consideration of the endogenous inner network that makes up an economy.

The re-consideration of the relationship between dynamics and structure follows different lines, some of which are represented in this volume. If we use modelling styles as classification criterion, we can focus upon the architecture of such models. In fact, if we think of models as computing devices, then their formal structures are architectures just like in hardware structures. Hence, we may compare models built upon a serial with models built upon a parallel architecture. In this light, the various lines can be grouped into only two views, reflecting distinct modelling strategies but also different images of the economic world. In one of them, the economy is seen as a large-scale replica of a 'standardized' economic agent, which is a complex entity by itself and therefore encapsulates whatever is complex in the economic process. Hence, either the agent is a metaphor for the system, or else, the latter is a metaphor of the former. This is a *serial view*, in that the model of the whole economy is a scaled-up copy of the model of the economic agent (or vice versa), interaction between agents adding but complications to the basic mechanism. The *alternative, parallel view* depicts the economic system as fundamentally a web of interacting parts (e.g. typically, agents but also institutions, markets, rules etc.). It is their interaction that determines economic dynamics and whatever complex features it may exhibit in time and space. The corresponding strategy simplifies the description of the small component unit, and simple agents/markets/institutions are made to interact to produce complex dynamic outcome. These two views have always been simultaneously present in economics. Their difference becomes relevant as soon as we leave the safe nest of the equilibrium-only analysis and extend our walk to the frontiers of out-of-equilibrium dynamics.

The dispute between the two views was never settled in favour of one or the other and this should be no surprise. (The same situation exists in the computing industry too, with the conflict between supercomputers and the philosophy of the web.) So far, neither modelling philosophy, too often taken to reflect pre-theoretical or ideological views, has proved superior. This book puts together examples: the macroeconomic chapters in Part II reflect mostly the former viewpoint, chapters in Part III the latter.

The conception of the economies as decentralised parallel structures of decision-making units has been traditionally considered the gateway to the dynamics of instability and fluctuations, in general what is now called complex dynamics. The classical theories of the business cycle as a disequilibrium phenomenon are children of this very idea, crystallised in R. Frisch's notions of structure and macrodynamics. An anticipatory analysis can be found in the contribution of Richard M. Goodwin on the dynamical coupling between sectors, where the mere phase interlocking between otherwise regular parallel oscillators is shown to be able to generate many sorts of complicated sectoral and aggregate time series. It may be useful to compare it with modern exercises on endogenous fluctuations and chaos where, instead, complex dynamics is basically the result of a non-linear model of a single-sector macroeconomy (thus, in the sense above, they show a *serial view*). But there is now also a vast literature on dynamics from interacting heterogeneous components, e.g. fundamentally economic agents, but also markets and sectoral growth cycles. The contributions appearing in this volume can be seen as a natural extension of the classical approach. Such models also try to cope with the issue of co-ordinating the disaggregated framework with aggregate outcomes, re-uniting micro and multisectoral with macroeconomic analyses. Does interaction *per se* generate growth, as well as, or as much as, fluctuations? Some of the contributions presented hereafter take up this point.

## Parts I and II

The interaction between economic fluctuation, growth and structural change is the main thrust in Part I which is dedicated to a survey of facts and interpretations. The strength of such an interaction is the fundamental motivation for Solomou's rejection of the 'methodology of stylised facts' searching for repetitive patterns and 'dynamical laws' of one sort or another. In an essay rich in both historical reconstruction and methodological reflections, the author highlights the complications involved: the varying patterns of causality/interdependence relations between the key factors of shorter term fluctuations, and the interlocking of oscillations at various frequencies with structural change. He points out that, contrary to common beliefs, the post-war experience of growth in the developed countries is fundamentally a unique string in a long time series of events. Thus, the author promotes a historical perspective as an alternative the methodology of stylised facts which yields anyway a rather unstable and thus interpretation-unreliable set.

Yoshikawa focuses upon the exemplary intermingling of growth and structural change in the post-war history of Japan. He criticizes in particular various existing



interpretations of the rapid growth era, to propose a two-phase model whereby an early (1950–60) modernisation process of a Lewis-type dualistic economy is followed by a dramatic break and re-orientation. The change in household structure and urbanisation, driving labour force away from traditional agricultural employment and creating new urban demand, generated the unprecedented expansion of the earlier phase. This yielded, at the end of the era, to market saturation creating the need for a new, externally driven expansion. Domestic demand was substituted by foreign demand as an engine of growth. The chapter contains also interesting remarks on the prospects of NICS of various generations and on the experience of countries like Italy sharing with Japan a dualistic structure.

In the chapter by Böhm and Punzo a new framework is introduced where growth is naturally associated with fluctuations and structural change is defined as a qualitative change in the growth model, thus spanning a dynamic menu that is richer than expected. The chapter reviews in this light empirical findings for a set of European countries, the USA and Japan. It is shown that these went through repeated structural changes, but also that growth models were different across countries and were strung differently in each country's history. Observed high irregularity and cross-country variability reflect shock responses, of course, but more deeply they reveal the workings of the countries' own structures. Looking for changes in the growth model is one way of capturing structural change, and it seems to be the most natural one in the formalised setting in the dynamical systems style: it is a regime shift. The notion of regime dynamics translates naturally into that of Day's multi-phase dynamics, whose application to very long run growth is well illustrated in the chapter jointly written with Pavlov (opening Part II). Their Generalised Evolutionary Model (GEM) focuses upon the evolution of economic and social macrostructures through phases of growth following sometimes an irregular, by no means determined sequence, and it accounts for such an evolution through the working of an internal instability mechanism. The GEM is calibrated to reproduce (in the simulation sense) what is known of the history of mankind, an exercise which illustrates an approach to qualitative analysis aptly termed *qualitative econometrics*.

In fact, the output of a dynamic model exhibits scenarios, artificial histories in other words. In general, what matters in these simulation exercises cannot really be the quantitative coherence or closeness of the artificial to the actual time series, so that debate goes on about their uses. One proposal comes from the real business cycle approach, illustrated in the chapter by Prescott, where some quantitative criterion is retained to assess the model at hand against evidence. As an alternative, following Day and Pavlov, artificial histories can be treated as qualitative descriptions. Their worth is in their capability of reproducing the shifting across phases (or regimes) following a given known pattern. Thus, the model may explain to a certain extent features of actual macroeconomic behaviour; adding some extrapolation exercises, we get to qualitative econometrics.

Clearly, an economy whose history exhibits repeated regime or phase switches can hardly be described by an equilibrium technique. The analysis of scenarios of out-of-equilibrium dynamics is the centre of the neo-Austrian approach proposed by Amendola and Gaffard, highlighting the conditions for the emergence of co-