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ЕКОНОМІЧНА КРИЗА 2020 І ШОСТІЙ ТЕХНОЛОГІЧНИЙ УКЛАД: ВЗАЄМОЗВ'ЯЗОК І ЗАКОНОМІРНОСТІ

Обґрунтовано, що економічна криза носить циклічний характер і пов'язана зі зміною технологічної парадигми. Економічна криза – це процес, який характеризується коливаннями економічної активності, проявляється в економічних, соціальних, екологічних і політичних потрясіннях. У шостій технологічній парадигмі економічне зростання забезпечується за рахунок впровадження принципово нових форм поєднання знань праці і предметів праці, здатних забезпечити максимальну продуктивність використання ресурсів. "Ядром" шостого технологічного укладу є альтернативна і атомна енергетика, охорона здоров'я, освіта, авіація, корабельне і верстатобудування, електротехніка, телекомунікації та ін., а його "ключові фактори" – інформаційні та комунікаційні технології, біотехнології, нанотехнології. Формування шостої технологічної парадигми істотно трансформувало структуру продуктивних сил і систему виробничих відносин, змінює продукт і процес його просування в різних сферах: охорона здоров'я, освіта, енергетика, комунальні послуги і т.д. Істотно змінюються якісні характеристики послуг і товарів, а також підвищується рівень доступності матеріальних і нематеріальних благ для всіх груп населення. У зв'язку з цим ефективність інклюзивних ініціатив вимагає консолідації зусиль громадянського суспільства, держави і бізнесу, реформування системи освіти і створення умов для підвищення рівня мотивації і соціальної відповідальності суспільства.

Ключові слова: економічна криза; шоста технологічна парадигма; біо- і нанотехнології; інклюзивність.

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ЕКОНОМІЧЕСКИЙ КРИЗИС 2020 И ШЕСТОЙ ТЕХНОЛОГИЧЕСКИЙ УКЛАД: ВЗАИМОСВЯЗЬ И ЗАКОНОМЕРНОСТИ

Обосновано, что экономический кризис носит циклический характер и связан со сменой технологической парадигмы. Экономический кризис – это процесс, характеризующийся колебаниями экономической активности, который проявляется в экономических, социальных, экологических и политических потрясениях. В шестой технологической парадигме экономический рост обеспечивается за счет внедрения принципиально новых форм сочетания орудий труда и предметов труда, способных обеспечить максимальную продуктивность использования ресурсов. "Ядром" шестой технологической парадигмы являются альтернативная и атомная энергетика, здравоохранение, образование, авиация, корабельное и станкостроение, электротехника, телекоммуникации и др., а его ключевые факторы" – информационные и коммуникационные технологии, биотехнологии, нанотехнологии. Формирование шестой технологической парадигмы существенно трансформирует структуру производительных сил и систему производственных отношений, меняет продукт и процесс его продвижения в различных сферах: здравоохранение, образование, энергетика, коммунальные услуги и т.д. Существенно изменяются качественные характеристики услуг и товаров, а также повышается уровень доступности материальных и нематериальных благ для всех групп населения. В этой связи эффективность инклюзивных инициатив требует консолидации усилий гражданского общества, государства и бизнеса, реформирования системы образования и создания условий для повышения уровня мотивации и социальной ответственности общества.

Ключевые слова: экономический кризис; шестая технологическая парадигма; био и нанотехнологии; инклюзивность.

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THE IMPACT OF THE LUCAS CRITIQUE ON MACROECONOMICS: A BRAIDING OF ECONOMIC AND CYBERNETIC INSIGHTS

The Lucas Critique has attracted discussion since it was published in 1976. This article evaluates its impact on the epistemology of Macroeconomics. It probes deeper than an analysis on Rational Expectations into a debate on theory and practice in macroeconomics. The originality of the research concerns the convergence/divergence between the Keynes and Lucas critiques of econometrics/econometric policy. The paper updates and refines Lucas's contribution to econometric policy evaluation framed by the Keynes – Tinbergen – Friedman – Lucas literature. The exegesis uses the expertise of the authors (one a cybernetician and one a macroeconomist) to provide a novel and stimulating platform for further debate.

Keywords: Lucas Critique, Micro/macro divide, Rational Expectations.

1. Introduction

This paper takes a meta view of the epistemology of Economics. It does not concern itself with the differences between the different schools which have developed over

the last three centuries but analyses the philosophical underpinnings of economics as a discipline. The paper is a critical appraisal based on a nuanced literature survey of the contributions to econometric policymaking covering

Tinbergen's structuralism, Keynes' refutation in his review to the United Nations in 1939, Friedman's essay on Positive Economics, the Lucas Critique in 1976 and recent writings by Krugman in the 2000's. Although the literature on comparisons of the Lucas -Keynes critiques in relation to modelling methodology is sparse, the selection offered can be seen as a convenient skeleton on which to frame an original interpretation using second order cybernetic thinking. Hidden in these critiques are many economic issues but the authors believe that the metaphor of equilibrium plays a central role. Unfortunately, the word "equilibrium" (as is the case with many economic terms) has different meanings when used in different schools and by different economists. A short glossary is therefore provided which details the meanings used in this article.

- Reality – this is "what is". The debate is whether reality is an independent entity outside and independent of homo sapiens (absolutist view) or an entity constructed by homo sapiens (constructuralist view)

- Equilibrium – its strongest meaning is when a system exists a state in which all variables are in balance or harmony. Deviations from this state are regarded as temporary perturbations and there is a systemic pressure to return to the equilibrium state.

- Homeostasis – is a weaker form of equilibrium when variables relate to each other in a self-correcting way using negative feedback. It can be called a dynamic equilibrium which means that the state is in balance, but this balance is not static.

- Homeorhesis- is the weakest form of equilibrium where there is a restoration of a flow. There is systemic adjustment not back to an initial stable equilibrium, as in homeostasis, but to some future stretch of the time trajectory. It focusses on the path not the destination. For a dynamical system, order and normalcy is maintained under internal and external disturbances.

- Systems Thinking – does not regard a system as an agglomeration of independent parts. It concentrates on relationships rather than identities. This allows properties to emerge in the whole that are not present in the parts.

- Cybernetics – first order cybernetics is used to describe the work initiated by Weiner and concentrates on feedback and circular reasoning. This is the meaning ascribed by Leijonhufvud [53] which focused on feedback control. The authors focus on second order cybernetics where the observer cannot be disentangled from the system. This has ramifications in measurements and objectivity.

- Structural Model – this is used by many economists to mean a linear model.

- Static Model – this is used by Economists to mean that time is not used as a variable. Entities and relationships are defined as fixed.

- Keynesian economics. A distinction is made in the text between what Keynes perceived to be the main thrust within his own theory [41], compared with Hick's famous suggested interpretation of the General Theory [33].

- Keynesian Thoughts: These are taken from voluminous repository of papers (30 volumes) of John Maynard Keynes.[45]. These papers, letters reviews reveal Keynes philosophical perspectives on economics.

2. Philosophical Issues

The issues raised by Lucas cannot be viewed in isolation. They are an instance of various epistemological queries that have existed since the inception of Economics as a discipline. The articles discussed are by necessity selective but chosen to cover all major issues.

2.1. The Invisible hand

Adam Smith lived at the onset of the Industrial Revolution which was the stimulus for great intellectual debate

about how an orderly society could grow and be governed [34] argues that it was the change in feudal land tenure that enabled landowners to consolidate their position and thus plan long-term investment in agriculture which resulted in the accumulation of wealth. Tax revenues controlled by parliament were then used to build a formidable navy which gave control of the seas and had a significant influence on international trade which contributed yet more to the growth of the wealth that fuelled the Industrial Revolution. This is hindsight but illustrates the combination of the prevalent political and economic forces which were taken up by Smith.

Although Adam Smith is regarded as the first Western economist, he regarded himself more as a moral philosopher who later applied his ideas to economics. His ideas are more clearly espoused in the "Theory of Moral Sentiments" [40] where he tried to explain how ordinary men can resolve their differences and live in a reasonable harmonious manner most of the time. At the centre of this work lies the concept of equilibrium but Smith departed from the prevailing ideas which were the strong version of equilibrium as an ideal state. This mechanical metaphor originated with Newton and was adapted by science into "the scientific paradigm". Smith introduced an element of uncertainty into Newton's machine and tried to determine what the restoration mechanism might be. He opposed Hobbes who argued that an equilibrium state be imposed by the absolute power of government but saw equilibrium arising naturally from the interaction of humankind. He postulated an innate tendency towards balance arising through moral sentiments, in particular "sympathy" which he defined as "fellow-feeling". This was an invisible force that returned the state to equilibrium. Although there were general rules, they are imprecise because of the indeterminism and unpredictability of human behaviour. He believed that small actions and the emotions of people could lead to a greater good.

Smith's work "The Wealth of Nations" is regarded as the first western economic treatise where the equivalent of "sympathy" was competition which behaved as "an invisible hand." Here, one person's drive for betterment is directed against another. It is in the unintended outcome of this competitive struggle for self-betterment that the invisible hand regulating the economy shows itself. Smith tried to create a "machine for growth" which involved moving from the strict form of equilibrium to homeostasis. He states:

".. some obscurity may still appear to remain upon a subject in its own nature extremely abstracted" [79]

showing that he is not fully comfortable with these ideas. Smith was interested in understanding how an ordered society could function and thus he created more of a theory than a practical tool. Despite this, his theory especially the invisible hand, was mentioned six times in Samuelson's general equilibrium study.

"Smith was unable to prove the essence of his invisible-hand doctrine. Indeed, until the 1940's, no one knew how to prove, even to state properly, the kernel of truth in this proposition about perfectly competitive market" [73].

Smith recognises an economy which has causal origins and is tending towards some sort of long-term equilibrium, but this is an abstract concept. He is aware of the imperfections of human nature and thus an economy will not run as a machine. Perhaps this is why he does not create a mathematical form for his theory as he realises that the precision needed does not and cannot exist. He

was aware of the difficulties in measuring economic variables and believed that their relationships should be understood (a systemic view). He also questioned whether the functional dependency needed for a mathematical formulation could be obtained. This also questioned the role of deductive reasoning in economics. He was warning about what Ryle [70] calls category mistakes and trying to separate theory from practice.

"If doing economics is just one other means of "reading" the world, and consists of no more nor less of "commentary" on it, then one can at least challenge the first order, epistemological privilege that is accorded to high economic theory and/or econometric analysis" [8].

Many elements of modern cybernetic theory and systems theory can be seen in his thoughts. The idea of an invisible hand is similar to Newton's concept of "gravity" which was only apparent from its actions. Einstein created more detailed models of gravity but its essence is still invisible. We thus have the intriguing situation where an unknown can be usefully employed in a working theory. A cybernetician would substitute "competition" by "organisation" *"Everything is organisation"* [9] A complex organisational system is organisationally closed but in a structural relationship with its environment (homeostasis) The approach today would be to use a "network" metaphor [10] instead of a mechanical one.

Smith is also recognising what is now termed emergence where the outcome is an unintended consequence of the parts.[79] This is a major component in non-linearity and the concept of a system. At the time, the consequences of people's actions (practice) were not known or even foreseen, but it was thought there is a convergence of ideas (theory) and behaviour (practice) that would lead to future unanticipated events. Smith describes the conditions that correspond to what is now termed a "free market". His concept of economic equilibrium is an ideal condition toward which a market is constantly and freely moving. Building on this assumption, mathematical models through Marshall [62] and Walras [87] became the sui generis of Economics. Many of these insights were taken up by Keynes which resulted in an epistemological crisis in 1939.

2.2. The Keynes Critique 1939

In the 1930's, a prominent theory on the microeconomic determinants of inequality was that of Tinbergen [59] who shared the first Nobel Memorial Prize in Economic Sciences with Ragnar Frisch in 1969 for having developed and applied dynamic models for the analysis of economic processes [16, 17]. He is widely considered to be one of the most influential economists of the 20th century and one of the founding fathers of econometrics [59]. Keynes' review, undertaken for the League of Nations in 1939, published in *The Economic Journal*, is a devastating critique of Tinbergen's econometric work [44]. In a letter to Harrod [30] prior to the Economic Journal review, Keynes outlined the restrictive and illusory character of the assumptions underpinning the Tinbergen econometric models. Specifically, he dealt with completeness, homogeneity, stability, measurability, independence, linearity and uncertainty [30].

Where Tinbergen tried to count and quantify different factors which influence cyclical movements in economies, Keynes maintained that a complete list of all the relevant factors would be required to avoid misspecification and spurious causal claims and that such a list would be impossible to construct [44]. To make feasible econometric inductive inferences, the system under examination needs to exhibit a large degree of 'homogeneity.' According to

Keynes most social and economic systems (especially from the perspective of historical time series) lack such homogeneity. Tinbergen assumes there is a stable temporal relationship between the econometric variables [82]. However, Keynes argued that it was not possible to make inductive generalisations based on correlations/regressions from long time series samples [44]. Tinbergen's model also assumed that all relevant factors were quantifiable. Keynes doubted if it is possible to quantify phenomena such as expectations, political, economic and psychological factors. Tinbergen assumed that the instrumental variables to be independent whereas Keynes argued that in a complex, evolutionary system like an economy, independence is a profoundly improbable assumption to maintain. To make the models tractable, Tinbergen assumed the relationships between the variables to be linear [82]. This was standard practice, but Keynes argued that non-linear relationships were most probable over the trade cycle. Finally, regarding uncertainty, Keynes, queried, on epistemological and ontological grounds, if it was possible to measure uncertainty using probabilistic risk procedures. There are two views about the meaning of uncertainty: one view is that "true uncertainty" is the same as the view that Keynes promulgated, namely that uncertainty in economics focuses on unknown events for which no probability function can be assigned. The other view, espoused by modern econometrics conceives of known events where stochastic processes exist but where the respective parameters are unknown or not knowable. Keynes's uncertainty is not used in current econometrics. According to Keynes [41] *"we live in a world permeated by unmeasurable uncertainty"*. Few if any of Keynes's contemporaries understood Keynes's interpretation of non-numerical probabilities. However, Keynes made this point stridently [41] in considering the pervasive influence of uncertainty in aggregate consumption and investment decisions [41] Nonetheless, this view is normally discarded by classical theory. It can be seen that Keynes' issues with the Tinbergen's econometric philosophy were profound.

"the basic, fundamental conflict between Tinbergen and Keynes....., is over the application of probability to conduct (decision making). Kalecki and Tinbergen are both frequentists, who believe in precise and exact, additive probability. Keynes was a logician who, proposed non-numerical probabilities, which were inexact, non-additive and imprecise, could be integrated with evidential weightings" [4].

In his thesis of 1968, Leijonhufvud [53] argued that in broad outline Keynes's own theory was a cybernetic one. But here Cybernetics is used in a different sense to the authors. Leijonhufvud refers to the first order cybernetics introduced by Weiner [88] which was heavily dependent of feedback and circularity. Leijonhufvud (ibid) did favour homeostasis over equilibrium, regarding the economy as having no long-run objective but a dynamical system whose behaviour over time can be studied regardless of whether or not it approaches any particular reference point. Leijonhufvud (ibid) could also invoke homeorhesis when he states:

"It might exhibit a strong attraction to certain reference points, but there will be circumstances under which it will not converge or will converge slowly or non-monotonically".

Keynes can thus be regarded as a prototype second order cybernetician in that he did not believe in the deus ex machina – the auctioneer who is assumed to furnish,

without charge, all the information needed to obtain the perfect coordination of the activities of all traders in the present and through the future.

Econometricians at first took Keynes's devastating criticism seriously [2, 49, 69]. The debate on the role of econometrics previous to Haavelmo [26] developed econometric procedures in probabilistic terms. Haavelmo (ibid) adroitly eluding the technical issues raised by Keynes, proposed a new framework which short-circuited the Keynes – Tinbergen – Koopmans controversy [52]. Haavelmo [26] proposed that actual data sets have to be chosen as complements of theoretical variables, and declarations inferred from theory must be backed by empirical data. Verification of such propositions do not necessarily sanction compliance with underlying theory, since the same prediction/hypothesis may be consistent with disparate theories. By means of this perception Haavelmo [26] was able to circumvent Keynes's disquiet about the lack of completeness of a list of all factors. Haavelmo [26] contended, that it is conceivable to use a regression equation comprising an incomplete list of causal factors, by the verification of parsimonious hypotheses which are nonetheless perspicacious in increasing knowledge [19]. Therefore, Haavelmo [26] articulated that both theoretic and observable variables should be envisioned as stochastic entities to rebuff Keynes's pronouncements to Harrod [29]. Haavelmo [26] maintained that statistical testing is a mechanism to derive inferences as to the nature of the mechanisms or propositions which generated the original data [19].

Haavelmo's philosophy (which conceived the role of econometrics to be an inferential paradigm embedded in stochastic terms) provided the footing for the empirical methodology embraced by Cowles Commission which pioneered sophisticated developments in econometrics [5]. The Cowles Commission's distinguished staff have included many Nobel Laurates including Haavelmo, Koopmans, Debreu, Simon, Klein, and Stiglitz. According to Christ [5], the Cowles Commission, in the years after Keynes's formidable appraisal of Tinbergen's methodology, subscribed to a corpus of precepts which constitute an a la carte menu of current econometrics. These include : simultaneous economic behaviour; linear equations and disturbances; systematic, observable variables without error; discrete as opposed to continuous variable changes; a priori determination of exogenous versus endogenous variables; the existence of reduced forms; independence of the explanatory variables; a priori identified structural models; normal distributions disturbances with zero means, finite with stable covariances and dynamically stable systems of equations

One way of approaching Keynes' objections is to examine the difference between theory and practice. The authors believe that knowledge is a concrete human activity which recognises the facts of the world in which it interacts. Predictions are intelligent guesses – nothing more. They are not accurate depictions of the future – that is clairvoyance. After a prediction is made, it must be checked and depending on its accuracy, decisions are taken, or the prediction amended.

In terms of macroeconomic theory, Keynesians were critical of the new classical theorist's utilisation of instantaneous market clearing in general equilibrium models [7, 11, 18, 20, 24]. Moreover, Trautwein [83] argues that Leijonhufvud maintains a similar perspective in his portrayal of DSGE models proposed by new Keynesians. However, new Keynesians argue that general equilibrium models inspired by Walras [87] are not relevant [7] because real mixed economies normally experience slow price

/output reactions because adjustment to equilibrium is gruelling due to market "frictions". Hence modelling economies experiencing shocks, under the aegis of general equilibrium is likely to be ambiguous and not suitable for examining economic crises. Free market mixed economies are not dependent on the tenets of general equilibrium theory [7]. Capitalist economies still endure whether general equilibrium models are empirically verifiable or not. Applied economics research aims to understand agent behaviour and explore paths for improvement. Classical and new classical theorists, however, embrace the view that free markets are self-stabilising which runs counter to ideas of Keynes and the Keynesians . New classical and original classical theorists contend that if the economy is shocked into disequilibrium the price system reacts quickly to regain equilibrium. Classical theorists typically argued that given wage – price flexibility Say's Law automatically restored equilibrium. Applying Say's Law allowed Classical theorists to propose that disequilibria were ephemeral because aggregate production yields sufficient income to move the economy back to equilibrium [41].

Keynes foreshadows modern cybernetic thinking which recognises that elements can exhibit different behaviour dependent of its level of recursion. A human need not exhibit the same behaviour when acting as an individual as when acting in a group situation. This conflicts with Adam Smith who believed that individual self-interest would replicate itself in group self-interest. Keynes also recognised that changes in behaviour cannot be attributed to external causes. Recent cybernetic thinking is that external events (shocks) will cause a human to examine his behaviour and will only be a potential stimulus to change. (Complex Adaptive Systems).

"The macroeconomics of John Maynard Keynes is then revisited to provide an example of how some economists in earlier times were able to provide powerful economic analysis that was based on intuitions that we can now classify as belonging to complex systems perspective on the economy" [13].

The actual change will be made by the element according to its own set of rules- culture, religion, tribe, nation, politics even the way it feels at the time. This is the case when Keynes disputed Tinbergen's research methodology. Keynes claimed that it was unrealistic to assume a "state where there is no changing future to influence the present" [41]. This was the basis for the Lucas Critique which argues that rational expectations cause agents to make reasonable predictions derived from economic theory based on optimisation principles.

2.3. The Influence of Friedman

The next important contribution to the role of economic theory was provided by Friedman in 1966, where he introduced the "instrumentalist "role of modelling", specifically:

The relevant questions to ask about the "assumptions" of a theory is not whether they are descriptively "realistic" for they never are, but whether they are sufficiently good approximations for the purpose in hand. And this question can be answered only by seeing whether the theory works, which means whether it yields sufficiently accurate predictions [14].

Friedman is arguing here that the strength of a theory (model) should only be judged by its outcomes in the sense that its predictions agree with what is perceived to be "reality". This is a problem if one believes in a constructed i.e., subjective reality which rests on assumptions. Friedman's (ibid) thesis is based on the existence of

regularities in nature from which "general laws" can be discovered. The prime task of economic theorists is to search for these laws which can then be verified by accurate prediction and thus produce an economic truth. There is a logical sequence here: empirical data is gathered, general laws are discovered using induction, deductions (predictions) are made which are then tested. In this view, theories are only instruments for making predictions. There can be no clear resolution to this polemic as outcomes rest on the philosophical beliefs of the user: for example, whether reality is constructed or absolute and whether there is an economic equilibrium. The authors favour the view of Cullenberg [8] that there are multiple bases for knowledge production, and it is impossible to set up criteria for deciding the "correct" one. Often the observations (data) used to test the predictions are selected to fulfil that purpose, thus producing tautologies.

Friedman initiated a useful methodological debate which reveals differences between theory and practice and, at a deeper level, the relationship between deduction and induction within economic epistemology [39]. Friedman concedes that the purpose of a theory need not only be prediction but could be understanding which is about "why" rather than "what" happened. The authors thus believe that predictive models can only apply to the limited context in which they are posed and even then, may not predict well due to unforeseen circumstances.

One of Friedman's key insights was that "expectation" was relevant to what actually happened e.g., his work on the augmented Phillips curve. Contrary to Keynes, he believed that "long-term" macroeconomic forecasting was possible although his view of the "long-term" was the time required for expectations to become aligned with reality [14]. Friedman's focus on adaptive expectations was a forerunner of the Lucas Critique although evidence is that he did not fully believe in rational expectations [134, 15]. Friedman's view of expectations were more adaptive than rational.

2.4. The Lucas Critique 1976

In 1969, Phelps wrote; "The New Microeconomics in Inflation and Employment Theory", in which he explained how money surprises could have real effects in the absence of nominal rigidities, using as an example markets physically separated; this metaphor is nowadays known as Phelps' island parable [66]. Phelps used the concept of adaptive expectations (which was central to Freidman) and then extended by Lucas by a seemingly innocuous assumption of rationality in his publication "Economic Policy Evaluation: A Critique" which questioned the ability of empirical economics to correctly model, test, or predict the economy [58]. This is since known as the Lucas Critique and caused a major upheaval in macroeconomic theory. Tinbergen-type structural models had been endorsed by Samuelson [72] when, for example, he argued that the Phillips Curve could be portrayed as a long run structural equation, thereby enabling a montage of macroeconomic policy options for governments [71]. At this time economists exuded the confidence of control engineers [61, 86]. Lucas's critique challenged Tinbergen-type models stating that they were inconsistent with the assumption of "rational" expectations [63], which undermined the *raison d'être* of macroeconomic policy intervention. The Lucas Critique denied the notion that the macroeconomy could be controlled by identifying specific failures of the Tinbergen-type econometric models where parameter stability in regression equations is dubious. Within this narrow focus, regarding stability and homogeneity issues, Lucas can be seen as restating some key criticisms that Keynes had levelled at the methodology and practice epitomised by the Tinbergen paradigm regarding specification bias [64].

The Lucas Critique concerned the feedback link (called rational expectations) which changed the relationship between microeconomic agent behaviour and macroeconomic theory. (see Fig. 1).

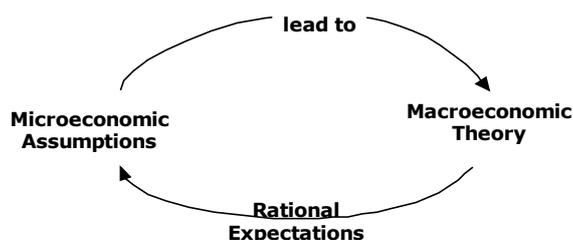


Fig. 1. The links between micro and macroeconomics

The core of the problem was that the linear equation models of the macroeconomy (typified by Tinbergen-type models) assumed that private agent behaviour was disconnected from a changing policy vector. Thus the policy maker could formulate macroeconomic policies independent of agent behaviour. However, if agents have rational expectations of policy variations, the policymaker is denied control of the macroeconomic system, because the agent's behaviour will change and render policy ineffective [74]. Thus, there is link from microeconomic behaviour to macro behaviour. Lucas emphasizes that rational agents can only realise the consequences of a government policy change by knowing the economic model used by the policy makers (the "true" model) and hence this model must consistently explain effects of policy deviations [47]. This can be difficult as in the case of wage setters, labour markets and phenomenon such as Stagflation. Discounting

perfect foresight, in formulating a model with consistent expectations, an agent must initially choose the "true model" perhaps based on the "wisdom of the crowd". Because a rational agent needs to evaluate the consequences of a policy option within an available model; the model will often be superseded by updated theories that convey superior opportunities.

The possibilities of such undermining of policy by rational expectations is undisputed today. What can be discussed is the accuracy of these expectations and their widespread use. Both links of the feedback loop in figure one need to be investigated.

For the upper link, the Tinbergen-models assumed that the micro economic variables were independent and stable. If this is not the case (and Keynes suggested that it isn't), then their models cannot provide accurate

predictions. In Lucas's Phillips curve exemplar, relative prices are constant by assumption; whence a disequilibrium (or suboptimal outcome) emerges caused by agent confusions regarding aggregate labour /product price levels. Applying this assumption, Lucas jettisons (in opposition to Keynes) the hypothesis that in a microeconomic labour market, causal relationships depend on macroeconomic issues. But, in the Critique Lucas does not provide a narrative for microeconomic market mechanisms whereby market prices are established regarding demand conditions, so the concept of feedback is not present. In such cases, then the idea underlying the Lucas approval of the requirement of micro foundations pre-determine macroeconomic phenomena lacks substance since all market relationships are interdependent. In labour markets, income effects, and/or insider/outsider issues may engulf relative price effects. It is difficult to judge which micro relationships are more essential than others. One microeconomic relationship cannot be considered more essential than another especially in the context of potential employment/output, effects at industry levels of aggregation. This idea was first developed by Triffin [84] in a critique of the theory of monopolistic competition Perhaps a version of the model insinuated by Triffin [84] that is superior to that which Lucas explicated, is a model where the quantity/labour supplied in each industrial market is positively correlated with the inputs/outputs supplied in all other markets and where an increase in the inputs/outputs supplied in one market tended to increase demand in all other markets and vice versa. In that case, deviations from aggregate supply would tend to be cumulative with multiplier effects entailing a more complex transmission mechanism. In such cases inflationary and/ or disinflationary booms might occur given a Triffin-type general equilibrium perspective on industrial completion [78, 84].

Lucas focussed on the lower link. One immediate difficulty is that if agents' base predictions on a given time series it follows that if regime change causes the times series to alter so will agent behaviour. It is not clear how agents can use rational expectations in the context of bubbles or acute external shocks since by extension no times series exists. Lucas argues that rational expectations require that the macroeconomic models must not only exhibit model consistent expectations but also take into account the ephemeral nature of the model itself. Consider an example relating to a positive fiscal policy boost. Most Lucas Critique "immune" theoretical/econometric models contend that the long-run effect of a fiscal boost results not in a rise output but a rise in the aggregate price levels. Rational expectations models predict that a rational agent's response is to raise prices immediately decreasing the output effect of a fiscal expansion to zero. However, considering the Lucas Critique in the Phillips curve example, raising prices may not be the rational response. This is because a rational agent may know uprated models where the best response is to do nothing on prices or lowering prices. In the Phillips curve models Nash bargaining outcomes might lead to lower prices. In Lucas's view, there can only one rational policy option. This case arises when the ultimate, undisputed "true" model is universally known and available Are such cases plausible? If the "true" model was common knowledge, or that the "true" model was being progressively enhanced rational agents would decide to do nothing in oligopoly [84]

Rational expectations as depicted by Lucas in the Critique requires an augmented choice criterion for the

context of what Keynes considered to "be true uncertainty" [41]. The message of the Lucas critique is ontological, driving an inexorable search for super - exogeneity in econometric model parameters. Therefore, the Lucas Critique may be viewed as an assiduous research incentive towards encompassing known "uncertainty" into economic theory. Rational expectations or feedforward modelling could be understood as a means of facilitating decisions in the face of otherwise paralysing Keynes -type "true uncertainty". [4, 41, 42].

Because of the Cowles Commission's acceptance of the stochastic approach, Keynes' strident critique of Tinbergen -type econometrics had been marginalised and the tricky issues regarding causal inferences lay buried until 1976 [51, 64] However, nowadays econometricians recognize that most of the problems Keynes raised were fundamental and his warnings such as those relating to business cycles are still relevant. The Lucas Critique essentially provides the intellectual basis for understanding Keynes critique of Tinbergen with regards to stability, completeness, independence and homogeneity in statistical time series research. To a degree the Lucas Critique is a special /niche case of Keynes's generalised appraisal of econometric/mathematical methods in economics [43].

2.5. The Legacy of Lucas

In his critique, Lucas [58] censures the macro-econometric policy paradigm inspired by Tinbergen-type models characterised by Klein [48] for failing to encompass fundamental microeconomic agent optimisation behaviours. This new classical critique led by Lucas [55, 56, 57, 58] and Sargent [75, 76] respectively, signalled a revolution in macroeconomic theory. In particular, the Lucas Critique argued that macro-econometric models needed to be built on micro-foundations, espousing rational expectations about the way that individual agents formed future expectations. This revolution meant that the New Classical School gained ascendancy in macroeconomics sparking a resurgence in macro -econometric modelling based on a search for the existence of stable long run parameters [3, 31, 32].

In the decades following the Lucas Critique, the microeconomics /macroeconomics divide widened. Macroeconomics was seen as esoteric based on curious psychological notions such as the marginal propensity to consume. By contrast microeconomic theory was esteemed as pristine, being grounded in rigorous mathematical derivations of consumer/producer behaviour based on the principle of utility/profit maximization. Thus, microeconomics was portrayed, both in partial and general equilibrium terms as the gold standard. Economists were urged to repose in the tranquillity of microeconomics (the area with solid substance). In the late 1990s, a quasi-theoretical consensus was achieved when new Keynesians integrated rational expectations into their macroeconomic models based on imperfect markets (Goodfriend, 1997). This quasi consensus engendered a new macroeconomic paradigm called the new neoclassical synthesis which displays New Keynesian aggregate demand/monetary features and new classical supply side norms [22].

The theory of rational expectations stigmatised the use of macro-econometric models based on large systems of equations as irrelevant. Predictions attached to large-scale econometric models particularly the Phillips curve appeared to be imprecise [36]. The New Classical School saw this inaccuracy as being the result of instability in the parameters of equations in the Keynesian models which excluded the

impact of policy change but the Lucas Critique disagreed arguing that, if a causal relationship between economic variables is widely known to be consistent, then policy makers, when developing future policies, cannot exploit that causal relationship because agents fully anticipate the new arrangements and policy targets are thereby foiled. The spirit of the Lucas Critique is exemplified by the Friedman-Phelps – Sargent thesis. [14, 65, 66, 74] namely that, monetary policy permitting inflation would fail to diminish unemployment because wage setters would adjust their wage expectations of future inflation, so negating the monetary stimulus. Fischer [12] however, reversed this conclusion using Sargent's rational expectations model in staggered wage setting environments.

An example of how economic theory has incorporated rational expectations is the attempt to run traditional feedback demand for money models against feedforward rational expectation models. In this respect Hendry [31] found, in an analysis of the M1 money aggregate in the UK that: "A statistical theory-model to discriminate between rival pure feedback and feedforward models was presented and the role of changes in the marginal models for the expectations processes was highlighted. The analysis reveals that for sufficient change in the marginal processes, it is feasible to tell the model types apart despite their similarities. In the particular example of the M1 aggregate the expectations interpretation of the conditional model was rejected". Moreover, Stanley [80] in a meta-analysis of the omnipresence of the Lucas Critique in econometric modelling found that:

"Although there is great dissonance concerning the Lucas critique, our meta-analysis revealed how the apparent applicability of the Lucas critique may be attributed to misspecification and the manner in which expectations are treated. When models with questionable specification are discounted, empirical support for the Lucas critique vanishes".

In support of this proposition Abbott [1] shows in an advanced cointegration study of the aggregate demand for beer in the UK, that surprisingly after a decade of significant government intervention in the industry all demand coefficients for beer demand in the UK tested as stable. This evidence is consistent with Stanley's (ibid) finding that perhaps in the context of properly specified econometric procedures empirical support for the Lucas critique disappears. Thus, empirical tests that seemed to undermine the very basis of rational expectations [80].

Sargent and Lucas [76] suggest that rational expectations will help solve the identification problem by introducing a new set of "cross-equation restrictions." However, the parameter identification issue in all macro-econometric models awaits convincing solution, this includes the modern practise of using Bayesian priors [78] which only increases the number of parameters to identify. Keynes in a letter to Koopmans [49] argued; " In much of the statistical research, in order to get enough observations, they have to be scattered over a lengthy period of time; and for a lengthy period of time it very seldom remains true that the environment is sufficiently stable. That is the dilemma of many of these enquiries, which they do not seem to me to face. Either they are dependent on too few observations, or they cannot rely on the stability of the environment. It is only rarely that this dilemma can be avoided." This was a key element in Keynes' critique [46].

There has been a sea change in recent years led by Nobel prize winners such as such as Krugman and Stiglitz.

They argue that macroeconomic theory does make successful predictions and any failures are not due to the theory but to the failure of economists to believe them. Utility Maximisation which is one of the foundations of microeconomics is not a fact about the world; it is also derived from similar psychological thought experiments, disparaged in macroeconomics. Krugman [50] makes the point that neither microeconomics or macroeconomics is useless nor that either sub paradigm is superior. The effort to make macroeconomics more and more like microeconomics – to establish everything in rational behaviour – is seen now as destructive [67] Krugman [50] believes that the second part of Lucas Critique – namely that rational expectations heralded the demise of macroeconomics since macroeconomics might become a branch of applied microeconomics is false. Both sub - paradigms provide a classic example of the difference between theory and practice. Proponents in both areas have realised that even robust theories cannot achieve anything unless they have the backing of strong government.

3. Cybernetic Comments

A cybernetic view of the Lucas Critique would consider several issues:

- Recursion. Cybernetics accepts that every entity has two identities – it exists as a whole and also as a part of a bigger whole. These are not either/or but are contemporary and simultaneous occurrences. Which aspect is operative depends on the observer? An economic activity can be seen from a macro or a micro viewpoint. The task is not to connect from microeconomic events to macroeconomics but to adjust the observation [41]. One is either looking at the economic "event" as complete in itself or as part of a larger event. This is the basis for the rejection of an independent i.e., objective reality. Keynes's subscribed to this viewpoint and is evident in Gruchy [25] Current cybernetic theory would suggest microeconomics and macroeconomics exist at different levels of recursion. They are linked but because of non-linear behaviour and the phenomenon of "emergence" (where the macroeconomic could have properties that are generated by the microeconomic but do not reside there) they are not causally determinate. Relationships can be expressed metaphorically as a pair of ballroom dancers making intricate patterns within the framework of accepted norms which are flexible enough to allow ad hoc decisions whilst preserving homeorhesis. It is interesting that Samuelson [73] used the same "dance metaphor when describing the progress of economics "two steps forward and one step back"

- Self-Circularity

Companies maximise some variables and provide data for the policy makers. Using this data, in a selected model, predictions are made which form the basis of a policy which is then implemented. The companies adjust to these changes and thus generate new data which forms a basis for new policy etc. Hence performance and policy are in a continual interplay – homeostasis. Lucas [58] assumes the companies will reach the same predictions as the policy makers (using same data and same model) and thus second guess the implementation. They can then change their behaviour to adapt to the change or to mitigate the effects of the change. Thus, the policy will not be fully implemented. All this means is that the economic dance is changed – homeorhesis is substituted for homeostasis. The economy still functions. This anticipation is not particular to a specific model so that Lucas Critique is a general observation and is present in all cybernetic models. Theoretically, it is resonant to second order cybernetics

where the observer is part of the system. Policy makers and the agents are all economists and will naturally form predictions. That these predictions interplay with each other cannot be avoided. One cannot say what things are, only how they are manifested. "*Models are neither true nor false but should be useful*" [81]. Truth expresses the relationship of the human collective to the things of its experience. "*There are no subjective or objective views, just relationships.*" [68]

- Data. How is the data selected, is there bias in the selection and how sensitive is the prediction to the accuracy of the data? Data are measurements but how does one select the measure for performance? If a machine is regarded as performing well, it may be inferred that it is achieving its designed task. But what is the designed task? This is difficult to pin down. Then how does one measure that it is achieving the task? There must be an evaluation or measurement against a standard. Christianson gives many examples where different measures (such as RONA and IRR) effect a company's performance.[6]. If performance means satisfying the measure, then how does one satisfy a measure. A measure is a comparator. So, improving performance means that a certain state is measured and compared with it timewise. This assumes that there is a desired, known state which reflects the view of reality. Often this desired state is seen as an equilibrium one.

- Causality. Even when using the same data and model, will "rational expectation theory" ensure that the agents arrive at the same economic predictions as the policy makers? This would only be possible for deterministic methodologies. Cybernetics assumes non-linear behaviour. Thus, a similar solution method could produce a different outcome. If the agents were cyberneticians, then they would be playing a dangerous game in continuously trying to second guess a putative state. Their time would be better spent in focussing on their internal problems. It is here also that Keynes was more prescient than Lucas.

A cybernetician (who is, by definition, an interdisciplinarian) could not help but notice that that in the same decade, Lorentz [54] published his paper on weather predicting, Mandelbrot [60] published his paper on Fractals, which were linked by Chaos.[21] (Von Foerster [86] published "Cybernetics of Cybernetics" which introduced second order cybernetics, and the quantum theorists began to come to term with the paradox that the measurer is inseparably linked to the measure. In mathematics, neural networks, [37] genetic algorithms,[35] and Fuzzy logic [89] were discovered. A similar debate was taking part in biology with the discovery of punctuated equilibria in evolutionary history, the distinction between selection and sorting, and group selection [38]. The common thread in these different branches of knowledge is that dichotomies ceased to be binary objects, but there satisfy a self-referencing feedback loop and are seen as complementary rather than distinct.

The authors argue that both microeconomic and macroeconomic processes drive economic change, and that macroeconomic change cannot be explained by micro level optimising alone. The distinction between reductionism and holism is of little use and in its place a recursive approach is proposed. This allows for both upward and downward causation and interaction between levels.

4. Final Comments

The basic idea contained in the Lucas critique is a simple one. It was that if agents are rational, they can

anticipate policy and will change their behaviour. It targeted the structural econometric models then in vogue [48] or econometric models validated by the tenets of the Cowles Commission) and concluded that macroeconomics could not be regarded as useful as it could not predict the behavior of an economy after a policy intervention. In the Critique, Lucas gave examples of where estimated parameters based on previous observation may change their value in a significant and unpredictable way, so counterfactual exercises of economic policy were pointless [58]. Generally, the issue of rational expectations was favourably received:

"The general point made by the critique is correct and was known before it was so eloquently and forcefully propounded by Lucas" [12].

Gordon argued that:

"Lucas is right when he says that not all simulations will provide useful results, however, some simulations may be useful. This may happen when parameter shifts can be estimated from the sample data or can be deduced from a priori theory [23].

But had misgivings about the broader aspects of the critique:

"but he (Lucas) goes too far when he charges the 'econometric tradition' is 'fundamentally in error'" [23].

Lucas disagreed with this view replying that:

"Gordon's comment manages to leave the impression that relatively modest modification of current models will serve to correct their difficulties. To me, this is like trying to design an airplane by putting wings on a steam engine" [58].

Lucas perceived fundamental errors in macroeconomic theory and did not believe it could be rescued by making modifications in a Ptolemaic fashion or using the Duhem-Quine thesis [28]. We agree with Gordon in that Lucas was correct in identifying the problems of rational expectations (although this was not new or irreparable) but we developed a rich heritage of economic thought and criticism, which preceded Lucas (in particular that of Keynes and Friedman) and that Lucas erred in his opinion of its effect on macroeconomics. This is the deeper question – the relationship between microeconomics and macroeconomics.

The relationship between theory and practice is a long-standing debate [27]. To quote Einstein, "*In Theory, there is no difference between theory and practice but in practice, there is*" [77]. The second order view is that theory and practice are examples of this cosmic dance. The success of a policy depends on whether and how the policy is executed. This is the message for economics. It must exist in two levels of recursion and its theories and practices are continuously oscillating together. Keynes foresaw this concurrence. Using classical theory, Keynes focussed on economic states within a static model. But in practice, Keynes believed in dynamic processes [25]. As the son of JN Keynes (a prominent English economist who advocated the use of both induction and deduction in Economics) and a member of Cambridge Apostles (which included, Whitehead, Moore, Russell, and Wittgenstein), the views of JM Keynes are not surprising. A Systems viewpoint was evident in all Keynes' work and the authors see his critique as fundamentally a juxtaposition between theory and practice. This key issue was undertaken by Friedman [14]. Gruchy [25] contends that, in Keynes' conception, economic science involves the notion of "events" including the past, present and future. Gruchy [25] also maintains that Keynes used a notion of equilibrium, in the context of specific labour/capital markets but deliberated on the balance of "psychological expectations" to explicate

equilibria when all markets in the economy were at play. These ideas are consistent with the concept of "process" in economic events and is also underpinned in Whitehead's philosophy [25]. This is the final conclusion of the paper that Keynes' thoughts were prescient, foreshadowing many ideas in second order cybernetic theory.

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ВПЛИВ КРИТИКИ ЛУКАСА НА МАКРОЕКОНОМІКУ: ПЕРЕПЛЕТЕННЯ ЕКОНОМІЧНИХ І КІБЕРНЕТИЧНИХ УЯВЛЕНЬ

Критика Лукаса викликає дискусії з моменту її публікації в 1976 році. Оцінюється її вплив на епістемологію макроекономіки. Вона проникає глибше, ніж аналіз "Раціональних очікувань" у дебати про теорію і практику макроекономіки. Оригінальність дослідження стосується сходження / розбіжності між критикою Кейнса і Лукаса щодо економетрики/економетричної політики. Оновлюється і уточнюється внесок Лукаса в економетричну оцінку політики в рамках літератури Кейнса – Тінбергена – Фрідмана – Лукаса. Екзегеза використовує досвід авторів (один – кібернетик, інший – макроекономіст), щоб надати нову і стимулюючу платформу для подальших дебатів.

Ключові слова: критика Лукаса, поділ на мікро/макро, раціональні очікування.

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ВЛИЯНИЕ КРИТИКИ ЛУКАСА НА МАКРОЭКОНОМИКУ: ПЕРЕПЛЕТЕНИЕ ЭКОНОМИЧЕСКИХ И КИБЕРНЕТИЧЕСКИХ ПРЕДСТАВЛЕНИЙ

Критика Лукаса вызывает дискуссии с момента ее публикации в 1976 году. Оценивается ее влияние на эпистемологию макроэкономики. Она проникает глубже, чем анализ "Рациональных ожиданий" в дебаты о теории и практике макроэкономики. Оригинальность исследования касается сходжения/расхождения между критикой Кейнса и Лукаса в отношении економетрики/эконометрической политики. Обновляется и уточняется вклад Лукаса в эконометрическую оценку политики в рамках литературы Кейнса – Тинбергена – Фрідмана – Лукаса. Экзегеза использует опыт авторов (один – кибернетик, другой – макроэкономист), чтобы предоставить новую и стимулирующую платформу для дальнейших дебатов.

Ключевые слова: критика Лукаса, разделение на микро/макро, рациональные ожидания.