An Essay on Late Structuralism

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Abstract

This paper traces the evolution of structuralist thought from the early European and Latin American structuralists through the late structuralism of Taylor and his followers. The genesis of the structuralist method is located in the writings of the early structuralists and necessarily leads to what neoclassicals call *ad hoc* theory. It is argued that simulation models are the logical outgrowth of the structuralist methodological trajectory and the validity of structuralist method is established by it *scope* as well as its realism.

1. Introduction

In this essay I examine the scope and method of the structuralist school in an attempt to identify precisely how it differs from the neoclassical system, in both its mode of analysis and its criteria for validity. There are four conclusions reached: first, the work of Taylor and his followers can be seen as a coherent outgrowth of not only Latin American Structuralism, as is often observed [25], but also the European or Early Structuralism of Levi-Strauss, Godlier and Piaget [27], [22] Piaget [37]. The early work, both Latin American and European, focused on rigidities and frictions in local economies [5] while in the *late* structuralism of Taylor and his followers, theory not only must account for the "macrofoundations" of behavior, but also global foundations, that is the constraints the evolution of the global system itself imposes on the players. Third, late structuralism is often criticized as *ad hoc* theory because is not grounded in optimization models

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[3]. I argue that the *ad hocery* of structuralism is not an accident but a logical consequence of what it defines as its theoretical object and what it considers valid methods by which the theory is codified. The fourth and perhaps most contentious proposition of my essay is the claim that the nature of structuralist theory naturally leads to numerical simulation modeling as its principal empirical tool. This will not be entirely surprising to some since the simulation approach has gained significant ground in many areas of science in the last decades. Others attack simulation models from the perspective of standard hypothesis testing, upon which the validity of the neoclassical theory is traditionally based. Here it is argued that the structuralist method entails its own internally consistent criterion of validity based on the *scope* as well as the realism of the model.

The paper is organized as follows: the next section traces the lineage of the structuralist methodology from its earliest roots in the themes of *wholeness, transformation and self-regulation.* The following section indentifies the main differences in the structuralist approach according to criteria of validity, comparing the role of econometrics in neoclassical theory to realism in structuralist theory. The use of simulation models is then justified in terms of the classical themes. This A final section summarizes the conclusions.

2. Neoclassicism and Structuralism

At its core the argument of this paper is simply that *realism* plays a more fundamental role, both in the historical evolution of structuralism and its current mode of validation than in the neoclassical system. Initially the orthodoxy embraced perfect competition in a way that was immediately and permanently rejected by the structuralist school as fundamental building block of the analysis. But recent neoclassicism is in flux and has shown considerable flexibility and lack of dogmatic attachment to the simple and unrealistic assumptions of its past.[1] Game theoretic experimental evidence is shaking the foundations of the rational model suggesting that individuals value *fairness* and are often more generous than what self-interested models would predict [24]. Dutt [13] makes the case for some *convergence* of the neoclassical school and structuralism, motivated in part by the blatant lack of realism of the former. There are examples from new trade and growth theory to new-Keynesian orthodoxy that show that neoclassicals can aptly handle imperfect competition and other "distortions" in their models. Stiglitz goes furthest in rendering a *new neoclassicism* more palatable to non-

[1] This essay does not intend to paint the neoclassicals *couleur de rose* and I hope that readers are not unhappy about how it is characterized here. Indeed neoclassicism is only "characterized" rather than defined because of the inherent difficulties in nailing down precisely what is and is not neoclassical.

neoclassicals than the old [46]. Taylor himself notes in a recent essay that modern neoclassicism is little more than an effort to co-opt structuralist's correct observations on how the economy works [51]. This usually takes the form of finding a "first principles" argument that allows the analyst to incorporate the observed behavior in an intertemporal utility maximizing model.

The convergence noted by Dutt is nonetheless one-sided. Structuralists have not nor, it seems, ever will embrace neoclassical "first principles" as way of rasing the truth content of their approach. While neoclassicals may ultimately come around to a version of structuralism, it will be a slow and circuitous journey. Even at the end, structuralists and neoclassicals may well differ on what constitutes a valid argument. We shall return to the issue of "validity" below, but flag here an absence of a dogmatic attachment to *any* theoretical device in structuralism. Rather the approach focuses on the *real,* in both its assumptions and results of its models to the exclusion of privileged theoretical constructs. In my view, this explains structuralists', and indeed Lance Taylor's, early attachment to simulation modeling as opposed to econometrics [47]. This break suggests a research program for the next decades that will follow the lead of other sciences in which simulation modelling has become an essential tool.

This is a bold claim, of course, and must be established. The argument presented here will unfold in two directions: first, we seek to locate economic structuralism in a broader tradition of structuralist writing in the 20th century, a tradition that systematically rejected the reductionist, atomistic approach to social theory. Second, the "early structuralists" validated their work in concrete history and there is a "thematic unity," to use an early structuralist term [16], with late structuralism's appeal to global economy-wide simulation models, on one hand, and a deep skepticism about traditional econometric claims for the validity of rational-model based theory on the other.

2.1. Early Structuralism

Structuralism in economics has a distinguished history. In the 1940s and 50s, it became obvious to the early structuralists, Lewis, [26] Prebisch [39],[40] Singer [44], Nurske [35], Noyola and Myrdal [34], that the nature of the problems facing small, low-income countries were fundamentally different from those of the larger, industrialized countries. As director of ECLA, Raoul Prebisch elaborated the Latin American Structuralist approach: the initial condition in the world economy, as seen from the Southern Cone, was that Europe and the U.S. were already industrialized. Trade along the traditional lines of comparative advantage offered little hope for industrialization while the developed economies would block any effort to gain a foothold in the market for manufactured goods. The developing countries were hamstrung by the structure of the world economy [30].

The working hypothesis was that the forces that made some countries rich and other countries poor were interlinked and the point was to identify the specific mechanisms at work. Increasing returns to scale in the capital and wage goods sectors of the advanced countries was a key idea. The implications were several: first, the developing economies would not be able to compete even on the basis of low wages in the majority of markets in world. Second, in the markets in which they could compete, trade barriers would be erected by the advanced countries to protect the jobs of their political constituencies. Third, in the markets that were residually available, the output of developing countries would largely depend on use of *imported* capital equipment. These three structural features acted in concert to slow the industrialization of the Third World in the immediate post-war period [26] [39]. Initially there was no formal modeling, but eventually dual economy and two-gap models appeared as the formal recognition of different internal structures in the center and periphery.

These observations on the structure of the world economy lay in stark contract to the neoclassical approach which was based on an extrapolation of the mechanics of perfectly competitive markets in general economic equilibrium, as noted. For the orthodoxy, why the advanced countries were rich and the developing economies were poor depended only upon the amount of capital per unit of labor and subsequent labor productivity. Both could increase their income *per capita* by the same means, and relatively independently. The world as a whole would be better off with free trade with both poles pursuing their own comparative advantage.

Even then the realism of the structuralist approach was compelling to many and certainly not all neoclassicals rejected the structuralists position. In particular, Lance Taylor's Ph.D. advisor, Hollis Chenery, embraced the theory as an alternative to the new-left Marxism of the 1970s. The impact was limited however and in orthodox economics, "structure" came to mean simply "localized rigidity". Chenery, writing in the *American Economic Review* in 1975, observed that

> The structuralist approach attempts to identify specific rigidities, lags and other characteristics of the structure of developing economies that affect economic adjustments and the choice of development policy. A common theme in most of this work is the failure of the equilibrating mechanism of the price system to produce steady growth or a desirable distribution of income [5].

2.2. Links to the Past

Chenery and other structuralist economists at the time made no reference to the structuralist tradition in other fields that pre-existed economics such as Levi-Strauss [2] and Godelier [22] in anthropology and sociology, Piaget [37] in psychology and Foucault in philosophy [16]. But it is possible to see structuralist economics, as it emerged in the 1940s, as an outgrowth or extension of earlier work in these and other fields. Jameson suggests the same connection, citing Prebisch who identified the "deep structure" of the world economy as divided into center and periphery as evidence of the similarity of approaches, but does not development the argument in any detail [30][25].

European or classical structuralists often spoke of structuralism as defined in opposition to *other* theory, antithetically, by what it is not. In particular, classical structuralism de-emphasized human agency in their critique of existing social theory. "And in current philosophical discussions," wrote Piaget [37] in 1968, "we find structuralism tackling historicism, functionalism and sometimes even all theories that have recourse to the human subject." Early structuralism sought truth through detailed empirical work. Levi-Strauss's focused on interpretations of myth through the shared structure of language and drew his conclusions from a massive amount of ethnological materials collected by field-workers worldwide [27]. For insights into nature of social systems, classical structuralists looked to mathematics such as the Erlanger program of Felix Klein and the N. Bourbaki who used the concept of groups to establish a constructivist approach to foundational mathematics. Structures were not simply enunciated or asserted but rather they had to be constructed. Althusser spoke of the "production" of knowledge, as if it were a function, in effect, a production function with thought as its output and previous thought as the inputs [1].

Certainly these features are shared in the project of the Latin American and late structuralist school. For Prebisch, the dialectic with neoclassicism was an important and productive force and came to see developing world as the inverse image of the developed. Modern structuralists are also comfortable with copious historical detail and, obviously, mathematical/statistical representation of it. Dutt notes that structuralists begin with "stylized facts" embedded into a coherent system of national accounting identities and structuralist computable general equilibrium models begin with social accounting matrices that provide an system-wide perspective [13]. In practice, Taylor and his followers rely heavily on the knowledge and expertise of in-country economists as they gather the details of the structure under study. Little attempt is made to generalize the data to a

[2] Levi-Strauss work focused on interpretations of myth through the shared structure of language.[27].

one-size-fits-all model, an often derided approach typical of the multilateral institutions and embedded in the neoclassical theory of the ubiquitous rational agent. Moreover, most, although not all, structuralist theory is rendered in mathematics.[3] Here are two important points to make: first there is little mathematics for mathematics sake. Not that structuralists are immune to the argument about the "beauty" of mathematical results; it is rather that aesthetics plays an insignificant role in the design of necessarily messy theory. Second, since the object of late structuralist discourse is the numerically rendered historical record, some mathematization is required for validation.

From classical structuralism, the modern idiom draws its emphasis on the constraints shaping human choice rather than the choice itself. Jameson [25] notes several elements of classical structuralism identified by philosophers of science, Keat and Urry [29], that have reappeared in the modern vernacular.[4] First, interrelated elements are analyzed as whole rather than separately. Second, structures are essential, and often "deep" rather than surface phenomena. Third structures change over time.[5] But the classical structuralists were themselves highly self-conscious and wrote of their method from the perspective of their own practice. Piaget, for example, summarizes the major themes of classical structuralism elegantly as *wholeness, transformation* and *self-regulation.*

2.2.1. *Wholeness*

Wholeness relates to the scope of investigation. Structuralists typically ask a broad set of questions about social and political institutions and their dynamics [32]. Feedback effects play an essential role and cannot be ignored. While it is not inconceivable that "sub-structures" exist, wholeness precludes an analysis of economic phenomena in isolation. Prebisch and the early Latin American Structuralists, as Jameson notes, departed from a view of the world as an "organized set of interrelated elements.." the center and periphery.[25] For modern structuralism, *wholeness* is most fully expressed in the analysis of the world systems, center and periphery together, interlocked in way that renders microeconomic analysis of agents anywhere on the globe entirely secondary. Formally, wholeness came

[3] See [11] for a spirited defense of the method. Lance Taylor's undergraduate degree is in mathematics (from Cal Tech).

[4] These ideas are treated in depth by Lane [31].

[5] Jameson also mentions *semiology* and *binary opposition* as critical elements retained by modern structuralists. As crucial as the notion of cultural interpretation of signs might be to anthropology its use somewhat forced in its application to late structuralist economics. Similarly, binary conceptual frameworks, master-slave, industry and agriculture, center-periphery, etc., appear now as dated signatures of classical structuralism rather than important methodological precepts.

to life in North-South models, pioneered by Taylor, Dutt, Chichilnisky and Heal, and others [48],[12], [7]. North-South models, unknown to the early structuralists, now specify in a consistent and convincing way the mechanisms by which growth and distribution in one pole of the system affect the other.[6]

Thus, wholeness implies that macroeconomic partial equilibrium arguments are largely absent from structuralism [25]. Most of structuralism's results are obtained from either Keynesian one-sector macromodels, two-sector variants of aggregate models or disaggregated multi-sectoral computable general equilibrium models. In the immediate short term, demand determines savings [49]. Savings, once known, has feedback only in the next period inasmuch as it, together with capital gains, determines the rate of change of net financial assets. Structuralist models are often criticized as entirely demand driven; but since net investment accumulates in the form of capital stocks which in turn determines the level of next period's capacity, technological change, productivity, and other supply-side issues are obviously involved. The point is rather that demand must be balanced to the growth of capacity or the economy will react adversely. Structuralist simulation models focus on capacity utilization as the key measure of the economy-wide balance of forces.

In many if not most of Lance Taylor's models, the financial sector plays a key role. Unlike the neoclassical school, the economy cannot be dichotomized into real and financial magnitudes. Financial shocks in the form large capital inflows may influence the nominal value of the exchange rate, but it is unlikely that any one player, such as the central bank, will be sufficiently strong to control the real exchange rate. Agents in structuralist models generally control only nominal variables, and only imprecisely; real magnitudes depend on the overall general equilibrium of the system. Inflation may be caused by inordinate growth in the money supply, but that would be an exception rather than the rule. In most developing economies, money is "endogenous, adjusting to the level of activity and rate of inflation."[49]. Inflation often has roots in conflicting claims or inappropriate indexation or some other localized characteristic of the economy.

Wholeness is ecumenical in structuralist analysis. No behavior is taken as

[6] As the Latin American structuralistsbegan to break away from the neoclassicals, a structuralist analysis of the economic relations between the North and South came into being, but in an immature state. There seemed to be no connection between the work of Sunkel, Prebisch, Singer, Lewis and Levi-Strauss, Godelier and Piaget. Only in Emmanuel was there a suggestion that the structuralists' observations on unequal development could be grounded in a more profound, radically anti-neoclassical theoretical framework [14] . Unfortunately, it was too radical, suffering in particular from the inherent limitations of classical Marxism. The late structuralists were unencumbered by any such theoretical attachments and developed a far more sophisticated vision of unequal development by way of North-South models.

"given"; there are no privileged, i.e., intentionally uninvestigated parts of the social and economic structure. Prices may efficiently allocate scarce resources under some conditions, but price signals may be burdened by the noise of institutional factors or other inherent characteristics of the system. Indeed, signal and noise are often confused and prices can be "wrong" with little negative impact, and sometimes a positive impact on growth. Queues and rationing can develop for scarce goods or foreign exchange and capital controls have a positive impact on growth as in South Korea and Chile [2]. Binding constraints are often built into structuralist models in virtual celebration of the *ad hoc.* Above all there are no givens about the role of the public sector; it can be productive or not depending on circumstances. The relationship between private and public investment, for example, might have both "crowding in" of private by public sector infrastructure as well as crowding out through the normal interest rate mechanism.

The characteristic of wholeness or completeness identified by Piaget, and many others, as fundamental to structuralism leads to significant differences in how the theories are applied. In neoclassical computable general equilibrium models, agents with the same level of income and wealth typically behave, i.e., save and consume identically. Strictly speaking this implies that the agents share a common preference ordering, but more often any differences which may well exist in the real economy are simply ignored. Lance Taylor, as well as other late structuralists, construct models that often contain a wide range of social classes that differ in their behavior, even when controlling for wealth and income [19], [49]. There is no assumption that economic agents are uniform, small or necessarily price-takers. Some may have swift and powerful reaction functions, while others react with a significant lag or not at all. This range of players must be identified by careful analysis of the existing conditions in the country in question.

At a more basic methodological level there is no attempt in structuralism to maximize the information extracted from a carefully chosen minimum set of parameters. The neoclassical general equilibrium model can be interpreted in this way and in this regard is unquestionably one of the major intellectual achievements of the past century. From a minimal parameter set which includes only tastes, technology and initial endowments, early neoclassicals were able to deduce the allocative path of a perfectly competitive economy. In a second wave, the program was extended to include imperfect competition and other distortions, but not with fully rigorous and commonly accepted microfoundations [41]. But less and less could be said about any specific economy to the point that in 1993 Bliss could observe that "the near emptiness of general equilibrium theory is a theorem of the theory"[42]. In his review of the reaction to arbitrariness of the aggregate excess demand function established in the 1970s by Sonnenschein, Mantel and Debreu, Rizvi notes that the absence of microfounded macroeconomics is now widely accepted in the profession. Macroeconomics is increasingly an abandoned field within the orthodoxy as the questions addressed sink into an abyss of partiality and utter lack of wholeness. This is in part due to the nature of the goals neoclassism set for itself.

Within structuralism, early or late, wholeness precludes the “max-min” intellectual project as an objective of the theoretical enterprise. Instead, as seen above, structuralists strive to account for a complete audit of the social setting. Historically-specific parameters, temporary constraints and other idiosyncratic features of a given economy are welcomed in structuralist analysis, enhancing rather than detracting from its theoretical prestige. In this, structuralism runs skew to the project of the neoclassicals and in this regard it is difficult even to contemplate any sort of convergence as suggested by Dutt.

2.2.2. *Transformation*

The early structuralists were sensitive to the criticism that once erected, structures would ossify and have no way to change over time. Theoretical constructs had to allow for change and thus were necessarily dynamic; *transformation* was embraced by the classical structuralists as fundamental to the program. Transformation is related to the third pillar of structuralist methodology, self-regulation, but it is not the same. To illustrate the difference consider perhaps the simplest structuralist model, a Markov chain [4]. Here the state of the system at any time X_t depends on a transformational matrix M such that:

$$X_t = MX_{t-1}$$

where X_{t-1} is the immediately previous state. The matrix of transitional probabilities, M, generates the change. From a structuralist perspective, this model is inadequate in that matrix M is not time dependent and second, it is a matrix, but at least it can potentially account for wholeness in a way that a one-dimensional growth model could not.

Markov processes generate steady states if X is an eigenvector of M and thus the transformational system becomes nontransformational. This raises an important problem since it might be argued that modern dynamic models that refer to long-run steady states are also problematic from a structuralist perspective. They ultimately become static in nature and therefore immune to change; the history that these theoretical structures generate, in principle, stops.

It is certainly true that many intelligent and useful dynamic models, which do converge to a steady-states, have been elaborated by late structuralists, including Taylor himself. But if, as argued in more detail below, the replication of the numerically rendered historical record is the ultimate test of validity of the structuralists endeavour, dynamic models that converge to a long-run steady state are ultimately inadequate to the structuralist project.

As one example, consider a simulation model of any real macroeconomy. In practice, there must exist, at a minimum, three distinct forms of capital stock, firm, household and government. Despite the elaborate theories of arbitrage offered by the neoclassicals, there is usually no observable mechanism to bring about an equality of growth rates of these three heterogeneous magnitudes. Indeed, it is even far fetched to argue that a steady-state could exist in a two-sector model with heterogenous capital, say industry and agriculture. But it is less plausible still to argue that the housing stock, and roads as well as the capital stock in these two branches of production must all grow at the same rate. Hence, steady-state analysis is irrelevant for the vast majority of, dare say all, functioning, empirical economies.

Fortunately this is of little practical consequence since steady-state models have found little or no outlet in *applied* structuralist work. While most structuralist models are indeed dynamic, they are typically made up for the medium run, 3-10 years and may or may not converge to a steady state. Note that transformation is implicitly interrelated to the issue of *wholeness*. Longer horizons are likely to run into an inherent contradictions inasmuch as major institutions can and do change and would then be excluded by a supposedly dynamic structuralist analysis. Wholeness with respect to scope is considered in more detail below.

The deeper methodological issue is that if the steady state is not practically relevant, then it follows that long-run stability cannot be part of the *validation* of the theory within the structuralist idiom. This is not true for neoclassicism; explicitly unstable neoclassical models are virtually unheard of and usually discarded as defective once the instability is discovered. From the structuralist perspective, however, instability can be interesting if there is an evident correspondence to the empirical conditions of the economy under study. As an example, consider speculative runs on currencies defended by central banks. These are often inherently unstable processes. But, this does not mean that they are unworthy of serious theoretical consideration. Instability in the structuralist model simply means that some of the "givens", i.e., the structural or institutional parameters of the problem, must undergo change. Financial instability in Mexico in the 1980s ended with the nationalization of the banking system and Taylor's more recent work has focused on how institutions changed in more or less profound ways as a result of financial crises brought on by globalization.[7]

[7] When dynamics are taken into account in the neoclassical system, it necessarily becomes more structuralist in nature. Take, for example, a rise in the real wage. Will this cause firms to substitute capital for labor? The answer is clearly yes in traditional neoclassical analysis, for all time and place. To say that agents will use more of the expensive factor of production

2.2.3. *Self-regulation*

In classical structuralism, self-regulation refers to the internal rules of the logical system and how those rules can be used to extend the scope of analysis. In mathematics any *group* is a self-regulating system as is statistical mechanics, or indeed any cybernetic or informational system in which learning takes time. Self-regulating systems incorporate feedback mechanisms in which accumulated values of *state* variables affect current-period *jump* or within period equilibrium variables. In this regard, the Markov process described above is transformational but not ultimately not self-regulating.

As noted, self-regulation was thought to be essential to the classical structuralist program and here late structuralism does not stray from its roots; much of the work of Taylor and his followers concern self-regulating systems [48],[49],[50]. Moreover, static models have only been important as special or transitionary cases, when the real object of interest is a dynamic process. This is in clear contrast to the orthodoxy in which many of the most celebrated theorems are obtainable in static models.

Self-regulation means that there is no *external* force that causes the system to follow a determinate path. Transversality conditions, intertemporal arbitrage or other mechanisms that stand outside the theoretical system are impermissible. To return to the example of the three capital stocks discussed above, if no mechanism for bringing their rates of return into equality can be identified as functioning within the structure of the economy under study, it would not be consistent with the notion of self-regulation to include an equilibrium condition as *deus ex machina.*

For structuralists, self-regulation does not necessarily imply predictability. Take for an example the logistic equation used in population dynamics as well as many other contexts:

$$\frac{dx}{dt} = rx(1 - x/K)$$

where x is the population, t is time, r is the base rate of growth and K is the "carrying capacity." In *continuous* time, this differential equation describes a stable path to a steady-state with $x = K$ [8]. In *discrete* time however, the

violates the basic premise of rationality that underlies the model. In the structuralist school, it is common to use fixed coefficients technology for any one period of time. As the economy moves through time, the coefficients can change, but relative factor cost is only one reason why they might; technological change is also an important factor. The typical way in which structuralists model technological change is to link it to capacity utilization. The "stylized fact" is that technological change is labor saving, not capital saving or neutral even though these are often presented in the neoclassical treatments as equally likely alternatives.

analogous difference equation is a simple example of a basic non-linear dynamical system with many of the complexities of higher order systems [9]. The structure is self-regulating but at the same time *chaotic* and unpredictable depending on the underlying nature of the problem.

This is perhaps the simplest and clearest example of a structuralist analysis, a whole, transformational and self-regulating system. The data and in this case even the choice of the units of time not only can make a difference but are indeed capable of the fundamentally changing the conclusions of the analysis. While many chaotic neoclassical models exist, few neoclassical models are designed to include critical dependence on the data describing the structure of the economy. Chaotic neoclassical models seek rather to identify regularities, *despite* the possibility of chaos.

In many applied structuralist models, the central variable which conveys self-regulation is capacity utilization. As noted above, it simultaneously registers both demand and supply side effects and many of the adjustment processes in the goods and labor markets are keyed to the rate of capacity utilization. Investment is most often is related to the accelerator, as is the rate of growth of nominal wages and labor productivity.

2.2.4. *Critique*

The content of this three-part definition of the methodology of classical structuralism, *wholeness, transformation and self-regulation,* amounts to the following: meaningful economic theory which aims to provide policy advice cannot be based on human behavior alone, especially behavior wrapped in flimsy or nonexistent conceptions of time and change. While human agency is not ignored in a structuralist account, the temporal evolution of the social arenas which constrain human behavior is of greater importance. Late structuralist models, as elaborated by Taylor and others, are comprehensive, including real and financial sides, dynamic but not necessarily end driven, sensitive to initial conditions and responsive to the underlying character of the data to which the model is calibrated. Still they have provoked a good deal of criticism. Agénor and Montiel note that the structuralist models may be "sensitive to arbitrary assumptions about private sector behavior."[3]. They also note that the Lucas critique, that decision rules should be policy-invariant, is applicable as well as the lack of any explicit welfare accounting [28]. Finally, structuralist models tend to ignore "transversality" conditions and can lead to conflicts with intertemporal optimization.

The first criticism is by far the most important and leads to the core of the distinction between structuralist and neoclassicals. Assumptions that do not follow the rules of strict optimization are not necessarily arbitrary; they may be historically observed patterns of behavior and if so would take precedence in the structuralist mode over rules that were derived from optimizing behavior but were not grounded in the historical record. Take, for example, mark-up pricing. If there is evidence of regularities in mark-ups available from data or case studies, structuralists will place more faith in this data than the claim that agents "should" behave otherwise. Structuralists are even more skeptical of extending the rational model to political economy and policymaking: how are rational central bankers supposed to behave or government officials in charge of important and highly visible national-level investment projects? In trying to describe public officials as rational utility maximizing agents, neoclassicals run the risk of drifting ever farther from a realistic account of the historical process. There is some validity to the first critique of Agénor and Montiel; arbitrary assumptions can do substantial damage to models and structuralist models are certainly not immune to mistakes, especially when key behavioral parameters must be "guesstimated. The method is inherently dependent on the quality of the historical record. But as the record improves, it will strengthen the structuralist position and weaken the neoclassicals.

The Lucas critique falls on deaf structuralist ears. In my structuralist models of the Nicaraguan economy during the Sandinista period, policy was driven by the external shock of the war. Agents in that country were utterly unable to neutralize government policy (Nicaraguan or U.S.) and certainly the Lucas critique was entirely irrelevant to the modeling of that process. [20],[21] Similarly, the "Tequila Crisis" of the mid-nineties in Mexico slips surly bonds of the rational model. It is very difficult, in light of only the smallest shreds of evidence that the critique is relevant, for structuralists to accept far fetched reasoning based on unbounded rationality. Ricardian equivalence is perhaps the most extreme example of how, in the view of structuralists, the methodological orientation of neoclassicism leads that framework far off track. There have been few other propositions that have attracted so much theoretical attention while at the same time were so completely lacking in empirical content. This statement could perhaps be challenged by followers of contemporary general equilibrium theory as the quotation of Bliss above suggests, but Ricardian equivalence stands apart inasmuch as it is a theorem about *tax* policy.

The limits of the rational framework also with vengeance to dynamic optimizing models. The "transversality" conditions ask to what extent the end state of a dynamic process should condition the path leading to that end state. With structuralist's objections to equilibrium steady state models, the response to this criticism is already clear: is there any empirical or real world relevance to the absence of transversality conditions in practical models? More generally, structuralists ask: Will policy-makers be more likely to believe and therefore use models which are consistent with neoclassical first principles or models which have the "look and feel" of the local economy?

2.2.5. Summing up

Stephen J. Gould notes that had Galileo been a biologist, he would have spent his time at the Leaning Tower categorizing objects according to shape and size, noting that each fell to earth with a unique acceleration.[23] But while structuralists are not overt "lumpers" in the sense of biological taxonomy, neither are they "splitters"; structuralism is not historicism in that theory has a significant role to play. The structuralist approach is distinguished from the neoclassical in that there is no quest for a "unified field theory", some general principle that unites the approach. In "wholeness" structuralists argue that not all problems facing developing economies are facets of one central deficiency, such as lack of savings, distorted markets, or what have you; rather there is an explicit willingness to accept the individuality of each experience. This a weakness from the neoclassical point of view but a strength from the structuralist.

To sum up what this section has achieved and what it has not, I believe it fair to say that while there is no traceable lineage of citation or direct influence between the early economic structuralists, Prebisch, *et al.*, and the classical tradition, there is significant "thematic unity" of the discursive structures. The same can be said of late structuralists, Taylor and his associates, who by-and-large have been uninterested in meta-issues of method, especially how ideas might or might not have applied in other disciplines. But whether self-aware or not, it still seems to be true that late structuralism is guided by concerns shared with the classics. When wholeness, transformation and self-regulation are viewed not as three separate criteria that might appear on a checklist, but rather three aspects of a discursive event, they enjoy some predictive power over which themes tend to recur in structuralism and which do not.

3. Validity

> *The Fundamental Theorem of Econometrics*: There exists a transformation, possibly nonlinear, such that any data set can be shown to support any hypothesis.–Conventional Wisdom

3.1. Meaningless Regressions

Lance Taylor recently objected to the spate of regression analysis done by the World Bank on the mushrooming data set that has resulted from numerous household surveys financed by the Bank around the world. He claimed that they were "meaningless regressions." At face value, this charge may be difficult to understand; on the other hand, structuralists have always had an uneasy relationship with econometrics. In particular, structuralists have not relied on econometrics to validate their theoretical claims about the way the world works. This section of the paper addresses some of the reasons why.

Arguably, econometrics analyzes the real history, that is, the data of actual experience. Because experience, history and the statistical record are held in high regard by structuralists, there would seem to exist a natural affinity to econometrics. But respecting data is not the same as respecting econometric models based on the data. Taylor's comment reported above suggests that structuralists continue to be suspicious of econometric results and Taylor himself argues that the skepticism rises with the degree of sophistication of the technique, as captured in the anonymous quotation at the beginning of this section.

The main reasons are as follows. The first is prosaic: classical statistical theory imposes stringent requirements on data which are not often met in the statistically unclean environment of developing countries. When drawing a sample from an urn, one can be confident that all balls of the same color are the same. In a dynamic economy, there is no analogy to the urn of colored balls, especially in time series. If the point of economic development itself is to systematically change the structure of the economy, then the assumption of structural stability required by the classical statistical model is hardly warranted.

Structuralists are also apt to identify a second class of "meaningless" regressions. These arise when analysts attempt to explain complex economic phenomena using models with one, two or very few variables, in so called "reduced forms." Structuralists hold that the world is a complex place and that there are few single-equation models of much usefulness. Linear combinations of poorly measured or qualitative variables are quite capable of producing spurious correlation with well measured variables on which the former are often indirectly based.[8]

But even if independent variables are properly constructed, structuralists are unlikely to accept simple reduced-form models as convincing evidence of much of anything. They would argue instead that the movers of any given variable are several and may well vary in any direction of influence. Apart from accounting regularities, there is no one variable in economics that determines any other one variable on its own. The theory embedded in the reduced form must be subject to independent verification.

One example is "crowding in" versus "crowding out" in the investment function." Whether the impact of government spending on private sector investment is on balance positive or negative depends on the resultant of concurrent and coun-

[8]Measures of "economic freedom" are often derived from proxies for the very growth they are correlated.

tercurrent forces. The net effect, most usually, must be determined empirically by assessing the relative strengths under the current or appropriate circumstances. Often little can or should be said *a priori*. Structuralists would argue that elevating either, crowding in or crowding out, to the exclusion of the other is wrong even though it is often done.

A second example of misleading, monochromatic modeling is provided by econometric estimates of the accelerator, α. Take, for example, the equation

$$I/K = \beta + \alpha u$$

where I is investment, K is capital stock and u is capacity utilization. For purposes of illustration, let us say that a fictitious estimation procedure produces the following results (t-stats in parentheses).

$$\begin{aligned} \beta &= 10 \ (2.2) \\ \alpha &= 1.6 \ (3.5) \end{aligned}$$

Thus, with α and β estimated econometrically, we have a calibrated investment function. Now, insert this calibrated equation into a simple Keynesian model:

$$Y = C + I$$

$$C = \bar{c} + cY$$

$$u = Y/Q$$

where Q is capacity income. If autonomous consumption, $\bar{c}$, can be calibrated to a SAM and we have some econometric evidence on the marginal propensity to consume, c, we have a fully specified macromodel. Assume a Keynesian adjustment mechanism:

$$\frac{dY}{dt} = \theta \dot{Y} = \theta(\bar{c} + cY + \beta K + \alpha Y \frac{K}{Q} - Y)$$

in which output grows if expenditure is greater than income. The adjustment parameter is $\theta > 0$. Capital stock, K and capacity output, Q are given in the short run. Stability of this simple system requires that:

$$d\dot{Y}/dY < 0$$

that is:

$$c + \alpha K/Q - 1 < 0$$

If K/Q is in the range of 2 to 3, and a is estimated at 1.6, it becomes obvious that the marginal propensity to consume must be negative for stability. Because the regression is oversimplified it has become "meaningless" and certainly not usable outside the context in which it was run. An α borrowed from such a study would cause a model into which it is transplanted to immediately become explosive. This critique of econometrics can be seen as an extension of the concern with *wholeness*. By embedding the theory in a reduced form, the theory itself becomes immune to scrutiny. The validation of theory by econometric tests is then piecemeal and haphazard. There is no comprehensive assessment of all aspects of the model.

But while econometrics is not always trusted, neither can the results be entirely ignored. Still, there are major differences between the way in which structuralists view econometric results and the role they play in neoclassicism. The orthodox model takes rational agency as an *a priori* given and then looks to econometrics for evidence that might falsify that assumption. If the evidence is not found or proves to be controversial, the core assumptions are not effectively challenged and is retained. Structuralism, however, has few core propositions, and thus it follows that falsification cannot play an important role in the validation processes. Verification, on the other hand, is not logically possible according to the principles of classical statistics and hence, econometrics tends to play a marginal role in the validation of the structuralist enterprise.

If econometrics is not the principal means by which structuralist theory is validated, what might it be? Certainly a range of methods from historical narrative to formal hypothesis testing to numerical simulation have been employed in the past. In the following section we take up the last of these and argue that simulation modeling is uniquely qualified to validate the structuralists' program. It is a method based on verification rather than falsification and, as will be seen below in more detail, provides ways of trapping internal inconsistencies in models that are whole, transformative and self-regulating.

3.2. The Duck Test

> *If it looks like a duck, it walks like a duck and quacks like a duck, then we say it is a duck*–Conventional Wisdom

As suggested above, it is most likely wrong to think that neoclassical theory is *validated* by econometric models. The ascendancy of game theory, optimal control and stochastic optimization in neoclassical theory in the last decades strongly suggests that other, even less defensible, criteria are in use. To an increasing extent, a result is validated in the neoclassical framework if is associated with an underlying optimization model.[9] The model is linked to the result and strengthens the result by throwing the additional weight of the optimization model behind it.

Structuralists would argue, however, that an optimization framework cannot increase the exposure of the theoretical framework to independent empirical verification.[10] Adding a utility maximizing model to a general theoretical framework in the neoclassical view does not increase the probability that the entire edifice is *wrong.* The procedure only increases the veracity of theory and only by definition. It is tautologically true that since the rational model is taken as true *a priori* the aggregate truth value of the theory is only strengthened, never diminished. In the structuralist mode, it is useless to add unfalsifiable components to the theoretical system. The key point is this: the value of the structuralist theoretical framework can only increase with additional exposure to the historical record. Falsifiability must increase in order for any new components of the theory to be valid. Better theory, for structuralists, is more complete theory in the sense that it has more opportunities to be wrong.[11]

In the neoclassical venue, it is rare that the properties of the underlying optimization model feed back on or affect the overall properties of the model, since it is usually possible to find a maximization model that is compatible with a desired result. The addition of an optimizing model never compromises the overall characteristics of the system and indeed the point is often to find a preference ordering that does not. This problem is not impossible. Debreu has noted that to every allocation in a competitive neoclassical system, there corresponds a preference ordering that establishes that allocation as a competitive general equilibrium . This raises serious questions about the scientific character of the program in fact

[9] For interesting history of these methods see [43].

[10] Dutt has argued that the optimizing framework of the neoclassical school is part of its core principles and therefore not meant to be realistic or subject to verification. He refers to optimization as an "organizing principle," that is, a way in which explanations are structured and which "make no statement about the real world."[13] But he then begs the question of what the organizing principle for structuralists is and it becomes simply what structuralists *do*. Realists, who argue that organizing principles are not even necessary are dismissed by Dutt. I am, in effect, arguing that the organizing principle of the late structuralists in terms of the characterization of what they *do* is the joint application of the same three principles enunciated by the classical structuralists as discussed above.

[11] Obviously, the process of verification may be subject to Kuhnian problems of paradigmatic focus. But as Sokal and Bricmont point out in their sympathetic assessment of the excesses of Kuhn and Feyerabend, relativism cannot be sustained over time in the observational evidence that supports scientific progress; better is simply better and comes to be recognized as such [45].

Debreu once remarked that it was his "contribution to radical economics."[12]

Indeed, it is difficult to think of examples in the neoclassical school in which the inability to generate an underlying optimization framework has caused the demise of the theoretical system. The adaptive expectations of the Keynesian model was the most obvious target, but it has been largely rescued for the neoclassicals by "New Keynesian" theorists.[13] It is no accident that structuralists have generally been unimpressed by the efforts of the rational choice Keynesians. This is not because structuralists are themselves committed to "old Keynesianism" but rather that the New Keynesian program fails to increase the "wholeness" of the theory as we have seen. Structuralists models are validated by how well they represent the complex reality they seek to model. They have gained popularity with policymakers because they pass the "duck test." They achieve their prominence by providing a comprehensive and realistic approach to the entire economic system simultaneously.[14].

Complex models that not only track the data well but are also based on algebraic formulations, recognizable as country specific, can be a powerful tool in an open policymaking arena. As the complexity of model increases, it might be thought it would become more difficult to adequately portray causal mechanisms. This is true, but is it not the objective of large-scale simulation models to highlight any subset of mechanism as it might be in a more analytical model. Indeed, it could be argued that the success enjoyed by structuralist models is entirely attributable to the appeal of the mechanisms by which the models are validated. In 1990, Lance Taylor edited a lengthy and influential collection of papers on simulation models written from a structuralist perspective [49]. Several of these models included financial sectors and some were dynamic. Since then, the structuralist models have become increasingly complex, including more of the relevant features of the economies under study and running for longer periods of time.[15]

[12] From private conversation. See [6] and [41] for an interpretation.

[13] The same cannot be claimed for Marxism. When analytical Marxism insisted that some microfoundations be adduced, some elements of Marxist theory died away, e.g., the capital logic school from which little has been heard recently.

[14] For an introduction to simulation models, see Pindyck and Rubinfeld [38] Chapter 12. Simulation models differ from econometric models, although they are closely related. As noted above, individually fitted regression equations can track historical data well, but when combined in a simultaneous equations model, may not pass the "duck test". Simulation models use regressions results, parameter guesstimations and other formal and informal techniques to adequately represent their theoretical object. There is nothing "pure" about them and their reputations hinge on how well they reproduce the "look and feel" of the real economy as portrayed in the historical record.

[15] Certainly there is a large number of neoclassically based simulation models in the literature. But often these models reflect little about the economies they study and are often unconvincing to policymakers. In recently published joint work, we provide a concrete example of a head-to-

3.2.1. Wholeness, Error and Validity

For models to look, walk and quack like a duck, they must evolve into complex entities. Passing the duck test leads structuralism to embrace complex simulation models and methodology. Simulation methodology has enjoyed a good deal of success in the last few decades, in meteorology, geoscience, astrophysics, and molecular dynamics and design, to name but a few areas. In social sciences simulation modeling has made fewer inroads, although as early as the 1960s and 70s policy models in economics, political science and even sociology were in use. By and large, econometric models have dominated the social sciences. The goal of this interpretation of the structuralist method is to have all the parts of the model function independently and then achieve simultaneous confirmation of the historical record. In this regard, structuralist models take a "full information" approach which allows cross-checking of one component by way of another. The more complete the model is, the more ways in which it can be wrong and hence, if right, the more confidence it earns.[16] From the user's point of view a complete model is more believable and trustworthy.

In contrast to the decoupling of the unfalsifiable optimizing foundation from its falsifiable results, structuralist models are thus interlinked. This provides an error-trapping facility in structuralist models by-and-large absent in the orthodoxy. An unrealistic characterization in one component of a structuralist model will feed into and produce errors in another. The errors that diffuse through the system are either systematic or random; the latter may well cancel out, but the former multiply (unless one systematic error luckily cancels out another). *Cross sectional* systematic error grows with the number of equations in the system, imparting content to the notion that wholeness is itself a criterion of validity. This same kind of error propagation is more familiar in time dependent systems. A time series generated by chaotical system, as noted above, is fully determined but cannot be predicted because of error propagation, either of measurement of the initial conditions or the model equations themselves. Unstable trajectories fail the same kind of test of realism, but not because the steady-state is particularly realistic but because trajectories that lead away from it multiply errors built

head comparison of two models, one structuralist and the other neoclassical, that were applied to the transition from apartheid in South Africa. In that comparison the neoclassical model does not appear at all realistic. What is surprising is that the neoclassical model has enjoyed far more influence than its credibility would suggest. See [17] and [18].

[16] Structuralists do not claim, as Milton Friedman once ignominiously did, that the method imposes no constraints on the components of the theory or that a theory is only as good as its over all predictive value [15]. Structuralists attempt to get each component of a model to image the reality they have in mind and ultimately to work together with all other parts of the model. No block of equations is immune to scrutiny and all must faithfully represent its object.

into the original structure. Hence whether models are ultimately convergent to a steady-state is not the relevant issue as noted above; it is rather that they remain transformational and self-regulating over both space and time.

Thus if the notion of wholeness is taken seriously, the structuralist model will be not be validated by the methods of classical statistics, but rather in terms of realism and scope relative to its object. The implications of this claim are far reaching. A fully valid model would be able to pass a suitably modified "Turing Test " after Alan Turing, in which participants in a blind conversation with an artificially intelligent machine would be unable to tell if were a human or computer providing the answers to questions posed to it [52]. In a more relevant context, the policymaker would be unable to tell whether the data provided by the structuralist model were simply computer generated estimates or the true numbers, no matter how familiar he or she was with the way in which the economy functions.

Structuralist models would then evolve in a direction that would be *less* constrained by individual choice-theoretic formulations and more so by interlocking substructures describing various aspects, real, financial, public, private, formal, informal, social, regional etc. of the economy. One can imagine that a model that was capable of passing the a version of the Turing test would be very large, taking into account the diversity of market structures and social classes of which the real economy consists. Just as simulation models of thunderstorms are more accurate as additional observations are employed to characterize local temperature, lapse rates and moisture content of the atmosphere, structuralist models would achieve greater reliability when far more structure than is currently employed is integrated.

In summary, wholeness entails its own criteria of validity. Interlocking systems, whether decomposable or indecomposable, propagate errors between their component parts. As larger numbers of subsystems are combined, errors in one part are propagated to other components, often magnifying the effect of the original error. With an arbitrary number of indecomposable parts, errors in any one subsystem would eventually surface, conflict with the duck test, and presumably be corrected. Bigger, in this framework, becomes better. Just as in robotics, models are more convincing not only when they can perform a task well, but as the number of *different* tasks they perform well multiplies.

3.2.2. Criticism

Simulation methodology in science generally has been subject to criticism, much of it valid. It is clear, for example, that complete verification and validation is impossible since natural and indeed social systems are *open*. One can never be sure of not overlooking some crucial feature that causes a turning point or some cross sectional component that all at once becomes relevant to the model. Cartwright argues that simulations are ultimately *works of fiction* which may resonate with their objects for a time and then arbitrarily (and inconveniently) lose any resemblance to the reality they are supposed to represent [36]. This criticism seems irrefutable but only demonstrates that simulation modeling is an imperfect tool. Moreover, inadequate models are a general problem in science, from robotics to computer graphics animation in motion pictures, and has plagued the development of complex artificial systems since their inception.[17]

Not everyone, even among those sympathetic to structuralism, will be comfortable with the claim that *truth* lies in some expansive numerical rendering of reality. Indeed, Mirowski has already denounced "machine dreams" as the new foundation of the new *neoclassical* economics. In his view, the program that began with von Neumann, Nash and Weiner, evolved into the information theory of Shannon, Weaver and Simon and ultimately into the artificial life and chaoplexy of Santa Fe, underlies an ultimately distorted vision of economic *agency* as "cyborgs."[18] In one passage, Mirowski lines up a number of suspects for summary execution:

> The characteristic moves of the cyborg sciences–capturing feedback motions in metal, framing biological reproduction in equations of automata, reducing thought to the Boolean logic of electrical circuits, leaching the problem of meaning out of the definition of information, treating probability as [solving] the problem of induction...strategy as dynamic optimality and "order" out of chaos...made their way into economics [33].

But Mirowski's romantic defense of humanness against machines begs the question of why cyborg methods were so successful in their respective disciplines. Apart from winning World War II, the critique ignores any positive contribution. Indeed, Mirowski does not address the question of validity of simulation at all, content to observe that neoclassicism has abandoned its "physics envy" and existence proofs in a new urge to *calculate*.[19]

[17] See, for example, the "crazy hair" outtake in the DVD version of Dreamwork's *Shrek*.

[18] See [33] for an extensive set of references to the literature.

[19] The critique will probably meet some stiff resistance. Most thorough-going neoclassicals, Lucas, Sargent *et al.* explicitly reject *ad hoc* models and even optimal control models on the grounds that agents expectations are represented in an overly mechanistic way [43]. They apparently do not recognize that the bodies of their rational actors are about to be snatched by Mirowski's cyborgs.

4. Conclusions

The thread of the argument can now be laid bare. The late structuralists, Taylor, his various students and colleagues have continued the tradition of the early structuralists adding to it a significant body of theory. The structuralist project has, as a result, moved into closer conformity with the mandate of the early European writers. For the classical structuralists more detail is better than less and we observe this same proclivity in late structuralism. The structuralist method is *ad hoc* and happily so and would look askance at attempts to validate theory via theoretical purity, as the neoclassicals have. Structuralists must ultimately validate their theories by reference to the structure itself, called here the duck test.

As the theoretical object of structuralism becomes more complex, simulation modeling presents itself as a natural alternative. Simulation models avoid the need for unrealistic assumptions, such as perfectly competitive markets, steady-states, terminal and transversality conditions and perfect foresight. Just as in many other areas of science, simulation models in structuralist economics are becoming increasingly realistic, taking on the look and feel of the real economy as recorded in the data base. The classical themes of structuralism, wholeness, transformation and self-regulation can be interpreted as guidelines for the future evolution of structuralism.

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