Frustrated Physicists x Baffled Biologists Yields Giant Hybrid Delphian Economists ???

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Nature offers many examples which parallel economic phenomena. Such ‘parallels’ may only serve as communication enhancing metaphors in Economics. Biology may help economic theorists to develop more powerful classification and systems descriptions. Biologists can conduct controlled experiments, and thus relatively safely expose the collected data to statistical techniques drawing on Fisher’s experimental paradigm and the Gaussian theory of errors. This avenue is rarely open to economists, who generally are unable to design control real experiments. The paper explores the potential use of a few metaphors borrowed from Biology; there are also comments on the non-experimental data problem, as well as a reference to the potential for examination and testing of more complicated theoretical models via simulation techniques.

Economist and biologists are required to study quite dissimilar processes and systems. Nature makes far more pre-programmed choices than conscious choices. Even though permanent changes can be observed, rigid deterministic and stochastic rules dominate behavior and outcomes. Nature is not often devious; it is ‘organized’, there is competition, but it does e.g. not form cartels or engage in inside trading. Biologists are able to observe many of nature’s constituents and processes first hand, at variable ‘resolution’ levels and depths; there are often opportunities for replications, and for controlled experimentation in natural settings as well as under artificial circumstances in laboratories. Biology has developed powerful classification schemes and systems-mappings describing the natural domain approximately as a continuum into which new knowledge can be effectively integrated. Nature does not possess media of exchange, such as money, nor asset markets. Exchange is of vital importance to the bio-system, but nature has, per se, no organized markets for ‘goods’ and ‘services’; proximity, pre-programmed transaction rules and compatibility, or opportunity, are the dominant forces driving the systems’ ‘accounts’, which may or may not balance [and not even tend towards equilibrium]. Still, it is quite easy to find at least metaphors within the bio-system which mimic economic behavior or processes. Economists may refer to dominance, predatory behavior, catalysts, symbiosis, parasitism, ana- and katabolism, osmosis, hypertrophy, metamorphism, aging, evolution, etc. ‘Parallels’ between nature and the economy may merely facilitate communication of notions or ideas, or polarize arguments or categorizations. ‘Parallels’ are unlikely to enrich theory significantly, unless they can serve as effective blueprints for models capable of incorporating additional important features and relationships. Below, a few selected ‘parallels’ between nature and the economy are briefly considered. Finally, opportunities of Biology and Economics to rely on experimentation and simulation is brought up.

The Great Macroeconomic Symbiosis

This casually developed case borrows the notion of a symbiosis [S] allowing two or more parties to benefit mutually from a given relationship. However, there is a twist; the system as a whole is set back as the intensity of S-activities increase beyond a given level. We are in the macroeconomic sphere, in a relatively rich society. The parties engaged in the symbiotic relationship [S] are, in order of relative power: [A] public authorities; [B] corporations and other businesses handling ‘sufficient’ cash flows, and major asset owners; and finally [C] the proportion of the voting population which can be reached and relatively easily, and influenced by transfers and subsidies.

[1] [A] derives power from reelection, and wealth
from current and future contacts with the private sector; [2] [A] provides, conditionally, [B] access to grants-economies, special privileges, and benefits; in return [B] supplies political contributions [funds, 'moral' support, and possibly even employment] at critical points in time, prior to elections, or during periods when important campaigns are in progress, or following the retirement of representatives; [3] [A] provides [C] with grants and income maintenance, also individuals' obligations to society may be reduced, and public goods prices may be set to zero or nearly so; in return [C] is expected to supply the needed votes to keep [A] in power [or to restore [A] to power [i is the incumbent, o is the leading opposition]]. The symbiosis, \( S = <A,B,C>\), is not a standard part of macroeconomic theory, even though, \( S \) is capable of inflicting considerable transitory or permanent systems damage, fostering e.g. inefficient allocations, or productivity or creativity reducing behavior. At the extreme, \( S \) can stand as a serious threat to economic and social stability, and to 'fair' sharing. Ignoring time, the social net benefits form an approximately s-shaped relationship as long as \( S \) remains in the range where net-benefits are positive; to the right of this range, social net-benefits take rapidly large negative values. Looking at reality, has \( S \) inflicted damage on the macroeconomy? \( S \) appears to have played a significant role in the process triggering relative decline of more than one advanced nation economies; \( S \) appears to have been an important force taking budget deficits and government debts to exponential growth paths. \( S \) appears able to shift the 'quality' of collective decision making far away from the theoretically assumed form. \( S \) can probably be measured by looking at political contributions and public sector consumption, as well as by looking at the administration of grants economies, at regulatory practices, and at deviations between intended and actual use of social welfare nets. If a S-Index is constructed, it can be applied as an 'enhancer' or 'deflator' to the authorities stabilization and development efforts [i.e. to predicted impacts, following monetary and/or fiscal policy interventions; and to predicted impacts, following support for e.g. training, education, R&D, and productive capacity expansion]. Traditionally, economists have tended to ignore important limits; not only limits to growth, also the limits beyond which macroeconomic deficits and debt loads 'dare' not move. Text after text reassures the reader not to be alarmed when exposed to massive national deficits and debts. Theory assumes [probably incorrectly] that the system is fully self-correcting under all circumstances; theory is not concerned with real change and sharp breaks. At some 'point' a system under pressure, will not bounce back; once it has become suitably inept, obsolete, and corrupt, revival will have to wait for a long, long time. Nation- and city-state economies' have risen to power only to decline steeply later; our history records these events, while Economics is preoccupied with relatively small deviations from current norms, unable to predict real turning-points. The failures to explain and predict, occurred not only because interventions changed parameters and relationships, or because new economic orders eased in; there are other problems, e.g.: [1] relative decline of the quality of the public sector's decision making and management capabilities [S moved far to the right]. [2] decline of the quality of new human capital in spite of increasing knowledge intensity within virtually all segments of every economy, [3] insufficient R&D, [4] insufficient creation of jobs, [5] increases of spending and borrowing, across the board, not matched by productivity increases — none of these phenomena are candidates for ceteris paribus treatment, or for exclusion. Biologists are acutely aware of nature's tendencies to change; they can move quite elegantly from micro- to macro levels and back; and they do not tend to neutralize the effects and roles of time with the help of discounting; they are not heavily addicted to use of tools, such as basic calculus, which offers no meaningful solutions once quantum jumps, discontinuities, discrete behavior, changing parameters, etc., must be taken formally into account.

**A Production Model Permitting Catalysis and Retardation**

Consider a production function set [\( q = \phi \{L,K,E,\bar{u},l,m\} \); with quantity being a function of: [1] human efforts and available human capital combined, [L]; [2] physical capital [K]; [3] external support economies [E]; and [4] stochastic forces [\( u \)]. The function depicts production of products/services taking place within the set containing different firms or production lines (i=1,1) using technology \( m_i=1,r_i \). Focusing temporarily on L, let L have a modal unit impact [g] on q. However, L enters the model as \( (e^{r_i}g(L))^\alpha \); with \( c=1,r \) being a productivity enhancing 'catalyst index' or factor; and \( r=1,v \); being a 'retardation index' or factor. L represents an amalgamated containing floor workers, support staffs, and management; thus c and r must account for the combined net-contributions of teams' corps de esprit, sufficiency and quality of work environments and of the leadership provided, internal stresses and
bottlenecks, discriminatory practices, etc. A subsequent model specification, which will not be developed here, may disaggregate L and also include interactions among at least L and K, as well as allow for the relative quality of K together with stresses emerging as q approaches the limits of K lm and/or as K reaches a critically high age. The outlined function set represents a passive one, i.e. the industries are not given any formal opportunities to learn on the run, to change course and form and implement appropriate responses to perceived problems. If a collection of living creatures with sensors and processors are given opportunities to take action, to learn, and to react, only an active model will do. To convert the just outlined function to active form, it will be necessary to add data collectors and processors (D&I), as well as decision blocks (P&M) which also implement findings. The active model which could be given a short-hand representation of the form:

\[ q = \phi \{ L, K, E, u, i, m \}, \{ D & I \}, \{ P & M \} \]

must be solved recursively, possibly adding goal programming- and simulation loops as well.

Biologist has here, so far, merely provided metaphors ("catalysts", "retardants", "sensors", and "processors"); to follow the footsteps of biologists, economists would now be obligated to determine what c and r are "made", how they affect productivity, and what [if anything] can be done to influence c and r. It would be a good thing, if economists became more curious about what "it" is made of, and how "it" actually works, rather than being preoccupied with formation of, and defence of theory which falls uncomfortably close to ideology.

Introducing Intra-Group Support into an Investment Environment

The neoclassical investment model focuses generally on a single project, considered in isolation from all others. The model postulates that every firm’s investments are conditionally motivated by non-observable sums of present values of future return streams. This model does not take project interdependencies, and the over-all financial position of the investing unit into account. Investments (I,J), (J=1,J) are risky and subject to considerable uncertainty. Risks associated with a single project, can only be assessed on the basis of available accumulated past experiences and/or via subjective future focused beliefs. The basic neoclassical model makes no realistic contribution to minimization of firms’ risk of failing. Nor do empiricists using these models pay formal attention to the massive data-theory gaps which confront them. It makes no sense to focus just one single project, over its anticipated period of existence; what matters is the financial unit’s health and strength [its balance sheet and its ability to cope with all the units responsibilities]. The role of the individual project is only of interest when the question is: how it affects the financial position of the investing unit over its likely period of existence. Present value positions are not of much interest here, either; as in nature, when the state of the system (i.e. the current and anticipated financial position, the relative appeal of the units equities, etc.) crosses one or several ‘danger limits’, the entire unit and all its projects will face a variety of problems, if not outright failure; crossings can happen any time.

The typical investing unit [e.g. a corporation] will diversify its collection of investment projects to minimize its risks of encountering a situation where the weighted ‘sum of targeted deviation-variables’ fall below the ‘acceptable’. There are many projects involved: [1] some which are new, \{Y\}; [2] some which are established and able to generate surpluses, \{AS\}; and [3] yet others which are established but being phased out, \{AR\}. That is the financial unit is accountable for: [1] set \{Y\}, young, unproven and indebted, cross-subsidized projects [equivalent to a living population’s juveniles which may or may not survive to become productive, surplus-generating adults]; [2] set \{AS\} [equivalent to a collection of normally surplus-generating adults]; and [3] set \{AR\} [equivalent to a collection of retiring adults [of any age], which may require support from \{AS\} to cover all obligations]. The set \{AS\} must be large enough and strong enough to support itself, \{Y\}, and \{AR\}, as well as able to cover most or all of the unit’s overheads [including e.g. R&D, staff, and technology upgrading, and start-up costs of new ventures], as well as able to generate funds covering a large portion of the unit’s external obligations [taxes, fees, debt servicing, certain dividend payments, etc.]. This approach to survival and development, runs parallel to the behavior of a highly organized social structure formed by e.g. animals or humans. The unit’s over-all objective is here unit survival in the long term through steady renewal and improvement of the unit’s capabilities, and of the opportunities confronting it. There are many objectives pursued at the same time, subject to hard- and soft-constraints [the latter could be represented by a suitable number of deviation variables [perhaps deviations of Z-scores from perceived critical thresholds]]. Also this model would have to be solved recursively, subject to alternative scenario. It is necessary, to allow for
birth and death, for transfers from the mature to weak, and for adaptation of surviving projects. At each stage the financial state [current and projected] of the investing unit as a whole, as well as impacts of individual projects on the unit’s future, will have to be assessed; unfavorable paths must be abandoned in favor of the most promising. In this investment and reorganization environment, the investing unit takes a pragmatic view of the content of its project collection; the aim is not simply to stay with the same products or to pursue profit maximization; the set of aims includes: ‘optimal’ renewal and development, as well as maximization of the likelihood of the investing unit’s survival.

Securing Realistic Feasible Variable Ranges and Solution Spaces

General Equilibrium theory [GE] can only be considered ‘general’, provided all possible outcomes fall within the feasible, real solution space. The key issue is identification of the feasible space; any solution, say, greater or equal to zero will not do. Traditional theorists have been satisfied with GE models able to establish equilibrium solutions subject to numerous convenient assumptions, and postulates; while important restrictions on demands, supplies, and external impacts were not formally imposed, if they were considered at all. Economics has, as a result, helped to sustain the naive belief that growth is unlimited, that important critical mixes and sequences ‘some how’ will emerge automatically, and that excess exploitation and excess waste can do no real harm. There are many roots and branches sustaining this folly; one is the now nearly forgotten von Neumann dynamic growth model. This model could not depict a real economy. It was, however, a model which could, following modifications, be applied in nature to a system resembling an automata. A modified model could e.g. describe the behavior of a rigid ant or bee society, exposed to constant returns to scale, and denied all forms of technical change [the modifications would impose division of a given society once maximal size has been reached, and eliminations of any new societies generated in this fashion, once the global growth limit is reached]. Economics gains nothing by adopting austere biological systems models; on the contrary there are losses because such models tend to establish charismatic lives of their own [soon they have hordes of economists well trained and busy taking care of them, and busy taking Economics down dead-end lanes, as they extend and refine them]. The von Neumann model comes to mind because most economic theory and associated models, readily at the end of the day, refer to ‘optimal’ solutions void of essential concerns for those they were supposed to provide effective explanations and/or advise to [namely humans, and the environments around them sustain them, and which must be sustained itself]. The extreme von Neumann model secures only subsistence wages for workers, only the products which are easy to produce are manufactured, technical coefficients and interindustry relations are constant, members of society have no choices to make [they are merely robots], and the derived maxima are absurd if exposed to the light and storms of reality. Modern economic theory may not appear quite so austere, however, the distance to von Neumann’s model is not that great. Whether critical restrictions and mixes relative to the human environment and relative to the natural environment are ignored, or covered by assumptions is immaterial; the fact is that they do not show formally up in either theories or models, with the result that these accommodate outcomes which cannot be considered feasible.

Economic theory has traditionally virtually excluded the most important capital stock of all, human capital, while growth potentials were effectively unlimited [the conventional concerns for scarcity does not impose upper bounds]. Human capital stocks, and the investment processes which must improve and maintain this stock proved, so far, too difficult to handle, because critical mixes and quality variability could not be easily incorporated into abstract models. Ignoring the most important factor set, economics helped even technologically advanced economies to converge towards what will be called ‘soft and dumb economics’ for the lack of a better label. Many economists classify this convergence as a recession, recommending the conventional cures — when diagnoses as well as cures are wrong, the patient is likely to get worse.

In his 1971 book “Anti-Equilibrium”, Janos Kornai called for “real theory”; i.e. for theory far richer and far more ‘relevant’ than the traditional GE theory. Kornai distinguishes between “Decision Theory” [“axiomatic in character” ... thus strictly speaking, “a logical mathematical science” ], and “Economic Theory” [“a real science, the subject of which is the explanation of economic reality”]. Kornai was ahead of his time, in the sense that he was aware of Main Stream economists’ inability to deal with what was to come, i.e. the break up of centrally planned economies, and the shift to extremely knowledge intensive, highly competitive, globally integrated economic systems. Modern theory has not served society well with advise, as
feared by Kornai already twenty to thirty years ago. Main Stream Economics is essentially identical to what he calls “Decision Theory”; theory relying on naive ‘free’ enterprise and market notions, as well as on benevolent, non-corruptible institutions. To improve their tools, economic theorists will have to do most of the hard work themselves, and without continuing the tendency to merely nibble at the edges of what is. Biology can serve as an example of a science which does not neutralize the real difficulties by adding overloads of convenient assumptions. Biology can also help economists directly, to come to grips with the limits to growth, and the needs to stay on the right side of critical boundaries. Similar cooperation with the other social sciences may help economist to take effective account of the human environment’s capabilities and requirements.

Experimentation

Biologists can, like members of all real sciences, engage in formally designed and controlled experiments in respect to most processes and problems of interest to them. Economists have to allow the economy itself to perform virtually all their ‘experiments’; they can neither design nor control these. In the verification phase, Biometrics and Econometrics provide estimators and inferential tools which confronts models and available data. However, the two analytical arms fare very differently; Biometrics is generally not in conflict with the experimental design paradigm, while Econometrics generally is. The Econometric “textbook approach” proceeds as if it is proper [unfortunately it is not] to adopt a hybrid-approach based on [1] Fisher’s experimental design paradigm, and [2] on Gauss’s theory of errors5. Applying the theoretical- and the econometric “textbook-approach” to passively generated, non-experimental observations, possibly covering several distinct epochs or strata, violates fundamental assumptions, i.e. conclusions are likely to be wrong. The approach is also incompatible with the requirements of the four major analytical tools used by economists: [1] formal logic and set theory [demanding constant categorizations and definitions]; [2] basic calculus [designed for well-behaved, non-stochastic constant parameter relationships containing ‘real’ variables undergoing only ‘small’ adjustments]; [3] ceteris paribus conditions and constancy postulates [a set of convenient assumptions and restrictions which alone objective use of logical deduction, often will rule invalid]; and [4] error modelling, and opportunistic variable inclusion/exclusion [both are inappropriate under any circumstances]. and traditional inferential approaches [designed for properly designed and controlled experiments]. Economists will, like everybody else, in Science, have to test their assumptions, treating all variables [including exogenous variables] as stochastic, while utilizing a ‘general to specific’ modelling approach. Analysts must model variables and their interactions, not errors; doing so without use of overloads of convenient assumptions.

Biologists have, in addition their laboratories and their simulation models; economists could develop ‘lab-like’ conditions by resorting to extensive use of advanced simulation tools and models. There is access to powerful desk-top computers and simulation software; e.g. to GPSS, SIMAN, and related discrete simulation software6, making this route practical and affordable. These programming tools provide simulation opportunities not offered by conventional Monte Carlo experiments. Laboratory analyses and simulations permit biologists and other scientists to explore their beliefs and their validity, by studying reactions to imposed assumptions, and restrictions, as well as reactions to shocks, positions of conditioning variables, changing regimes, stochastic parameters, and alternative error distributions, error volatility, etc.. Economic theorists could and should follow their example. A single human mind in the process of developing or refining a given theory, can neither maintain the strict objectivity needed, nor handle the many details which easily can be introduced deterministically or stochastically in a simulation program. Simulation permits theorists with or without data, to explore e.g. the sensitivities of supply-demand systems to parameter or distribution asymmetries, to shocks, etc.. Theorists have numerous opportunities to simulate the impacts of deviations from critical mixes, as well as opportunities to imposes restrictions, and parameter- or error distributions of any type. A macro economist may e.g. explore the performance of a macro model, allowing also for human capital stocks, as well as for what above was called ‘the great symbiosis’ [5]. Or the set of production functions described briefly earlier, could be taken into active mode, via simulation. Simulation environments are, of course, not identical to reality. The main aims of the exercise is to attempt to identify major model gaps and flaws, and to examine the impacts of model extensions.

Concluding Remarks

Do economists need to look critically at the content in their tool-box? The proof is in the pudding — everyone has to ask, for example: How
well did the economists do in the recent past? — for example: [1] did they foresee the new World Order; [2] did they explain and foresee the shortage and the reduced quality of job-offerings, and the shifts to the right of income distributions; [3] did they explain growth and development differences separating the emerging nations; [4] did they stand ready with explanations and cures useful to former socialist economies opting for ‘market approaches’; [5] did they anticipate and stand ready with effective cures when the British Pound and other currencies came under attack; [6] did they foresee the many debt crises now burdening the World’s financial system, producing solutions in time; [7] has the quality of life and the distributions of burdens and shares received adequate attention from economic theorists; [8] has Economics dealt effectively with micro- and macro-level issues and relationships involving human capital [creation, maintenance, financing, critical mixes, and allocation, etc.]; [9] has Economics dealt effectively with short-term and long-term micro- and macro-level issues and relationships involving the natural environment and the economy; [10] has Economics paid sufficient attention to human culture and organization, and to fundamental human behavior at micro- and macro-levels? The answers to these and other queries involve theory appraisal, and e.g. 100 parallel investigations would probably produce a very heterogenous collection of often conflicting findings. Heterogeneity is by itself not a surprising feature, every academic discipline will encounter variety and conflicts. However, eventually a consensus about ‘what’ explains and predicts best must and will emerge; that happens also, more or less in Economics, the problem is that when we ‘take the proof from the pudding itself’, neither explanations nor predictions tend to be of sufficient quality and precision; and Economics seems to be perpetually behind in its detection of major shifts and breaks. Universal prescriptions and a methodology, so tight that all possible ‘-isms’ [Conformationism, etc.] provide identical conclusions, cannot be expected, and regardless of investigator leanings and interests, methodological pluralism cannot be avoided.

Biology can provide many examples of interest to economists. Biologists have accumulated considerable experience with categorical analyses, and they are masters of classification standardization, and development of systems descriptions or maps. What begins as metaphors may wind up as powerful components in economic models, however, it is difficult assess the benefits before concrete cases have been carefully developed and tested. Economists must not pretend that they too have vast collections of experimental data; they must model variables and relationships, not errors. Biologists and other scientists have engage in simulation of complex systems; economic theorists could learn from their example. However, the economy, which is a unique and changing creature, cannot be studied effectively by other sciences; economists must accept the difficulties [not continue to go around them], and they must develop a powerful methodology of their own.

Notes and References
1. The ‘deflator’ side and the ‘enhancer’ side of the index will not exhibit symmetry, and the former will probably have to be used far more frequently on advanced nation macroeconomics.
2. Every investment decision goes through a lengthy preparation process. Realized investments bear often only a slight resemblance to the project envisaged at time of ‘no return’. Non-realizations are rarely detected, and there are no data available for projects which did not materialize. Nor does the economist know much, if anything at all about the evolution of project related expectations from the point of conception, to the point of execution [i.e. in regard to realized projects]. Investment analyses face inevitably severe censoring and truncation: without formal recognition of the constraints on data and information, severe biases are bound to be built into investment theories.
3. Deviation variables refer to actual or projected differences between critical performance related variables and their respective critical thresholds.
4. The critical thresholds could be defined as the ones set down by the most demanding evaluation team — the investment unit has one team, share holders [existing and potential] have another, and current and likely future creditors mount also a team.
10. When trying to look ahead, economists fared generally poorly. Marx did clearly not provide adequate predictions of conditions to emerge in the 20th Century, nor did Schumpeter or Hansen. Extreme monetarists saw ‘only’
inflation dangers. Economists rely on extrapolation, or naive random walks [to make sure they are never too far off, until the major break], and they do not possess a General Theory.