

**CULTURE, COMPUTATION, CONSCIOUSNESS AND THE
RATIONAL ECONOMIC PERSON:
A METHODOLOGICAL FORAY
(An Essay in Honor of Professor Ranganath Bharadwaj)**

**ABHAY PETHE
DEPARTMENT OF ECONOMICS
UNIVERSITY OF MUMBAI
MUMBAI 400 098**

0. PREAMBLE

This essay comprises of methodological reflections in honor of Professor Ranganath Bharadwaj, written on the occasion of his completing 75 years of a truly rich and fulfilling life. There is a distinction between those who merely lecture and those who *teach*. He was a teacher in the true sense of the term. He was not so interested in communicating the diagrams and equations perhaps because – in his view – that could be construed as an insult to the intelligence of the students. He was much more interested in discussing the underpinning and the methodological stance in the treatment of particular and specific topics. His nuanced one-liners and some critiques dealt with in style have helped many others and me and indeed continue to help us evolve as teachers and scholars. Non-dogmatic and humorous in his rendering, he has left a un-delible mark on our psyche. On my own part, every time I write something methodological, I find a resonance in what Professor Bharadwaj had said at one time or another. His impression and impact has been felt by me and others over a period of time. He thought and taught us to ‘think out of the box’ when it was not so fashionable. As a teacher he did not lead us down the well trodden path but inspired us to have a self belief to create our own. For all that he has done to shape my (and that of many others) personality; I can but say a heartfelt and sincere *thank you*.

1. PROLOGUE

This is an essay in methodology in the context of economic theory. Up until the recent past one began such a piece with an apology. Not any more, thanks to a whole lot of dedicated work by many first rate economists, methodology is now recognized as an important sub-discipline in economics. Yet, many an economist to this day feigns disinterest in matters of *method*. Whilst it may be hindrance to start with methodological inquiries/issues to begin with, it is positively dangerous to avoid these once a more mature stage has been attained by the concerned discipline. Every once in a while, the practitioner must pause collect her bearing and reflect on what one is about. It is in this spirit that the current exercise is undertaken; the devil's advocate must not only be tolerated but indeed encouraged, for, deconstruction must precede a meaningful construction. Further, the concern is almost entirely with theoretical issues. Economics – like any other – is a many faceted subject, with each facet of crucial importance from a particular angle. A given paper however needs to be delimited and our choice of focus here serves precisely this purpose.

The role of economic theory in the main is to **understand** and **explain** economic processes. The explanation must be forthcoming in publicly communicable language. In a Wittgensteinian vein, we hold that things that one claims to understand one must be able to express in words of a public language. After all, whether we consider economists to be practicing a *science* or a *discipline*, we would all agree that it is not about mysticism or witchcraft! It may be pertinent to note here that to ***understand and explain does not necessarily imply ability to either predict (forecast) or control***. Of course, given that many economists are driven by the urge to be useful to the society they may require these attributes – ability to provide useful policy inputs – for them to be interested in becoming economists in the first place. Our limited point here is that **if their theoretical constructs do not yield the means for prediction or control economists *qua* theorists may not be criticized**. For example as Frank Hahn has pointed out, that while we reasonably well understand the nature

and causes of earthquakes, we are not quite (yet, at any rate) able to either accurately predict or control them.

Economists are a breed of story tellers, especially when they are theorizing. This is perhaps as it should be, but when they start telling stories like the one about a lady who went to the races and always won, betting on the horse with the shortest tail, even the suspended disbelief gets strained. The plot may be complex and logically tight but the one important feature that a relevant story must have is the characteristic of plausibility. Otherwise it will simply fail to persuade. In putting together these stories, some assumptions are naturally required. One such assumption of considerable importance is that of rationality, whose extensiveness, limitations and indeed substance I propose to look into in the present essay. The assumption of rationality on the part of economic agents is a convenient working assumption. This implies that it is *not* assumed that everyone is always rational, further there are no normative undertones either, i.e., it is not assumed that everyone *ought* to be rational. What the assumption simply means is that if agents are not rational then economists *qua* economists can proceed very little by way of analysis. There is one final caveat that needs to be entered before I get down to business proper. The rationality that one is referring to is what is termed as *procedural* or *instrumental* rationality. Thus whereas the preferences are over an outcome space and hence about ends as it were, there is some distance to go for attaining those ends. Depending on the context there is little or much theory and computation required in the selection of strategic means towards these ends. There are of course some other ways in which rationality has been looked at by such important philosophers as Habermas, Weber and Kant. Yet others like Hume and Keynes have sought to explain the essential driving force for action in the realm of ‘passion’ and ‘animal spirits’ respectively. Even then I am talking in the domain of theory. In order to pass from this domain to the real world application there is a further *correspondence principle* – made famous by Paul Samuelson – to be sorted out. Let me now delve into the layers of the substantive meaning of rationality. In

doing so I naturally go from the simple formulation to the more complicated and then on to more complex one.

2. CORE

The core of this paper deals with – explains and analyzes – the various attempts made by economists to model the rational economic person. The treatment is successively complicated and complex. Starting from static, perfect/complete information situation, we introduce dynamic elements and then uncertainty in its various aspects. I then go on to elaborate the ‘revolutionary’ response of the mainstream economists viz., that of *rational expectations*. The explanation is interspersed with critical comments and shortcomings. In the later sections I have tried to highlight the role of culture and nature of social reality especially as it differs from physical reality. It ends with a very brief discussion of the Penrose critique of AI (Artificial Intelligence).

2.1 RATIONALITY : MARK ONE

Let us begin at the beginning, with the basic structure of any economic problem. Economics is about choice which at the very least must presume comparability. Unfortunately, an agent typically faces a set of decision objects, which does not have the property of complete or linear order. In other words the decision objects are heterogeneous in character. One thus requires a transformation from the set of decision objects to one which is linearly ordered set. This allows us to put tags onto the objects between whom we must take a choice. Given the underlying preference structure, the consequent utility function (which presumably is to be maximized) and the budget constraint, one can now make the actual choice. In symbols, economic problem is about a search for a functional: $\varphi : R^n \rightarrow R$. In a word, we are looking essentially for a *dotting vector*. As an aside, I may mention that this position is implicitly assuming *linearity of processes*. Of course, one knows of chaotic and catastrophic processes to prevail in reality. Whilst I will have a few comments to make later about such complications, I will choose to simply take refuge behind the fact that we do not

yet completely know how to handle these higher order complexities either in terms of diagnostics nor identification. So to return to our simpler theme: economics then is importantly concerned with the evolution and the characteristics of such a dotting vector. The study must encompass the manifold ways in which such a vector come about. It could be derived as a price thrown up by an institution of market or it could be purely subjective and yet again it may represent the solution to the dual problem of a standard activity analysis problem treated as a primal. The point is that – however it may come about – without such a valuation mechanism one cannot hope to take even the first step in the arena of economic analysis. *Values then enter on the ground floor of economics.* Let me hasten to add that whilst this implies that it is mandatory on the part of an analyst to make these clear, it does not in any way reduce the importance or the scientific character of economics. Economics is thus built implicitly around a value loaded theory of rationality. I however do not agree with Hausman when he opines that the theory of rationality is essentially normative. *After all, the tools of analysis are one thing, the use to which one may put them, is quite another.*

The formulation is rather simple in a static world with full information and in a Robinson Crusoe type of an economy to give a substantial meaning to the concept of rationality. But, this does not get us very far, for, this simply is a false start. I will argue that except for classificatory, definitional or taxonomic purposes or indeed for pedagogic or purposes of elucidating principles in the abstract, this approach is not very useful. Economic *analysis* requires that we situate the economic agent within a society with its historically evolved and evolving institutions. This as I shall note later, requires that socio-economic analysis cannot be *a-historical* and must be dynamic. This way of viewing things sets off myriad questions all pretty thorny but crucial and hence must be faced.

To begin with there is very little meaning that one can give to a one-person ‘society’. This implies that whether it is the problem of choosing between picking berries or catching fish (static optimization between alternative consumption bundles) or the problem of catching fish with hand or investing in the construction of a net (the inter-temporal dynamic optimization), it is

essentially a technological or an operations research problem. Thus, given his or her preferences, the problem juxtaposes the individual against 'nature'. It cannot legitimately be in the domain of social science inquiry, which must concern itself with the *relationship of a person with another*. Given the data such a problem is easily solved 'algorithmically' and the computational requirements for the solution are not very stiff. It is also relatively simple then to specify the utility function of the individual too. This is most succinctly thought of within the Marxian distinction of wealth creation and value creation. Whilst the first is undoubtedly important, the latter alone can legitimately fall within the domain of interest of a social scientist.

As we shall see later even this problem becomes rather messy when we concern ourselves with the individual situated in the historically evolved social substructures, such as the family, for then even the specification of the self is not straight forward. I may venture to suggest that an individual in a social situation assumes a membership of several loose groupings simultaneously that may form a relevant set for specific decisions. This can be modeled by using theory and tools of fuzzy sets/ analysis. A fuzzy set represents fluidity where the traditional set represents solidity. Formally, a fuzzy set is a function from a set X to a compact set (normalized as a zero-one interval). Membership of each fuzzy set within a nested family (individual qua individual, qua member of a family, nation, human race etc) creates a complexity that we referred to above as the 'identification of the self. The complication then arises out of different magnitudes of strengths that have a bearing on the decision making by the self does not help/ simplify matters either.

2.2 RATIONALITY ; MARK TWO

Let me begin to complicate things a bit. This I do here by creating more than one Robinson Crusoes and putting them all together in a group to form a

quasi society. My argument at the fag end of the previous section gives some insight into why I use the prefix 'quasi' in the previous sentence. Clearly a society (even from the point of view of realism in modeling) is not a haphazard throwing together of a few Robinson Crusoes; they are together 'bound ' by some – however loose – historically conditioned and evolved institutional relationships. Be that as it may, even in this 'simple' contrived set up, things get rather complicated even if keeps 'production' out and considers only the exchange economy. First of all, there need to evolve institutions like 'markets' where contracts may be reached. Further, either functionally distinct supervisory bodies are required or else incentive compatibility has to be built into the design of contracts for them to be actually implementable. Since Maxwell's demon one has known that information is not free and search thus implies costs. In taking rational decisions then one is bound to take into account the omnipresent costs.

The way I have set up things here (with identical replicas of agent types) there are two implicit assumptions that are usually made. One is about the common knowledge rationality (CKR). This means that the rationality is not only practiced, but indeed this fact is common knowledge with respect for other agent's rationality. This leads to one of the most enduring and important concepts of equilibrium, viz., that of Nash equilibrium. Common knowledge rationality is not sufficient to justify Nash equilibrium since people must form same probability of assessment about hat is likely to happen, when they go to work with same information. This leads to the relevance (non trivial) of the assumption of independence of irrelevant alternatives, but the further complications and elaboration will be seen later, especially when I introduce '*culture*'. This further leads us to the other assumption that is about consistent alignment of beliefs. This implies that the fact that different agents are identical stretches right through to their belief structures. They are destined to act and react in exact same fashion. Thus, common alignment of beliefs means that no instrumentally rational agent can expect another similarly rational agent, who has the same information to develop different thought process. This leads to rationalization of Nash equilibrium in mixed strategies as well. Clearly, this

imposes homogeneity on agents that is stifling. A little reflection will convince one that these are horribly constraining assumptions. The macro system here is merely the microcosm uniformly reduced or expanded. The only diversity here can be rationalized in the form of incomplete (asymmetric) information structures of agents. Surely this is not enough, but since I am proceeding slowly, let me first introduce complications that arise due to dynamics and uncertainty. Whilst both these are independent sources of complications, together they pose rather formidable problems.

2.3 RATIONALITY: MARK THREE

From what I have said so far, it should be clear that dynamics is crucial to realistic conceptualization of the economic problem. In the mainstream economics **Roy Harrod** introduced the agenda for providing limbs of economic dynamics, when he perceptively observed that static and dynamic are two distinct modes in the sense of being birds of different feathers. Dynamic analysis requires a different way of thinking and as Harrod showed in his 'knife edge problem', leads to startlingly counterintuitive results. The problem here which is a cousin of the static constrained optimization problem, requires a higher order of *computational effort*. The dynamic optimization whether viewed in the **Pontryagin** frame or that of **Bellman** leads one to solve the problem backwards. The actual solution method involving the 'cost to go' approach, the storage (stacking) of Riccati equations and the extraction of the feedback rule need not hold us here. Thus, *life here is understood backwards, unfortunately it must be lived forward*. The important fall out of dynamic analysis is that expectations become important. Once expectations are important, one cannot very well keep mistakes (out of equilibrium actions) out. I shall only note this here and elaborate on the economists' response to this challenge in the next section and my critique thereof in the subsequent ones.

It is evident that underlying any (rational) choice is an implicit or an explicit decision model. Given that the relations in economics are inexact, the 'realizations' of model equations are estimated or are econometric in nature.

These involve, uncertainties reflecting the uncertainties of the real world and constraints on data availability amongst other things. These uncertainties take different forms and are of different magnitudes and need to be taken into account in different ways. Rational decisions in such an environment represents a higher level of difficulty as far as conception as well as computation is concerned. In technical language, there is the system noise or the additive uncertainty, the estimated parameter noise or the multiplicative uncertainty and then there is the measurement noise. Fortunately, it is not only possible to acknowledge these uncertainties but indeed to incorporate the magnitudinal aspects of these in analysis. Continuing computational advances have thrown up various techniques for which user friendly codes have been written and are available. *The Kalman Filtering and Stochastic Control* techniques are quite popular and represent a useful addition to the tool-kit of a professional economist. The realistic and hence useful work in this area is still in its infancy and much more work by way of Monte Carlo simulations with different models, as well as numerical treatment of non-gaussian distributions remains to be done, but the good news is that the work has begun. This will allow us to get an insight into the links between the patterns of uncertainties and the most efficient algorithm, such as the certainty equivalence, or passive learning or active learning that should be used. My hunch here is that analytical tools in this area have for the moment reached their saturation point and a real advance in this area will come through computational advance and efforts (the work of David Kendrick and Hans Amman is particularly important and should be to be followed closely).

2.4. RATIONAL EXPECTATIONS: AVOIDING THORNY ISSUES

As a response to the various criticisms vis-à-vis the non-existence of an acceptable expectations frame which is so crucial in the treatment of dynamics, as also the search for micro foundations, the mainstream economists (neo-classical, if one cares for labels) proposed the rational expectations hypothesis (REH). Muth's early work was taken as a beginning point. The hypothesis was

based on the entirely plausible assumption that agents do not make systematic mistakes. The crucial question then ought to have been about how agents *learn* about the underlying model representing reality that generates correct forecasts. However, *if it is assumed* that agents somehow learn the underlying model, the optimality properties of the REH can be easily verified. REH can be taken to imply that the subjective conditional distribution of some random variable coincides with its objective conditional distribution. It is no surprise that the property of being unbiased and best was crucial in endearing the REH, particularly to the applied economists. The Ratemian analysis works on the assumption that a true structure always exists for a given economy. The economy is modeled as being away from the true structure but tending towards it at any given point of time. The procedure then is to specify the most general form of equations, including the error correction term. The true structure thus simply needs to be identified. It is generally assumed to be characterized by stable parameter values and a white noise error process. The Ratemians thus fall into the category of positivist school, which seeks to validate models by their ability to provide accurate forecasts.

In sharp distinction to this, Keynesian practice was concerned with disequilibrium in a fundamental sense. There is no presumption of a 'true' model that just needed identification. In fact, most Keynesians would deny that true structural models ever exist for an economy (in the *a priori* sense), a view reinforced by recent research on sunspot models. This view, I may note is also close to the view of the present paper. Thus, Keynesian approach (especially econometric modeling) looks for 'good approximations'. Theories are just approximate representations of the real world and are confronted with data for the purposes of uncovering macroeconomic regularities. Of course, this method has inherent in it the possibility of multiple model / equations representation. This however is not looked upon as something undesirable, since it is believed that there is no 'one given and certain' interpretation of truth.

The Ratemian models that are advocated, on the other hand, use the Arrow-Debreu 'contingent claims model' in an essential way. They are basically

driven by optimizing action of agents and are interpreted to rule out disequilibrium and learning. Such models, 'small analogue economies' are supposed to be useful ways of carrying out experiments that would be costly in the real world. As Lucas puts it, "the central idea is that individual responses can be documented cheaply....'. This indeed is the much maligned method of 'casual empiricism' or simply keeping your eyes open. However to formulate such models not of isolated Robinson Crusoes but of entire economies, a theory of group behavior is clearly needed. This issue is avoided by the contrivance of the so called 'representative agent' about which I shall have something to say a bit later.

It is clear that rational expectations hypothesis requires agents to know the true model underlying the economy. This means that agents either already know or are able to learn the true model over time. While it is true that rational agents learn from mistakes, it is not clear why such learning should lead them to rational expectations equilibria (REE). One would have thought that out of equilibrium beliefs and learning from mistakes would form a major agenda for economists. These issues have been largely ignored and only recently some work has been done in this area. The results are not very clear and as Pesaran has pointed out, all these models assume that the agents know about the true relationships in the economy, but do not explain how the agents learn about these relationships in the first place. In response to the criticism that agents here are akin to the super efficient automata, an alternative strategy has been used, that of modeling 'boundedly' rational learning. Here the agents are not required to know the relations but they are expected to follow a plausible learning rule to which they remain committed throughout the learning period. But this is problematic because since the rule is not a closed feed-back one, the commitment of part of agents implicitly assumes an extra modular knowledge the source of which is unexplained.

Let me now say a few things about the contrivance of 'representative agent', which irons out the heterogeneity in a macro set up. Now, macro economic outcomes are a result of the coordination and interaction between

several agents. Rather than model the group behavior by studying the entire collection of channels through which agents interact, the 'analogue economy' school makes the short cut assumption of a representative agent (for a good measure of pedigree they cite the example of Alfred Marshall's representative firm). A hypothetical representative agent is assumed, whose actions are deemed synonymous with the macro-economy's responses. Thus, macroeconomic activity, rather than being seen as a result of interplay between agents' actions is seen as mean-aggregative microeconomics. No serious thought has been given to verify if such a short cut is indeed validly possible. One way of rationalizing the representative agent is to look at the individual as mimicking the aggregate, with the implication that the aggregate made up of several optimizing agents, itself 'behaves' like an optimizing agent. *There is no formal justification for this.* Indeed, this argument involves the fallacy of composition. Individual rationality – as is well known – does not engender collective rationality. A very simple example of this is the Prisoner's dilemma. Thus, unless one wants to risk the position of individual foundationalism (more on this in the next sub-section), such models ought not to be used. They yield no useful insight theoretically and they are positively dangerous when used for policy formulation. Of course there is further shortcoming in that, all considerations of distribution, as well as response diversity are ruled out by definition. It is in this context that consideration of culture becomes relevant.

2.5 CULTURE: THE CRUCIAL PARAMETRIC ENVIRONMENT

At a general level, one can conceive of an agent being faced with an objective function and has to face certain constraints. The agent must then compute the optimal action. The way the agent perceives her objective function and constraints as also the strategy set available to her is importantly determined by an interpretation filter. This filter is conditioned by the conceptual frame. The conceptual frame – in the socio-political-economic-milieu is a complex of folklore, psychology and ideology. It is this which I term 'culture'. There is a dialectics of sorts that is going on between the perception and conception, for after all, as

Kant put it, 'perception without conception is blind and conception without perception is empty'. It is in this context that culture assumes a crucial role in shaping the parametric environment. It enters the situation in several ways. In the first place, the formulation of the objective function is culturally conditioned. Further the interpretative mechanism is a product of specific historico-sociological experiences. Thus, the very consciousness is a reflection of the socially learnt traits. The next step of computation of the optimal action, involves in the first instance the transformation from 'what is to be done' to 'how to do it'. *The tools-of-computation as well as the relevant strategy-set depends rather heavily on the social norms.*

Economic theory however makes relatively little use of this concept. The term culture, as Max Steur put it, quite simply is used to refer to that part of agent behaviour unconsciously imitating the conscious or the unconscious examples and experiences of the surrounding society. Here the stable co-existence of fundamentally different modes of learning is a very real possibility. This is in direct conflict with the mainstream assumptions of common knowledge rationality (CKR) and common alignment of beliefs (CAB) with the imposition of homogeneity. Realistic analysis must allow for many stories and should not impose imperative of uniform-indeed identical-types. The homogeneity postulate, the representative agent come into serious question and the very substance of the meaning of optimality and hence of rationality becomes a contingent category.

Culture then, leads to the reduction of strategy sets open to an agent in a given society. The reduction that I am referring to here is not the standard reduction on the basis of dominance principle. That is allowed even within the mainstream framework and retains only the 'rationalisable' or 'worthwhile' strategies. One knows that this kind of reduction leads to the solution equivalence with the original game. On the other hand, the reduction that I am hinting at is 'norm based'. Obviously here there is no necessity for the solution equivalence with the original game to be preserved. The other way in which 'culture' would enter is with reference to the different speeds of learning which

would in turn depend on the social paradigm and tolerance (with mistakes). Culture allows for heterogeneity which is inter as well as intra temporal in nature. Thus different agents would use different algorithms (of differing levels of sophistication and hence costs) for computing their strategies. Also, the same agent may use different algorithms to solve different components of a macro problem that she faces.

Having looked, all too briefly, at the way in which culture importantly enters the scheme of things, let me now return to the theme of 'foundationalism' implicit in retexian analysis. Foundationalism allows economists to *rule out* irreconcilable inter-agent differences. There is no scope for different 'sign systems' to exist simultaneously and stably. Their existence will be seen as an error which will be ironed out for only one of them is 'correct'. Indeed, ***conceptual differences are seen as differences of perception arising out of asymmetric or incomplete information.*** The presumption that there is only one story has led to the famous result which goes under the name of Harsanyi-Aumann doctrine or the startlingly simplistic theorem that '**rational agents cannot agree to disagree**'. A critique of foundationalism and the related position of the ontological individualist, from a hermeneutical point of view has been advanced. This is the handiwork of mainly the sociologists and cultural anthropologists. They have debated questions between the relation between parts and the whole which is of great relevance to us. This naturally is related to our view of social reality. It is to this that I now turn.

2.6 NATURE OF SOCIAL REALITY : IMPLICATIONS FOR SOCIAL SCIENCE

A discussion and criticism of foundationalism, leads one to the question of the very understanding of the relevant reality as also to the micro-macro debate in the context of economics. Whilst macro phenomena *depend* on micro reality they do have a statistical existence of their own. Of course one need not subscribe to the extreme position of Comte, that aggregate (macro) reality has an *independent* existence of its own. The position of the ontological individualist cannot be *completely* negated. Rather the difference between the two realities

may be understood in the following way. When one is asking a question about the individual behavior, the answer comes in terms of *intentions*. However one cannot get a similar answer when one poses a question about the existence of an institution at the macro level. Here the answer has only an *implicational* connotation. There are any number of such examples in economics (say that of the existence of money). An attempt to understand the whole in terms of intentionally acting individuals will lead us astray. The crucial distinction between intentional and implicational behavior parallels the micro and macro behavior. Further this leads to a distinction between the substantive content of rationality associated with the intentional behavior and that which is attached to behavior which is only implicational in nature. To elaborate in a word, in analyzing social institutions, many a time, intentional rationality is applied and optimality inferred. This is clearly wrong headed and incorrect, for the *existence* of institutions may come about due to historical accidents. For their *perpetuation* what is required is not their optimality but that they be not completely detrimental to the existence of the system in which they exist. Thus a tolerable viability, *given that the institutions already exist* is what can legitimately be inferred. The only formal concept currently in the tool-kit of the economists that comes close to being useful for such analysis appears to me to be that of *evolutionary equilibrium* in Game Theory as modified by Kaushik Basu. Let me leave this discussion here for continuing in this vein will lead us far a-field and more into specific economic propositions.

One basic tenet of the practice of social scientists, especially in the context of economics has been the practice of **monism**. This has implied that – as I have already noted – homogeneity is imposed on the agents' behaviour that is modelled, economists have looked to physical or natural scientists for inspiration and imitation as far as tools of analysis are concerned. This, notwithstanding the fact that Von Neumann so long ago, in formulating the *theory of games* had noted that the underlying problem is qualitatively different from that faced by the natural scientists. The two branches of inquiry fundamentally differ in many ways and yet the practice of scientists has not reflected this. One

difference of a fundamental nature is that social science (economics) deals with *intelligent* systems. Apart from the inability to conduct controlled experiments, this has implied that analysis and the announcements of propositions have the capacity to influence the agent behavior that is being analyzed. The act of observation and analysis of the subject matter has the power to change that which is being analyzed. To give an example, which clarifies the distinction between social and natural sciences one is hinting at, one knows that plants orientate their leaves to expose maximum leaf surface to sunlight. Yet, one does *not* feel the need to put the question as ‘why do plants behave in this way?’ Thus, despite the fact that the optimizing behavior on the part of plants may be computed by the scientists, there is not connotation of *intentionality* attached.

In the case of physical sciences, the concept of truth is very often related to discoveries. Even in case of inventions the nature of truth is conceived as being ‘something out there’ waiting to be uncovered or perceived. In contrast, when it comes to social sciences, it relates to ‘the consistency of the property of propositions’. Social reality then is to be construed as a *meta* (becoming) concept. This opens up the possibility (inevitability) of our (priors) belief structures influencing (posteriors) what will come about. The way to think about this is the familiar Giddens’s concept of **structuration**. This incorporates the important idea that *action and structures are mutually constituted in the practices of society*. All this leads to several important implications for situating social science research.

Traditionally, economists have been involved in the bottom-up activity of aggregating micro into macro economic propositions. Now I intend to say something about the process by putting it on its head. I stress this here because it is far less (indeed not at all) recognized. Macroeconomic research propositions, whether true (valid) or not have the power to create *sunspots which feed into agents’ micro behavior via their expectational frames*. How then do the agents learn or derive expectational content from the received macro propositions? My conjecture is, not unlike the learning by children. Social learning of technical economic propositions never goes beyond the first stages of Piaget’s scheme. It

is thus through simple analogies and associations. Individual learning in the social context is culture constrained, taking place through fables and simple morals. Though there is a tacit recognition of the complex nature of things, at the operational level, anecdotes and fables are what survive as simple learned truths. These are historically reinforced by associations thrown up by casual empiricism. *Cultural constraints and belief formation then become central to the whole process of expectations formation which feed into the micro behavior and indeed provide the parametric environment for rationality.* There is increasing realization that belief formation needs to be endogenised and that ignoring them is illegitimate as economists have finally woken up to the importance of self fulfilling beliefs and sunspots. One interesting and pertinent interpretation of sunspots is that they provide a signaling device that co-ordinates actions and also work as a randomization device to convexify opportunity sets. All this leads to pluralism of possible outcomes a fact that economists are uneasy about. One can only hope that they realize that the fault lies in their insisting on understanding even the macro phenomena in an ontological vein (which they hope will lead to uniqueness) rather than interpreting and accepting them in an existentialist spirit.

Let me now briefly touch upon the Penrose critique of the **AI** and its possible implication for practice of economics. One of the central themes of the Penrose critique has been to argue that by use of our consciousness we are enabled to perform action that lie beyond any kind of computational activity. This goes strongly against the commonly held view point that our conscious mentality, - in all its various manifestations – could, in principle, be fully understood in terms of computational models. The conclusion is that conscious thinking must indeed involve ingredients that cannot even be simulated adequately by mere computation, still less could computation, of itself alone, evoke any conscious feeling or intentions. Understanding is after all what science is about – and science is a great deal more than mindless computation. Penrose strongly contends that an essential ingredient is missing from our present-day scientific picture. This missing ingredient would be needed in order that the central issues

of human mentality could ever be accommodated within a coherent scientific world view. This consciousness is of course not held to be beyond science, but the scientific endeavor needs to be appropriately expanded so as to bring it within its realm. Otherwise science would fall profoundly short of pretension to completeness. Thus, if one poses the two extremes, one which holds that all consciousness is appropriate computation and the other that consciousness is beyond the pale of any computation or science, then obviously the last mentioned view has to be discarded. For, that would lead us to mysticism.

It should be obvious to the discerning, that my position in this paper is close to the Penrose position. Of course, no one in the right frame of mind would hold that consciousness is about *mindless* computation. The important difference between our positions is that whereas Penrose is looking into the internal processes (in the small) and contending that one needs to expand the scientific scope for the quantum transition from computation to consciousness, I hold that economic science must expand to accommodate the parametric environment (culture) so as to analyze the *appropriate* computation. Whilst the precise physio-psychological processes are important and must form an integral part of the unified theory such a construction must await another day. Even apart from that there is an important missing link in the current practice of economics which I have tried to highlight as being rather more urgent and crucial for relevant theorizing.

3. EPILOGUE

And now I am done. In this piece, I have tried to critically look at the modeling of the rational economic person as per the current professional practice. I have argued that the simplest situation of static – complete information scenario presents no great difficulty in conceptual or computational terms. Here a caveat needs to be entered. Even in a deterministic situation, chaotic dynamics does present considerable complexity. This leads to unpredictability and being *information non-preserving in nature no learning is possible*. The fact that it is extremely sensitive to initial conditions poses further

difficulties. The only solace in practical terms is that chaos is a non-generic phenomenon and so hopefully will not be encountered too often.

My argument has been that static situation as a beginning point for economic analysis is a false start. The primary myth of economic analysis must be an individual situated in a society with its specific historical institutions. This means that a-historical analysis is no good. Also dynamic considerations are of prime importance. I have tried to show how dynamics on one hand and uncertainty on the other lead to conceptual and computational difficulties of a higher order. Fortunately the computational prowess has grown due to the tremendous advances in computational technology and that is good news. I have then looked at the neo-classical response by way of rational expectations.

The main problem with rational expectations is that they do not make clear the sources of extra modular knowledge on the part of agents that they assume. Further, they impose homogeneity by assuming that 'there is only one story'. In spite of acknowledging the fact that even with rational expectations, mistakes are possible, no attempt is made to seriously develop a theory of individual or group learning. The entire crucial issue is bypassed by remaining within the realm of steady state. This conforms to the tenet of 'searching for pin under the light'. Also, Rastekian approach is riddled with individual foundationalism arising out of the contrivance of the so called 'representative agent' which never allows one to come to terms with either modeling the whole (macro) system or to work out its relevance to the micro level decision frame. It is in this context that I have advocated the importance of 'culture'. I have tried to present the different channels through which it enters the substantive make up of reality. I have also argued that consciousness is conceived and hence perceived organically through the filter of 'culture'.

In looking at the social reality, I have implicitly argued that society is *not* so many Robin Crusoes thrown together, but they are bound together and should be seen in the context of *structuration*. The meta nature of social reality implies that belief structures are important given the self-fulfilling prophecies, bubbles and sunspots. The interactive dynamics or a theory of group behavior is clearly

crucial for the proper understanding of macro as well as micro level rationality. Computational considerations are important, but in the context of social norms, there may be 'leader follower' relations. After all, there are any numbers of illustrations from revolutionary action to the realm of theosophy or the entrepreneurial actions in economics where individual actions take place not necessarily as a result of computation but either as *learned* social behavior or of *passion* or indeed *animal spirits*, not to mention *ideological praxis*. In any case relevant research agenda in economics – I believe – must be based on a meaningful dialectics between the pure theorist and empiricist. The current professional agenda is too engrossed with analytical refinement project which I fear will lead to nothing but 'the atoms and the void'!

POST-SCRIPT

This piece has been written in an essay format. Thus, there are no references provided. The interested person may refer to the relevant essays in an earlier published monograph: **TEACHING THEORY AND PRACTICE ECONOMICS: *Essays in Methodology***, Indian Economic Association Trust for Research Development, New Delhi 1996. Those interested are also encouraged to read the new classic, **EMPEROR'S NEW MIND** and the more recent **SHADOWS OF THE MIND**, both by Roger Penrose, published by Oxford University Press.