ON COMPLEXITY IN SOCIAL STUDIES, THE CASE OF UNEVEN DEVELOPMENT*

Valentin COJANU**

Abstract. *Unevenness seems to control, besides material prosperity, important characteristics of social life as well; there is a pervading popular sense of accidental, inevitable evolutions that govern people's life along imbalanced and probably undeserved destines. This paper attempts to dismiss one common view that there is a tension between 'formal' and 'verbal' models of cumulative causation. Economic modelling as much as historical social analysis may be misleading and at any rate futile provided that one continues to think of economic evolutions in the logic of 'physical' imagery of the natural systems as is suggested by their common recourse to complexity studies' language, mindset, and analytical discourse. The complexity-based argumentative mode reveals inconsistencies in terms of both subject matter and methodology and outlines an incomplete epistemological context in the study of social evolutions as suggested by the theory of uneven development.*

Keywords: *high development theory; world-system analysis; complexity; cumulative causation; epistemology; social evolutions.*

1. Introduction

Uneven development is a result of historical evolutions relative to cumulative acquisition or deprivation of wealth usually assumed to occur within a large geographical area and over a sufficiently long period of time. The topic provokes an elementary question: why should "uneven development" require a different treatment as subject matter than, say, more neatly elaborated alike topics such as "economic growth" or even "development economics" *per se*? The scientific discourse has not been deprived of attempts that seem to have eventuated in settled analytical

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** The Academy of Economic Studies, 6 Piața Romană, St., Bucharest, Romania.

frameworks. Out of these traditions, two theoretical schemas stand out for their encompassing explanatory power: the economic modelling of 'high development theory' (HDT) and the analytics of historical social systems encapsulated by the 'world-system analysis' (WSA).

We argue that the epistemological basis of inquiry in the study of social evolutions can be enhanced by a contrasting perspective of these modes of argumentation. Radically opposing methodological approaches take the two visions apart. As Krugman repeatedly informs, the central feature of enquiry in his tradition – its *differentia specifica* – consists of the fundamental role formalism plays in guiding the investigation towards useful insights, "to help bridge the congenital communication gap between the social and physical sciences" (1994) and to put forth ideas "in the kind of tightly specified models...increasingly becoming the unique language of discourse of economic analysis" where "good mainstream" economics is equated to "full formal models" (2004). The world-system analyst is proposed in her turn a theoretical schema endowed with its own unit of analysis (the 'world-system'), language, method, and core assumptions (cf. Wallerstein, 1974, 349 and Wallerstein, 2004b, 17, 97ff) in opposition to "the dominance of one particular mode of scientific method (which we may label simplistically 'Newtonian'), which has claimed to be the only legitimate mode of scientific behaviour" (Hopkins and Wallerstein, 1996, 7).

We are in the presence of two reputed bodies of knowledge which ignore one another by virtue of a self-professed claim to *the correct approach*. The more so intriguing, three similarities along their respective paths of inquiry startle any observer, namely the question they ask, the answer they find, and the wholeheartedly embrace of complexity studies' epistemic insights.

The next section proceeds with an overview of these similarities and attempts to dismiss one common view that there is "a tension between 'formal' and 'verbal' models of cumulative causation" (cf. Setterfield, 2001). The discussion shows instead that the theory of uneven development is built on an equally shared core set of consolidated premises. On this basis, it is subsequently put forth a criticism of the two bodies of knowledge. We propose a more radical observation which does not partake of those opinions that attempt to find a right balance between quantitative and interpretive methods in the study of historical evolutions. Economic modelling as much as historical social analysis may be misleading and at any rate futile provided that one continues to think of economic evolutions

in the logic of 'physical' imagery of the natural systems as is suggested by their common recourse to complexity studies' language, mindset, and analytical discourse. Of particular interest here, the comparison between their argumentative modes reveals inconsistencies in terms of both subject matter and methodology and outlines a different epistemological context in the study of economic evolutions as hitherto suggested by the theory of uneven development.

2. The common language of uneven development

The theory of uneven development is obviously inspired by uncontested evidence of increasing differentiation between aggregate economies in historical time. What does it take for a historical accident to propel some countries or regions on the path of development much faster than others? And, following Kaldor's (1960) search for "an alternative theoretical scheme", why things "happen in a certain way and why they do not happen in some other way?" (p. 247). These are the very questions to which, as is going to become evident along the way, both modes of theorizing have proposed an encompassing set of answers that have made them so prominent.

In both perspectives, the theory of uneven development grew out of a familiar set of ideas built on the core concept of *circular cumulative causation* (CCC). We channel the discussion towards the common embrace of 'the science of complexity'– often used interchangeably with 'chaos theory'– a choice that fittingly sheds light on the underlying rationale of uneven development.

The common language of cumulative causation has been a working hypothesis in mathematical writings at least since Jules Henri Poincaré (*Science et méthode*, 1908) asserted:

"A very small cause which escapes our notice determines a considerable effect that we cannot fail to see, and then we say that the effect is due to chance...It may happen that small differences in the initial conditions produce very great ones in the final phenomena. A small error in the former will produce an enormous error in the latter. Prediction becomes impossible..." (quoted by Gleick, 1987, 321).

The mathematical branches of topology and non-linear dynamic systems, which led Poincaré to fame and inspired him the above thoughts, as well as insights from then newly nascent physics of thermodynamics, have so begun providing answers to a scientific study of chaotic behaviour of complex systems. Its mathematical apparatus' capability to substitute

the rules of reversibility and determinism for those of irreversibility and randomness (Prigogine and Stengers, 1984, 8), as well as to depict 'out of chaos' emergence of "rich kinds of behaviour that never occur in linear systems" (Gleick, 1987, 24) has made a strong appeal to scholars in both traditions.

In trying to make sense of the logic of *unpredictability* that so manifestly affect development in its various materializations, both modes of theorizing have seized this methodological alternative that seems to reflect at best a twofold epistemological concern for (1) a valid replacement to justify their overt dissatisfaction against the mainstream view; and (2) an original, insightful conceptual thinking able to embody at once both causal explanation and accidental occurrences.

What one eventually gets consists of two distinct analytical frameworks erected on the common logic of historical accident and indeterminate evolutions. In quantitative tradition, the problem of inquiry arises as an intellectual artefact, under no spatial or temporal conditionality; for world-systems analysts, the experience of uneven development is a dual reality, of systemic and of historical change.

The mathematical models of complexity lend themselves so persuasively to the social study thanks to their feature to resemble real-world phenomena. For example, the asymptotical process intrinsically associated with chaos modelling shows that the developmental gaps widen until dampened by countervailing processes. In historical evolutions this belief in progress or in the ineluctability of catching-up embedded capabilities seems to be the analyst's will-o'-the-wisp. While still remains subject to unpredictable evolutions, the modelled action of countervailing processes that close off the endless accumulation of advantage allows for patterns of periodic reconfigurations of spatial economy in a way which seems to be hard to include, for example, in orthodox convergence models.

In another instance, the 'nonlinear' mechanism is apt to lead to a life-resembling representation by using difference instead of differential equations and hence enabling the process of evolution, be it natural, biological or social, to make jumps from state to state instead of changing smoothly (cf. Gleick, 1987, 61). Evolution proceeds through feedback loops, that continuously reinsert end results as *new* values of the parameters in the system, and is so able to produce *novelty*, of which no foreknowledge is possible. Further still, non-linearity leads to points of bifurcation, that is, points where there are two equally valid solutions for the equations, critical states of evolutions at which established configurations are no longer sustainable. Which equilibrium – read *high* or

low level of development – the economy ends up, runs the argument, depends on the previous history of the system, which in fact is a very technical issue reducible to the change of parameters and endless computer simulations. As the story goes on, *the history* so understood may illustrate at once a recurring narrative of punctuated equilibrium, of growth and decay, and an irreducible random element of historical accidents leading to long-run cumulative consequences.

Scattered analytical narratives have been used in the WSA tradition to depict a historically thick part of the reality as it became to emerge from the sixteenth century on: three different modes of labour control (i.e. forced labour, free labour, and an in-between form, share-cropping); increased dominance of long-distance trade as a source of "rapid accumulation of capital"; a geographical distribution of productive forces as a function of technology, possibilities of transport and communication, and political system; and the consequential emergence of a capitalist world-system distributed across three types of economies, a narrow, rich *core*, a middle zone – the semi-periphery – that enjoys partial prosperity at the risk of shortly possible decline, and, a vast, poor periphery. "Which areas play which roles is in many ways accidental" says Wallerstein (1974, 355), but the overall picture is one of an economy-world which perpetuates inequality to the extent that the core-periphery relationship indicates the degree to which surplus-value is unevenly distributed and cumulatively augmented in the direction of the core.

The thread of reasoning leads again to ascertain that the historical accident of the cumulative effect of small differentials would leave some regions in disproportionate (dis) advantage. Here is a WSA exemplar that concludes on the development gap between Eastern and Western Europe:

"One region has a *slight* edge over another in terms of one key factor, *and* there is a *conjuncture* of events which make this *slight* edge of central importance in terms of determining social action, then this slight edge is converted into a large disparity and the advantage holds even after the conjuncture has passed...The *slight* edge determined which of the two alternatives would prevail. At which point, the *slight* edge of the fifteenth century became the great disparity of the seventeenth and the monumental difference of the nineteenth" (Wallerstein, 1974, 98-99).

Later development of the theory (e.g. Hugon, 1991; Wallerstein, 2004b; Lee, 2004) has however connected the logic of uneven developpment to complexities studies as fundamentally as its rival epistemology. In the new conceptualization, the peculiarity of historical systems implies that (1) they are not eternal and, consequently, "they had beginnings, lives

during which they 'developed', and *terminal transitions*" (Wallerstein, 2004b, 18; emphasis added), and (2) the cyclical processes (medium-run trends, expansions and contractions) along with their crises "cannot be resolved within the framework of the system, but instead can be overcome only by going outside of and beyond the historical system of which the difficulties are a part" (Wallerstein, 2004b, 76).

The intriguing observation that one can be provided with a quasi-identical explanation by two opposed modes of argumentation will be subsequently followed through.

3. Understanding historical evolutions: a critique of the theories of uneven development

Our perspective is grounded on the observation that the *subject matter*, as well as the *method* of both theories are crippled by inconsistency if one follows the logic of complexity in historical processes to its ultimate consequences. The point is subsequently advanced along the lines of a discussion relative to the mathematical assumptions and interpretation of development.

In perfect confidence of the explanatory power of the natural imagery of chaos theory, Gleick (1987) narrates how a scientist of life sciences chooses the analytical toolkit:

"A physicist...finds the right equations from the first principles. Then he solves the equations, if he can. A biologist, by contrast, could never simply deduce the proper equations by just thinking about a particular animal population. He would have to *gather data and try to find equations* that produced similar output" (60; emphasis added).

One defining characteristic of economic modelling is the belief that the logic of mathematical formalism resembles the real world, of biotic populations, as well as of human affairs; what is theoretically possible is of necessity a fair description of economic reality: "Economists insist that their equations actually do say something about the real world" (Krugman, 1998).

Economic systems are indeed prone to unpredictable behaviour, runs the argument of HDT, due to the existence of economies of scale. An early version of the theory (Krugman, 1981) proves that 'uneven development' is a necessary outcome in a two-country model of capital accumulation and growth: on the presumption that the industrial sector exhibits increasing returns to scale, "an initial discrepancy in capital-labour ratios between the

two countries will cumulate over time, leading to the division of the world into a capital-rich, industrial region and capital-poor, agricultural region".

The availability of new modelling techniques for non-linear dynamic systems has made possible a more realistic, detailed view of the economic systems that translates in fact as an ever more challenging mathematical construct. In more developed variants (e.g. Fujita et al., 1999; Krugman, 2004), the economic descriptions can barely be visualised or theoretically assembled unless a computer simulation emulates a real-world situation.

In a typical simulation of, say, the three-region case, the computer run would yield four equilibria, three in which all manufacturing is concentrated in one location and one in which there is an equal distribution of manufacturing across locations. Where have these outcomes resulted from? It turns out that the answer is but a figment obtained *for the most interesting range of parameters*, which for that matter were only three, i.e. the elasticity of substitution among products in the manufacturing sector, set for this example at 4; the share of manufactures in expenditure, set at 0.2; and the transport cost between any two locations, set at 0.4 (cf. Krugman, 1994).

It is only now that details of economic evolutions enter the scene. The location of economic activities is at the behest of the simultaneous work of centrifugal and centripetal forces, which in their turn are determined by a complex combination of variable factors. For example, the cost of transportation may be conducive both to a greater mobility of factors or to a locally based economic development, as the availability of pools of knowledge and technological spillover may reinforce or abate the trend when abundant or scarce, respectively. The economic landscape thus changes in unpredictable configurations from path dependant and locked-in processes to endlessly agglomerative processes and vice versa. Prosperity (poverty) follows the inherently superior (inferior) activities in terms of generating increasing returns.

The preceding discussion has shown that the essential feature and minimal assumption of cumulative causation consists of the emphasis on economies of scale. That income-generating activities possess distinct intrinsic capabilities to spawn increasing returns to scale may indeed be a source, *the* source, of exponential differentiation, but neither is this of necessity the case, nor the direction of causal link, if any. That is why our contention to economic modelling regards its in-built capability to provide a 'historical' account of equilibrium and not of *development* per se, with a resulting significant loss of critical social detail along the way.

One may nevertheless notice a nuance of interpretive concession. As at any moment in time the future course of diverging evolutions is explained by *a set of initial conditions* these latter may be conceived in terms of historical specificity. "Whether one prefers to explain the greater initial accumulation of capital in one region by the slave trade or the Protestant ethic, this is a model in which small beginnings can have large consequences". (Krugman, 1981) By implication, *any* other historical set of circumstances could so replace economies of scale as model's premise as long as, of course, they could be made tractable in quantitative terms.

It may be also retorted that the choice of equations' parameters in the first place has been indeed a case of economic appraisal of how the world works. This assertion is already weakened by an assumed Friedmanian type economics which advocates analysis on its capability to predict evolutions irrespective of the realism of its assumptions. "A set of clearly untrue simplifications… dictated partly by guesses about what is important, partly by the modelling techniques available" (Krugman, 2004). For those insensitive to these presuppositions, it could be further assumed that the formal model may turn someday into a more realistic image of the world based on similarly more realistic assumptions by virtue of increased computational complexity and continued recalibration.

For this reason, our counterargument that critical details in the representation of subject matter get lost in the modelling approach apparently becomes superfluous. This is not however the case precisely because it is the very logic of formalism and not its analytical capability which is of little relevance in historical contexts. Its main explanatory power is based on in-built 'predictive' characteristics of the models, which misleadingly takes *mathematically necessary* outcomes for *historically possible* economic evolutions.

Consider again Gleick's narrative of the choice of method. The mathematical parameter, say x, lends itself to interpretation across scientific disciplines *exclusively* according to the researcher's modelling needs. The amount of heating or of friction in physical systems may correspond in biology to fecundity of the fish, the propensity of population to boom and to bust, concentration of substance, whereas in economics metamorphoses into concentration of manufacturing or of employment in a given region or industry. What is used to describe characteristics of population like birth rate, death rate, or the amount of resources available becomes characteristics of local levels of economic activity such as migration, share of income spent locally, size of market or the region's

'export base' (cf. Gleick, 1987, 60, 63; Prigogine and Stengers, 1984, 194, 160; Fujita et al., 1999, 27-28).

By the same token, the computer simulation in economics will as meaningfully describe the successive evolutionary steps of the process dependent on some parameter *x* as in physics or in biology. The isomorphism translates from cases of climatic fluctuations or ecological evolution to spatial configuration of larvae of coleopteran, construction of a termites' nest or arrangements of a population of macromolecules to examples of spatial configuration of economic activities or of emergence of dominant cities (cf. Prigogine and Stengers, 1984, 181, 190, 194; Fujita et al., 1999, 27-28) according to the technique of choice. The logic of reasoning is of purely technical character: the degree of nonlinearity and hence of unpredictability rests on the abstract manoeuvring of the various levels of parameter *x*.

The emerging picture of evolution includes, in truth, explanations of "the nature of the positive feedback that can lead to self-reinforcing growth or stagnation" (Krugman, 2004) but only for a snapshot of its temporal sequence. Capturing historical growth and development processes in 'formal' models does not make however possible to escape the trap of linear chronology. Evolutions cannot be accurately explained along the *widening gap* curves: the increasing complexity of production and social life in general is neither unambiguously beneficial nor harmful to growth, nor do circumstantial factors inevitably and irrevocably doom an economy to a future of relative decline or progress.

To bring the argument more forcefully to light, let us take an example fully disclosed in its most significant details by various researches. The Dutch economy was for fairly long time – cca. one hundred years – the leading force of economic progress in the sixteenth and seventeenth centuries. This achievement was made possible by a unique combination of economic capability "in the historically oldest form of food production, that of gathering, in this case the gathering of fish" (Wallerstein, 1980, 39) and a shrewd control of power in the Baltic trade. The whole set of economic activities – fishing industry, agriculture, livestock husbandry, textiles, shipbuilding – constituted itself indeed in a favourable environment, with its forward and backward linkages, but only a peculiar contingency embodying the circumstances of political power and economic tradition triggered the boom. The envying naval position in the Baltic's in fact reinforced the advantage of the shipbuilding and eventually placed the Dutch "in the happy circumstance of the spiral effect: circular reinforcement of advantage" (Wallerstein, 1980, 40).

The Dutch economy example is just an instance of the causal sequence that connects the monopoly power of "trade circuits and communications" (Braudel, 1982, 153) to ordinary episodes of economic life. A distinct implication of this historical account is that specialization does not appear any more as mere result of the interplay of maximizing decisions in a constrained environment. It even comes out that its relevance in determining a certain course of evolutions in the long term is virtually nullified as long as prosperity has recurred mainly in association with the influence and political power of deeds of trade. What conventional economic theory expounds as reciprocal benefits of free trade, the historical fact describes rather as an indeterminate interplay of historical circumstances. In the light of historical evidence, the famous Ricardian example of Anglo-Portuguese trade becomes an historical outcome of "an inheritance, the consolidation, historically achieved over time, of a situation dating from some earlier period... established progressively as a chain of subordinations" along which "Portugal, once a rich country…had been pushed towards the other direction [of unequal exchange]" (Braudel, 1984, 48).

The supposition of economies of scale or of any other tractable economic fact as one all-covering causality is further weakened by other works that place cumulative advantage within a rather diverse range of sources besides power relations. For instance, Neckerman and Torche (2007) and Berger and Elsner (2007) emphasize the circular cumulative causation of specific organizational contexts, whereas Martin (1999), in the same vein, enlists a host of important locally-varying factors (e.g. infra-structure, state spending and intervention, regulatory arrangements, human capital formation) to make up for what geographers call "institutional thickness".

A claim to valid interpretation is also advanced by the literature that ascribes a role for "growth spurts" (Fearn, 2004) or "power jumps" (Mann, 1986, 525) as isolated or unique economic episodes instrumental in generating positive feedback over time (se also Martin and Sunley, 1996; Nayyar, 2006). Economic externalities may become indistinguishable in a socio-cultural context that is the millennia receptor of human breakthroughs ranging from animal domestication and iron smelting to satellite television and digitalization of arts.

Even the literature sympathetic with quantitative techniques has to concede a sort of middle-range theorising in favour of historical interpretation. The latter may include concepts like "countervailing and supporting changes of cumulative causation" (Myrdal, 1957, 13, 20),

"attitudes to risk-taking and money-making" (Kaldor, 1960, 228) or "entrepreneurial response" (Setterfield, 2001). The role of increasing returns, of no negligible importance in *ceteris paribus*-based abstract reasoning, goes nevertheless almost unnoticed within a historically embedded sociality which eventually explains why "spatial agglomerations occur in particular places and not in others" Martin (1999).

Our thesis therefore implies that quantitative theorising cannot but lead to results expected by virtue of the in-built features of the model itself. This is just a restatement of the trivial evidence that, by their very logic, mathematical propositions – within the presuppositions underlying their construct – may well prove infallible as the truths are logically deduced from premises which are themselves definitions. For event regularities and law-like phenomena, this approach could indeed make sense, but as will become evident in the ensuing discussion of the interpretive thinking, they occupy but a secondary position in the economic study.

4. Concluding remarks

It might be assumed that, in a more historically based study of economic phenomena, unpredictability is essentially linked to the randomness of the overlapping sequences rather than *a priori* centres of agglomeration (attractors) or dissipation (bifurcations), or any other possible natural imagery. The sequential causality implies a more radical view on unpredictability: it not only regards future events, but also past events. In a phrase attributable to Mark Twain, it is hard to make predictions, especially about the past.

Historical specificity embedded in the subject matter (e.g. uneven development) builds up the argument from broad historical sequences (e.g. capital accumulation, control of power) to narrower and subordinate, explanatory sets of events (e.g. capital-labour ratios, trade cycles) to the least historical events, those historical particulars, that recur more or less identically over time, such as pricing in the period of severe drought or selling under conditions of monopoly, and which are characteristic to a market economy in this very narrow sense.

"Where chaos begins, classical science stops", said Gleick (1987, 3), whereby pronouncing a radical departure from a resolutely deterministic approach to physical science. Soon after, scholars from various fields, including social science took in earnest his predicament, for better or for worse. It is much in the spirit of this paper to conclude by saying, where

socio-economic evolution begins, natural imagery withers. The logic implied by this paper suggests that we do not possess an explanatory framework akin to natural events when inquiring about economic phenomena, but we do now what to look for: a historical toolkit that combines understanding of sequences and techniques for the particulars.

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