Journal of Economics Bibliography
econsciences.com
Volume 12 March 2025 Issue 1

Legacies of rational expectations, Lucas's contributions, and philosophy of time and existence

By Hiroaki HAYAKAWA†

Abstract. This paper explores the close affinity between the theory of rational expectations that revolutionized economics in the 1960s and 1970s and the phenomenology of consciousness and human existence in philosophy that preceded it. In so doing, we trace the evolution of the views in economics on the decision making modes and the role of the market system, from Keynes, to Friedman, to Muth, and then to Lucas, and place the theory of rational expectations in perspective in relation to the phenomenology of the inner time consciousness a la Husserl and of human existence a la Heidegger as well as to Aristotle's ethics of human life as a life of actions. It is argued that the theory of rational expectations, along with its insight and implications, has brought economics to its home ground, that is, the ethical nature of human existence.
Keywords. Intertemporal optimization; Rational expectations; Phenomenology; Internal time consciousness; Human existence; Anticipation; Environment; Neutrality of Money; Econometric policy evaluation; Ethical nature.
JEL. A12; B10; B11; B20; B21; B22; D01; E00; E41.

1. Introduction

In the first couple of decades of the post World War II era, Keynes's *General Theory* (1936) swept across the field of economics. This theory offered a new view that could explain why and how an economy may fall into the state of involuntary unemployment as an equilibrium phenomenon if prices and wages are rigid enough. It was revolutionary against the classical economics, which held on to the view that glut and involuntary unemployment are not tenable because prices and wages cannot remain rigid under such conditions. The core feature of Keynes's theory was later formulated as an IS-LM model by Hicks (1937) and Hansen (1949, 1953), which served as a guiding model for policy making as well as for pedagogical purposes until inflation became a central issue after the 1960s. The Keynesian theory is based on the premise that the economy can be structurally modeled by a set of the so-called behavioral equations that are supposed to remain invariant to economic policies since such policies, despite their endogenous nature, are treated as external forces that are applied to the economic system from outside. It was a common belief at the time that these equations, regardless of the level of sophistication, can be statistically estimated from the historical data. The behavioral equation approach, combined with econometrics, turned into an art of econometric policy evaluation, the foundation of which had already been laid out by Tinbergen in his theory of economic policy (1952). As the theory took over the center stage, business cycle theories of the 1930s and 1940s (e.g., Schumpeter 1939, 1942) were pushed

† School of Business and Economics, University Brunei Darussalam, Tungku Link, Gadong BE1410, Drunei Darussalam.

to the sideline with a belief that business fluctuations can be taken care of by appropriate stabilization policies. The optimism was in the air, particularly in the United States under the flag of the Employment Act, which was enacted in 1946 and put the responsibility of controlling unemployment and stabilizing prices on the shoulder of the federal government. The Phillips curve, due originally to Phillips (1958) who observed an inverse relationship between the unemployment rate and the rate of wage inflation in the United Kingdom for a period of 1861 through 1957, added to this optimism with a belief that the curve is stable enough for stabilization purposes (Gordon, 2009).

Despite such optimism, already in the 1950s, it was observed in the consumption-income data that while the marginal propensity to consume is less than the average propensity in the short-run, consumption is largely proportional to income in the long-run, hence with little gap between the two propensities. In retrospect, it was the discovery of this discrepancy that opened the Pandora's box. The search of new theories looked into the idea of intertemporal optimization as an alternative way of modeling the decision making modes of economic agents. Two important theories were introduced along this line, one by Modigliani & Brumberg (1954) who proposed a life-cycle hypothesis of consumption-saving, and the other by Milton Friedman (1957) who introduced the notion of permanent income. Both theories have endured to this day and are still inspiring many economists (Deaton, 2005; Sargent, 1987). The profession apparently shifted its focus from the short-run to the long-run in search for a normative theory that can integrate short-run choices with long-run planning. The permanent income hypothesis, in particular, was a prelude to a revolution that was to take place soon afterward, under the name of rational expectations. Three seeds were already present in Friedman's theory: first, on the question of which income-generating process makes Friedman's distributed-lag computation of permanent income optimal; second, as a corollary to this question, on the inseparability of rational decision making modes from the environment in which such decisions are made; and, third, on whether agents' decision making itself hould be viewed as a process rather than as a stable structural relation. Later, Muth (1961) gave an answer to the fist question by identifying an income generating process that makes Friedman's distributed lag computation optimal, and, more than a decade later, Lucas (1976), extending Muth's insight, answered the second question by elucidating how rational decision making modes are intimately related to the features of the economic environment including a politico-economic policy regime, and cast a serious doubt on the validity of the then popular practice of econometric policy evaluation. Lucas's demonstration led to a new view that decision making is a process, be it consumption or investment, rather than a structure and that even the entire economy as an aggregate might be understood as a process. Thus, a more fluid holistic understanding of the dynamics of decision making modes and the movement of the economy has replaced a rigid structural view, and because of this radical shift, large macro-econometric models, that had been developed and widely used for economic forecasting and simulation for more than two decades at the time, yielded the center stage to stochastic process models.

It was not widely known at the time, among economists or social scientists in general, that prior to the 1960s there was a radical shift in philosophy under the name of phenomenology attributed to Husserl and Heidegger. This phenomenology aimed at seeing things as they are including human

consciousness and existence. For our purposes, we pay special attention to Husserl's phenomenology of the inner time consciousness and Heidegger's phenomenology of human existence, as they are directly relevant to the theory of rational expectations. The first delves into the internal working of our consciousness as to how this consciousness reconstitutes perceived things as temporal objects, and the second looks at how human beings exist, not as an ideal object, but as existence itself. Both have discovered temporality as the primordial principal. More specifically, the inner time consciousness always works with the temporal horizon of protention, presence, and retention. Likewise, the human existence consists in the ecstacies of temporalized temporality in its movement. Heidegger's analytics of Dasein is a phenomenological re-reading of Aristotle's *Nicomachean Ethics*; in this sense it has brought the age-old theme of ethics under the new light of phenomenology. We will argue in this paper that there is a close affinity between these phenomenologies and the revolution that took place in economics under the name of rational expectations. In retrospect, this affinity should not be surprising, because the way we make rational decisions is an expression of how we exist apart from any particular life it lives, which is made possible by the internal working of our own consciousness and is made visible by the actual choices we make in an environing world we encounter by our own self-movement. Through this encountering, we discover a multitude of things in it, and we deliberate over them as means to achieve the end of our life. There is no objective world in which all things in it are already there with their essences perfectly known to us. Everything hinges on how our consciousness is activated as an intentional activity, how our daily living is conducted with this intentionality, and how resolute we are in taking up the responsibility of making our life complete and meaningful with the potential we are endowed with. All of this underlies our economic decisions, for the choices made by such decisions are aimed at the ultimate end of making our life a successful project. We know that philosophy advocates thinking that goes beyond presuppositions, assumptions, or hypotheses so as to come closer to the truth of things, tangible or intangible, including our own existence. Although economists have argued tirelessly that it is imperative to keep economics safe from the intrusion of the quagmire of philosophical arguments, economics and philosophy are not, and should not be, enemies to each other, contrary to the stance often taken by both camps. To be sure, our understanding of the way humans make choices is greatly enhanced by a deeper understanding of human consciousness and existence. Our consciousness as an intentional activity is aware that the time we allocate, be it subjective (internal time) or objective (the world time), is not unbounded, and that our existence as a teleological activity cannot escape the predicament that it is always constrained by the means at our disposal including time.

With such affinity between philosophy and economics in mind, this paper inquires into a close affinity between Husserl's phenomenology of the internal time consciousness and Heidegger's characterization of Dasein (human being) as unified ecstacies of temporalized temporality, on the one hand and economists' notion of the rationality of expectations unified with the temporality of decision making on the other. It is our view that this connection, historically speaking, was made visible and lucid, when the idea of intertemporal optimization was conjoined with rational expectations. In making this inquiry, we focus on Lucas's contributions along with those of

Friedman and Muth, to highlight how a different way of viewing the decision making modes of rational agents has radically changed the course of the science of economics. At the same time, we are quick to see that this revolutionary view is not something that was discovered for the first time by those who advanced the rational expectations revolution, for it can be, in essence, traced back to Aristotle's ethics that the life of human beings is a life of teleological actions. However, Lucas was among the first to point out, by demonstration, that the decision making modes of intertemporally motivated agents are inseparable from the decision making environment, and to integrate the idea of intertemporal optimization with the idea of endogenous expectations, to come up with the notion of market equilibrium as a rational expectations equilibrium path, which led to the view that an economy, as an endogenous system, is a process rather than a set of stable structural behavioral equations.

The paper is organized as follows. In section 2, we review Lucas's contributions to economics sciences, and relate them to Aristotle. In sections 3 and 4, we look at Husserl's phenomenology of the internal time consciousness and Heidegger's phenomenology of human existence, respectively, and relate these phenomenologies to the ideas of rational expectations and intertemporal optimization. In section 5, we trace how the notion of the rational expectations equilibrium has come about by overcoming many of the difficulties that will be mentioned. In section 6, we take up the concept of a policy regime and Lucas's critique of econometric policy evaluation, to see why and how decision making modes are intertwined with an economic environment including a policy regime. In section 7, we trace the development of monetary theory from Friedman to Lucas along the quantity theory of money, and show how the stage was set for Lucas's contributions. In section 8, we examine Lucas's theory of expectations and the neutrality of money in detail, so as to place his contributions in a better historical perspective. In section 9, we conclude this inquiry by discussing further the theory of rational expectations and Lucas's contributions in relation to the phenomenology of the internal time consciousness and existence.

2. Lucas's contributions and Aristotle's ethics

Two decades after the publication of the papers: "Expectations and the Neutrality of Money" in *Journal of Economic Theory* (1972), and "Econometric Policy Evaluation: A Critique" in *Carnegie-Rochester Conference Series on Public Policy* (1976), the Royal Swedish Academy of Science awarded Robert Lucas, Jr., Professor of Economics, University of Chicago, the Nobel Memorial Prize in Economic Sciences in 1995. It was in recognition of the path-breaking importance of the view he introduced; that is, the rationality of decision making of economic agents as a conjoined rationality of intertemporal optimization and expectations in the context of a decision making environment. In the immediate Press Release as well as in the Advance Information released by the Academy, the two papers above were cited explicitly as his major contributions that made a lasting impact on the later development of economics sciences, along with the recognition of his contributions in investment theory (Lucas & Prescott, 1971), financial economics (Lucas, 1978), monetary theory (Lucas, 1980a, Lucas & Stokey,

1987), dynamic public economics (Lucas & Stokey, 1983), international finance (Lucas, 1982), and economic growth (Lucas, 1988). His contributions to business cycle theory, without mistake, should also be mentioned (Lucas, 1980b, 1981, 1987). His legacies are very much alive today, not only in the core theory of the New Classicism founded explicitly on the ideas of intertemporal optimization, rational expectations, and market equilibrium, but also in the opposing camp of Keynesianism that has been revamped, side by side, by such ideas as information imperfection, frictional adjustment, monopoly power, and strategic behavior. Lucas's influence on the camp of Keynesianism is attributable to his idea that economic phenomena result from the two-way relations between the decision making modes and the environment in which such modes take specific forms. It is, therefore, not surprising that the Keynesian economics, that had long dominated the profession in the postwar era with its advocacy of a structural view of an economy, reviewed its presumptions and resurged with a new stance that decisions of economic agents and the decision making environment cannot be separated as well as with a renewed commitment that an analysis of economic behavior must be based on the rationality principle conditioned by this environment. We often heard that the profession was divided into two camps, the New Classicism and the New Keynesianism, but such characterization is no longer tenable, for whatever approach one takes, we now share the same aspiration that decision rules of economic agents and the decision making environment (including the internal conditions of the decision makers as analyzed in behavioral economics) must be integrated by the rationality principle.

Thomas Sargent made the following remark at the 25th anniversary conference that commemorated the publication of Lucas's paper on expectations and the neutrality of money.

> Equilibrium macroeconomics continues 'M.I.T. economics' in the ways it uses small but self-consistent 'parable' economies to confront broad facts. From the beginning, Solow's one-sector growth model and his growth residual and Samuelson's overlapping generations model were the vehicles that drove rational expectations revolutionaries to the front. Many of us regard Lucas's 1972 JET paper as the flagship of the Revolution; it is different from the flagship of that earlier revolution, Keynes's *General Theory of Employment, Interest, and Money*, which was ambitious, wide-ranging, imprecise, and vague enough to induce twenty-five years of controversy about what the book really meant. Lucas's paper was a narrow, technical study of a modification of Samuelson's parable economy, designed to be a counterexample to interpreting a negative unemployment-inflation correlation as something that a particular type of monetary *cum* fiscal policy could exploit. There was never any confusion about what Lucas's paper meant, any more than there was about Samuelson's or Solow's. If Lucas's paper was slow reading for macro-economists, it was because we were unfamiliar with contraction mappings, and with thinking of equilibria as *functions*.
>
> It extends our appreciation of Lucas's contributions to remember that he did not work in a vacuum, and that among his many gifts is the ability to demonstrate by choice of engaging examples the importance for macroeconomic policy questions of making pre-existing ideas fit together. Sargent (1996: 536)

In the 1960s and 1970s, large macroeconometric models of the US economy as well as economic forecasting conferences based on such models were popular, along the Keynesian tradition that stable behavioral equations can be

estimated from the past data. While the debate between the Keynesians and the Monetarists was heated, the Monetarists' claims were still in the black box, although Friedman was striding along with his own theories of consumption and asset demand that are fundamentally different from the Keynesian theory. At one of these conferences held at the University of Michigan, Professor Warren Smith was urging the Monetarists to make their black box explicit so that both camps might be able to have a more fruitful debate on how output, employment, and prices are determined. It was not easy for the Monetarists to respond to such a call because they were actually attempting to go beyond the behavioral equation approach. Lucas's paper on expectations and the neutrality of money came at the time when this debate was at its peak.

We were all taught the Keynesian economics, and Lucas's paper must have been read with suspicion first, partly because the theory behind it was the quantity theory of money (as opposed to Keynes's liquidity preference theory), and partly because the paper introduced a completely new idea of rational expectations as a function and the notion of the rational expectations market equilibrium as a fixed point (as opposed to adaptive expectations, which was based on an error-learning scheme). In retrospect, the Keynesian theory, popular at the time, was dominated by a certain epistemology that was founded on the presumption that an economy has a structure constituted of a set of stable behavioral equations, the parameters of which were believed to be estimable statistically from the past data. This epistemology was regarded by many Keynesians as a positive approach to the modeling of a macroeconomy, but left many questions unanswered, such as: (1) How is short-run related to long-run in decision making? (2) What does it mean to say that an economy is an endogenous system if expectations are left out of it? (3) How can we identify structural parameters by econometric methods when agents are forward-looking in nature? (4) How can we model forward-looking agents whose expectations are endogenously formed? (5) How are the decision rules of such agents related to an economic environment in which decisions are actually made? (6) How valid is it to view economic policies as exogenous forces when they are in fact endogenous responses of the authorities to contingent economic situations with the information they possess? Without answering these questions, the Keynesians proceeded to estimate the structure of an economy statistically and used it for evaluation of policies assuming that policies are exogenous forces to the system. On the contrary, Lucas tackled many of these questions face to face, and offered a very different way of modeling the decision making modes and an economy against the Keynesian methodology. Most importantly, he viewed economic agents as forward-looking planners, who make optimal intertemporal decisions with an endogenously determined market equilibrium taken into account, through the idea of expectations that are formed endogenously to be consistent with this equilibrium. This was an extraordinary achievement.

If we place this contribution of Lucas in a historical perspective, we see that the idea of rational agents as forward looking decision makers is a new vision of the age-old view that can be traced to Aristotle's *Nicomachean Ethics*. According to Aristotle, the life of human beings is a life of actions that are teleological in nature, hence must be directed and guided by the first principle of living well, by cultivating the virtues of character and intellect and by wisely exercising practical wisdom (the all-overseeing virtue of intellect, *phronesis*) in deliberating over the means that are within our power and choosing the

best means to achieve our end, in every situation in which such choices are made. Our life is a continuous process of endless activities to achieve a series of inter-connected ends that arise spontaneously from within ourselves. Because all actions are mediated by resources of one kind or another, all agents have no choice but to deliberate over which actions to take and which means to choose, paying attention to the environment in which such actions are taken. All this is done with foresight in regard to the consequence of any particular action or choice before it is actually taken. If actions and ends are connected sequentially, every agent must foresee the future environment in which future actions will be carried out, and make a plan of actions accordingly. Since the consequences of actions cumulate to define the initial state from which to start our planning anew at any point in life, we have no choice but to make the best plan of actions from this initial condition in order to live our life of actions to the best of our ability. This is little different from the principle on which economics is based; that is, the explanatory power of economics is derived from the principle that choices we make are the best choices from the set of feasible means for our objectives. Thus, despite the common understanding that the origin of economics is in the idea of management of household or state, the real basis of economics can be traced to the ethical nature of human existence. Unfortunately, this plain fact had remained unheeded, until the theory of rational expectations and intertemporal optimization brought it back explicitly and made it a solid part of economic theory.

In *Nicomachean Ethics*, Aristotle defines the essence of human existence as *energeia* (activity), and the first principle of this existence as *eudaimonia* (or, more precisely, *entelecheia*as the activity in which its end is realized in the activity itself), and explicates what it entails in terms of deliberation over feasible means as well as choices made from such means. Influenced by Aristotle, Heidegger, in his *Being and Time*, characterized human existence as care and *ekstasis*. Whether such *ekstasis* means being thrown into the truth of being or the temporality in which human existence unfolds itself, human beings act for an end, understand and interpret the history of what they have done, and constantly project their being into its own most possibilities. Heidegger summarized such temporality by saying that the future makes the present in the process of having-been (Heidegger, 1962: 326 and, 374). Human beings are historical beings, and our starting point is always given by the history of the irreversible path of actions we took in the past, but, under any given initial condition we try to choose the best plan of actions into the future. Aristotle says in Book VI of *Nicomachean Ethics*: "we deliberate about things that are in our power and can be done", and "deliberation is about the things to be done by the agent himself", and "what is last in the order of analysis seems to be first in the order of becoming." That is, by deliberation, we deduce from our end the best actions to take. Our deliberation ends when the choice has been made by the principle in ourselves. Thus, "choice will be deliberate desire of things in our own power." Can we find any better way of putting that we are, by nature, economic agents making the best feasible choices to achieve our own end? In Book III of *Nicomachean* Ethics, Aristotle says:

> We deliberate not about ends but about means. For a doctor does not deliberate whether he shall heal, nor an orator whether he shall persuade, nor a statesman whether he shall produce law and order, nor does any one else deliberate about his end. They assume the end and

> consider how and by what means it is to be attained; and if it seems to be produced by several means they consider by which it is most easily and best produced, while if it is achieved by one only they consider how it will be achieved by this and by what means this will be achieved, till they come to the first cause, which in the order of discovery is last. For the person who deliberates seems to investigate and analyze in the way described as though he were analyzing a geometrical construction (not all investigation appears to be deliberation – for instance mathematical investigations – but all deliberation is investigation), and what is last in the order of analysis seems to be first in the order of becoming. And if we come on an impossibility, we give up the search, e.g. if we need money and this cannot be got; but if a thing appears possible we try to do it. By 'possible' things I mean things that might be brought about by our own efforts; and these in a sense include things that can be brought about by the efforts of our friends, since the moving principle is in ourselves. The subject of investigation is sometimes the instruments, sometimes the use of them; and similarly in the other cases – sometimes the means, sometimes the mode of using it or the means of bringing it about. It seems, then, as has been said, that man is a moving principle of actions; now deliberation is about the things to be done by the agent himself, and actions are for the sake of things other than themselves. For the end cannot be a subject of deliberation, but only the means; nor indeed can the particular facts be a subject of it, as whether this is bread or has been baked as it should; for these are matters of perception. If we are to be always deliberating, we shall have to go on to infinity.
>
> The same thing is deliberated upon and is chosen, except that the object of choice is already determinate, since it is that which has been decided upon as a result of deliberation that is the object of choice. For every one ceases to inquire how he is to act when he has brought the moving principle back to himself and to the ruling part of himself; for this is what chooses. This is plain also from the ancient constitutions, which Homer represented; for the kings announced their choices to the people. The object of choice being one of the things in our own power which is desired after deliberation, choice will be deliberate desire of things in our own power; for when we have decided as a result of deliberation, we desire in accordance with our deliberation. (*Nicomachean Ethics*, Book III, Sec. 3) (Underlying is mine.)

Aristotle's point that deliberation is about the things that can be done by the agent himself is particularly important for economics, precisely because the same principle underlies microeconomics. At one of the conferences the author attended, Milton Friedman made a remark to the effect that the essence of microeconomics consists in the fact that each person makes the best decisions for his or her end. That is, the deliberation on what to choose from the feasible means should be left to the person making such choices, not to any third party. The influence of Aristotle was the mark of the Austrian School founded by Carl Menger, who published his *Principles of Economics* (*Grundsätze der Volkswirtschaftslehre*) in 1871, and von Mises, Hayek, and Friedman carried the spirit of the School with faith in individual choices and free economies founded thereon. And, Lucas was definitely influenced by Friedman, and indirectly by Carl Menger and Aristotle. In fact, we can detect the Aristotelian influence in Lucas's contributions in the two papers we mentioned? In the auto-biographical account released by the Royal Swedish Academy of Sciences, Lucas writes and indicates that he read Plato and Aristotle:

> I attended Seattle Public Schools, graduating from Roosevelt High School (where my parents had graduated in 1927) in 1955. I was good at math and science, and it was expected that I would attend the University of Washington in Seattle and become an engineer. But by the time I was seventeen I was ready to leave home, a decision my parents agreed to support if I could obtain a scholarship. MIT did not grant me one but the University of Chicago did. Since Chicago did not have an engineering school, this ended my engineering career. But when I began the 44 hour train trip "back east" to Chicago, I was pretty sure something interesting would turn up. What to do instead? I took some mathematics at Chicago, but lost interest soon after my courses got past the material I had half learned in high school. I did not have the nerve to major in Physics, which is what you did at Chicago in those days if you thought you could make it. The real excitement for me was in the liberal arts core of the Chicago College, courses from the Hutchins era with names like History of Western Civilization, and Organization, Methods, and Principles of Knowledge. Everything in these courses was new to me. All of them began with readings from Plato and Aristotle, and I wanted to learn all I could about the Greeks. I took a sequence in Ancient History, and became a history major. Though I had no real idea what a professional historian does, I had learned that one can make a living by pursuing one's intellectual interests and writing about them. I began to think about an academic career. (Lucas, 1995) (Underlying is mine.)

And, in the same autobiographical note, Lucas writes about his experience with Milton Friedman's price theory sequence.

> In the fall of 1960, I began Milton Friedman's price theory sequence. I had been looking forward to this famous course all summer, but it was far more exciting than anything I had imagined. What made it so? Many Chicago students have tried to answer this question. Certainly Friedman's brilliance and intensity, and his willingness to follow his economic logic wherever it led all played a role. After every class, I tried to translate what Friedman had done into the mathematics I had learned from Samuelson. I knew I would never be able to think as fast as Friedman, but I also knew that if I developed a reliable, systematic way for approaching economic problems I would end up at the right place. (Lucas, 1995)

With this review of Lucas' contributions, I now turn to Husserl's phenomenology of the internal time consciousness and Heidegger's of phenomenology of Dasein, in sequence. These phenomenologies preceded the idea of intertemporal optimization and rational expectations in the 1960s and 1970s by several decades. Unfortunately, English translation came much later. As we show, they do have an important bearing on the essence of the rational expectations equilibrium theory.

3. Husserl's phenomenology of the consciousness of internal time

In his lectures: On the Phenomenology of the Consciousness of Internal Time (1983-1917) (hereafter PCIT), he suspends "world time, the real time, the time of nature in the sense of natural science and even in the sense of psychology as the natural science of the psychic", and focuses his investigation on appearing time and appearing duration as appearing, that is, on the immanent time of the flow of consciousness (PCIT, pp. 4-5). This stance is analogous to Kant's critique of pure reason (immanent reason) that examined

what pure reason is capable of and how it works, rather than criticizing particular outcomes of speculative reason (Kant, 1781).

On the essence of time and temporal objects Husserl writes:

> The question about the essence of time thus leads back to the question about the "*origin*" of time. But this *question of origin* is directed towards the *primitive* formations of time-consciousness, in which the primitive differences of the temporal become constituted intuitively and properly as the original sources of all the evidences relating to time. (PCIT, p.9)
>
> If we disregard all transcendences, there remains to perception in all of its phenomenological constituents the phenomenological temporality that belongs to its irreducible essence. Since objective temporality always becomes constituted phenomenologically and stands before us in appearance as an objectivity or as a moment of an objectivity only through this constitution, a phenomenological analysis of time cannot clarify the constitution of time without considering the constitution of temporal objects. By *temporal objects in the specific sense* we understand objects that are not only unities in time but that also contain temporal extension in themselves. (PCIT, p.24)

According to Husserl, the temporal object must include temporal distinctions, which are constituted in three acts: primal consciousness, retention, and protention (PCIT, p.40). We catch what is coming as something indefinite, perceive it by primal consciousness, and retain what is perceived as memory. To elucidate these acts, he first delves into the most intriguing unity of experience called memory, and the act of protention in relation to this memory. He observes that every memory contains expectations-intentions, and what animates the temporal object originally is the act of protentions that catch what is coming. Memory and recollective consciousness tells us that these protentions not only catch what is coming but also have caught and brought what has been caught to fulfillment, or re-fulfillment, to be exact. While original protentions catch what is coming as indefinite things (because how things that are coming will turn out to be are left open at the time of protentions), our expectations in recollection are settled in from the beginning. In this sense, recollection is not the same as indefinite expectations, but it has a horizon toward the future, which is also extended to the original protentions. Husserl writes:

> Now in order to understand the insertion of this constituted unity of experience "memory" into the unitary stream of experience, we must take the following into account: every memory contains expectations-intentions whose fulfillment leads to the present. Every process that constitutes its object originally is animated by protentions that emptily constitute what is coming as coming, that catch it and bring it toward fulfillment. However, the recollective process does not merely renew these protentions memorially. They are not only there in the process of catching what is coming; they have also *caught* it. They have been fulfilled, and we are conscious of this in the recollection. The fulfillment in the recollective consciousness is re-fulfillment (precisely in the modification that belongs to memorial positing). And if the original protention belonging to the perception of the event was indefinite and left open the possibility of things' being otherwise or not being at all, in the recollection we have an expectations settled in advance that does not leave all of that open, unless in the form of an "unfinished" recollection, which has a different structure from the indefinite original protention. And yet this too is included in the recollection. Thus there are already difficulties of intentional analysis here for the event considered

> separately, and then in a new way for the expectations that concern the succession of events up to the present: Recollection is not expectation, but it does have a horizon directed towards the future, especially, towards the future of what is recollected; and this horizon is fixed. As the recollective process advances, this horizon is disclosed in ever new ways and becomes richer and more vital. And in this process the horizon is filled with ever new recollected events. Those that formerly had only been indicated in advance are now *quiasi*-present – *quasi* in the mode of the actualizing present. (PITC pp.54-55) (Underlining is mine.)

Then Husserl says that a duration of a temporal object is always represented with intentions directed at the past and with intentions directed at the future. This is particularly important because Husserl is saying that a temporal object, which has a temporal extension, cannot be perceived as such without these intentions. We note in passing that our life is a temporal object, hence has a temporal extension, and that this life as well as every temporal object in it have a duration, long or short. If so, it must be represented by the same two directional intentions, one directed toward the past events or experiences and the other toward what is anticipated to come. This point observed by Husserl should be projected into the way we make choices, that is, into the fact that decisions made are, in fact, under similar directional intentions, one directed at how we have come to where we stand now, and the other directed at what we intend to fulfill in the future. Because it is always the same internal consciousness that is working, every temporal object of whatever kind must be subject to the same patterns of intentions and expectations.

Husserl says that every representation comes with the reproduction of the consciousness of the past enduring object and the consciousness of past or present or future attached to this reproduction, that the life of consciousness flows continuously, with every new memory reacting on the old in a retroactive way, and with the forward-directed intention belonging to the old being fulfilled, and that this consciousness is permeated with one unifying intention aimed at a series of possible fulfillments. He writes:

> ...A duration cannot even be represented, or better, cannot even be posited, without its being posited in a temporal context, with the presence of intentions aimed at the temporal context. Moreover, it is necessary that these intentions have the form either of intentions aimed at the past or of intentions aimed at the future. To the duality of intentions – to those directed towards the filled duration and to those directed towards the filled duration's place in time – there corresponds a dual fulfillment. The total complex of intentions that makes up the appearance of the past enduring object has its possible fulfillment in the system of appearances that belong to that same enduring object. The intentions aimed at the temporal context are fulfilled by the production of filled connections up to the actual present. Hence we must distinguish within every re-presentation between the reproduction of the consciousness in which the past enduring object was given, that is to say, was perceived or in some way originally constituted, and that which attaches to this reproduction as constitutive of the consciousness "past" or "present" (simultaneous with the actually present now) or "future."
>
> Now is the latter also reproduction? This question can easily mislead us. Naturally the whole is reproduced, not only the then-present of consciousness with its flow but "*implicite*" the whole stream of consciousness up to the living present. That means – and this is a fundamental part of *a priori* phenomenological genesis – that memory

> flows continuously, since the life of consciousness flows continuously and does not merely piece itself together link by link into a chain. Rather, every new reacts on the old; the forward-direction intention belonging to the old is fulfilled and determined in this way, and that gives a definite coloring to the reproduction. Thus a retroactive effect, necessary and *a priori*, shows itself here. The new points again to the new, which, in making its appearance, becomes determined and modifies the reproductive possibilities for the old, and so on. Moreover, the retroactive power extends back along the chain, for the reproduced past bears the character *past* and an indeterminate intention aimed at a certain location in time in relation to the now. Thus it is not as if we had a mere chain of "associated" intensions, one bringing to mind another, this one recalling the next (in the flow); rather we have *one* intention that in itself is an intention aimed at the series of possible fulfilments. (PICT, pp.55-56)

Husserl also points out that foreground cannot be foreground without background with respect to the temporal things, just as what is visible is visible against its background, or what is in space is in the spatial world as its background. In the case of temporal things reproduced as durations, such things are always inserted into a temporal form and a temporal background as a constituted temporality of before, now, and after. At the same time, such things are oriented to the living now. The point is particularly important, not only for internal time consciousness but also for human existence as this is a temporal object with its duration and its constitution as the past, the present, and the future as well as with its orientation to one's living. There is a clear connection between Husserl's inner time consciousness and Heidegger's human existence, Dasein.

> ...Foreground is nothing without background. The appearing side is nothing without the nonappearing side. So too in the unity of time-consciousness: the reproduced duration is the foreground; the intentions directed towards the insertion [of the duration into time] make conscious a background, a temporal background. And this is continued in a certain fashion in the constitution of the temporality of the enduring object itself with its now, before, and after. We have the analogies: for the spatial thing, its insertion into the surrounding space and spatial world; on the other hand, the spatial thing itself with its foreground and background. For the temporal thing: its insertion into the temporal form and the temporal world; on the other hand, the temporal thing itself and its shifting orientation in relation to the living now. (PICT, p.57)

Furthermore, Husserl says that what is actually present now is there itself. The two are essentially equivalent in the sense of coinciding. Such coinciding takes us all the way to Heidegger's Dasein, which literally means "being there", that is "there itself". In Heidegger's view, we are "there itself" but in a different sense since Dasein encounters what presences in the present. But, despite the difference, what is there is what is present now, be it a thing or a Dasein.

> The fundamental *temporal* distinctions: now, past (future). *How is the now related to the there-itself*? What is actually present now is there itself. And what is there itself individually is actually present now. The intuitive there-itself and the intuitive now (the adequately given now) coincide. *The now taken universally is therefore=there-itself+the objectivation: "simultaneous therewith."* (PITC, P. 218)

Thus, Husserl sees that our inner-time anticipates what is coming by protention, catches and brings it to its fulfillment in the present, and retains it as having-been in its memory, which is reconstituted retroactively as new

experiences are inserted into it continuously. Every temporal object has a duration that is always posited with two-directional intentions: those directed at the past and those directed at the future, with perception constituting the present. That is, our inner time consciousness is always constituted with three moments: past, present, and future. There is no consciousness of past or future without perception constituting the present. There is no past without any future, nor is there any future without any past. Thus, a duration of any temporal object in the inner time consciousness has the horizon extending from the past to the future through the present. But, it is protentions that animate the process of constituting a temporal object as they anticipate what is coming and fulfill it in the present as what has been (PCIT, p.58). This is analogous to Heidegger's temporalized temporality that the future makes the present in the process of having-been, as will be seen below. If our inner time consciousness has these moments, all of our actions including perception must have a horizon of past, present, and future. The now in which what is actually present is present is equivalent to being there itself and simultaneously to being therewith, and we always perceive what presences now against the temporal background as well as against the background of living now or a project that is being pursued. In the case of decision making, what animates every process of decision making is expectations-protentions as to what we anticipate as coming as the consequence of the decision made and what is fulfilled in relation to what we intend to achieve in our life against the background of an environing world as well as against the background of our life as a project to be completed. If we are to model the decision making modes of rational agents, it is important to consider the bi-directional intentionalities of our time consciousness and base our models on the temporal horizon of the past, the present, and the future. The theory of rational expectations and intertemporal optimization has captured this temporal horizon in decision making through the notion of making a plan of interconnected actions over time as well as through the notion of an economic environment, now and future, which helps define the budget constraint of the resources that mediate planned actions. The theories that preceded the rational expectations and intertemporal optimization, the Keynesian theory in particular, did not base them on the temporality of our consciousness and existence, hence separated economic theorizing from the normative aspect of decision making.

Husserl's phenomenology of the internal time consciousness had a significant impact on the later development of phenomenology, with its view that our consciousness acts on perception with its inner-time, which is constituted as a duration having the horizon of retention, presence, and protention. His analysis showed how it is possible for human beings to perceive anything as a temporal object and keep it in memory that has its unities and continuity. The inner time consciousness left its influence on Heidegger, who shifted attention to the "there-itself" of human existence, which he named Dasein. Heidegger characterized Dasein as unified ecstacies of temporalized temporality. Cearly, Husserl's horizon of retention, presence, and protention acquired a new meaning when it is cast in the existential structure of Dasein.

4. Heidegger's phenomenology of Dasein

In the year 1927, Heidegger published his *Being and Time* (hereafter BT), in which he made a phenomenological inquiry into Dasein (human being in its existence as "there is") and characterized it as unified ecstacies of temporalized temporality. We now turn to this characterization and see in what sense the existence of human beings is such ecstacies. Before we do so, we note that Husserl's inner time consciousness, as internal process of consciousness to constitute temporal objects, can be characterized as similar unified ecstacies, in which its three phases: retention, presence, and protention are intergrated in the sense that protentions animate the process by catching what is coming and bringing it to its fulfillment in the present, and retains it as memory. The difference is in where the "there-itself" shows up, in human consciousness in which temporal objects are caught with the horizon of past, present, and future, or in human existence where Dasein is animated by anticipatory resoluteness in projecting its being into its ownmost possibilities. Clearly, the two are inseparable and intertwined.

Heidegger's analysis of Dasein takes *Angst* as the phenomenal basis for grasping the primordial totality of the being of Dasein as *care* (BT, p.171). The being of Dasein is understood as self-projective being toward its ownmost potentiality-for-being, which implies that Dasein is always already ahead of itself (BT, p.179). But, because Dasein is always already thrown into the world, being ahead-of-itself is the same as being-ahead-of-itself-in-already-being-in-a-world (BT, p.179). Dasein is also being together with other beings that are encountered innerworldly. Dasein as care is thus understood as Mitsein, being-with-others (BT, p.180). This is quite similar to Husserl's observation that the now is the there-itself and that there-itself is simultaneously there-with, as noted above. As consciousness is intentional, hence active, it is possible to think of the primordial totality of animated consciousness that Husserl refers to as something analogous to "care" in Heidegger in existential terms.

If Dasein projects its being toward its ownmost potentiality-for-being and if Dasein is always a Mitsein, as being with the things encountered innerworldly, care must reckon with time. That is, time as within-timeness must turn into temporalization of temporality of Dasein as a project of projecting toward its ownmost potentiality to be completed in the horizon of time (BT, p.217). Husserl's inner time consciousness as a constituting activity is, in Heidegger, mobilized by Dasein's being toward its ownmost potentiality-for-being.

What is then projected is always revealed as anticipatory resoluteness (BT, p.299), which is the being toward its ownmost potentiality-of-being. This perdured coming toward itself is the primordial phenomenon of the future. That is, Dasein is futural in that it always anticipates coming toward itself (BT, p.299). But, Dasein is a thrown being, therefore, is "there" always as "already was". It is possible to take over this thrown-ness only if futural Dasein always comes back understandingly to its ownmost having-been (BT, p.299). Anticipatory resoluteness then discloses the situation and makes what presences in it present to be encountered in action (BT, p.300). Heidegger says:

> Futurally coming back to itself, resoluteness brings itself to the situation in making it present. Having-been arises from the future in such a way that the future that has-been (or better, is in the process of

> having-been) releases the present from itself. We call the unified phenomenon of the future that makes present in the process of having-been *temporality*. Only because Da-sein is determined as temporality does it make possible for itself the authentic potentiality-of-being-a-whole of anticipatory resoluteness which we characterized.*Temporality reveals itself as the meaning of authentic care*. (BT, p. 300)
>
> Future, having-been, and present show the phenomenal characteristics of "toward itself," "back to," "letting something be encountered." The phenomena of toward..., to..., together with ... reveal temporality as the *ekstatikon par excellence*. *Temporality is the primordial "outside of itself" in and for itself*. Thus we call the phenomena of future, having-been, and present, the *ecstasies* of temporality. Temporality is not, prior to this, a being that first emerges from *itself*; its essence is temporalizing in the unity of the *ecstasies*. What is characteristic of the "time" accessible to the vulgar understanding consists, among other things, precisely in the fact that it is a pure succession of nows, without beginning and without end, in which the ecstatic character of primordial temporality is levelled down. But this very levelling down, in accordance with its existential meaning, is grounded in the possibility of a definite kind of temporalizing, in conformity with which temporality temporalizes as inauthentic the kind of "time" we have mentioned. Thus if we demonstrate that the "time" accessible to the common sense of Da-sein is *not* primordial, but arises rather from authentic temporality, then according to the principle *a potiori fit denominatio*, we are justified in calling the *temporality* now set forth *primordial time*. (BT, p.302)

This is Heidegger's view of Dasein, the way human beings exist. Dasein, as a thrown being with its having been, always projects itself toward its ownmost potentiality into the future and always comes back understandingly to its ownmost having-been. This projection releases the present in which Dasein encounters what presences in the disclosed situation. Thus, the future makes present in the process of having-been. The three moments of temporality are joined as unified ecstasies of temporality and self-transcendence toward one's ownmost potentiality.

In *Nicomachean Ethics*, Aristotle saw the existence of human beings as a life of actions. Each action has its end, but this action-end dyad is not an isolated linkage, but is connected to other action-end linkages, to form a chain of linkages to achieve a higher end, and this chain itself is open-ended toward *Eudaimonia* or *entelecheia*. Heidegger has given Aristotle's ethics his phenomenological reading, and captured the way the human being exists as a thrown being and projects its being into its ownmost potentiality and disclosing to itself what it encounters in action. In worldly terms, human beings, motivated to live well, constantly aim at an end in action and deliberate what needs to be done to achieve this end (make a plan of steps to be taken toward an end), acting not in the abstract but in the actual concrete situation that is disclosed and in which what presences in it are encountered. By making a plan of actions into the future, what is expected to bear is brought to its fulfillment, and what is fulfilled shapes the past from which to start a new plan of actions. This phenomenology of Aristotle and Heidegger on the ethics of human existence, be it authentic or inauthentic, shows that this existence is futural or anticipatory as well as historical, and that all actions are temporal in the primordial sense. Heidegger draws a line between authentic and inauthentic existence, a line that separates the world of authentic existence from the world of the they and the everydayness of our living, as the

latter, guided by taking care of things and by circumspection under the usual concept of time, is the vulgar version of the former. Heidegger makes this point clear as follows:

> The temporal interpretation of everydayness and historicity secures the view of primordial time sufficiently to uncover it as the condition of the possibility and necessity of the everyday experience of time. *Da-sein expends itself primarily for itself* as a being that is concerned about its being, whether explicitly or not. Initially and for the most part, care is circumspect taking care of things. Expending itself for the sake of itself, Da-sein "uses itself up." Using itself up, Da-sein uses itself, that is, its time. Using its time, it reckons with it. Taking care of things which is circumspect and reckoning, initially discovers time and develops a measurement of time. Measurement of time is constitutive for being-in-the-world. Measuring its time, the discovering of circumspection which takes care of things lets what it discovers at hand and objectively present be encountered in time. Innerworldly beings thus become accessible as "existing in time." We shall call the temporal quality of innerworldly beings "*within-time-ness*." The "time" initially found therein ontically becomes the basis for the development of the vulgar and traditional concept of time. But time as within-time-ness arises from an essential kind of temporalization of primordial temporality. This origin means that the time "in which" objectively present things come into being and pass away is a genuine phenomenon of time; it is not an externalization of a "qualitative time" into space, as Bergson's interpretation of time–which is ontologically completely indeterminate and insufficient–would have it. (BT, p.306)

Finally, we heed what Heidegger says on the mode of Da-sein and on the connection between care, selfhood (the ontological constitution of the self-constancy of Dasein), and the factical falling prey to unself-constancy. In particular, the structure of care includes the phenomenon of selfhood and contains the danger of falling prey to the constancy of the they-world and fleeting from the authentic potentiality.

> Da-sein is "*authentically itself* in the mode of primordial individuation of reticent resoluteness that expects *Angst* of itself. In *keeping silent*, authentic *being*-one's-self does not keep on saying "I," but rather "is" in reticence the thrown being that it can authentically be. The self that is revealed by the reticence of resolute existence is the primordial phenomenal basis for the question of the being of the "I." Only if we are phenomenally oriented toward the meaning of being of the authentic-potentiality-of-being-a-self are we put in a position to discuss what ontological justification there is for treating substantiality, simplicity, and personality as characteristics of selfhood. The ontological question of the being of the self must be extricated from the forehaving, constantly suggested by the predominant way of saying-I, of a persistently objectively present self-thing.
>
> *Care does not need a foundation in a self. But existentiality as a constituent of care gives the ontological constitution of the self-constancy of Dasein to which there belongs, corresponding to the complete structural content of care, the factical falling prey to unself-constancy.* The structure of care, conceived in full, includes the phenomenon of selfhood. This phenomenon is clarified by interpreting the meaning of care which we defined as the totality of being of Da-sein. (BT, p.297)

The phenomenologies of Husserl and Heidegger are about the same human being, one seen from the inner time consciousness and the other from human existence. They are homologous in structure. Every object that is perceived

and constituted as a temporal object and every action that is planned and implemented to achieve an end are cast into a temporal horizon of past, present, and future. If the intentionality of human consciousness has dual orientations, one directed toward what has been fulfilled and the other toward what is yet to be fulfilled, and if it is the expectations-protentions that capture what is coming and bring it to its fulfillment as having been, all human actions, deliberated in consciousness, must have the same temporal structure. That is, the ecstacies of temporalized temporality of human existence and the inner time consciousness of every temporal object as a duration with retention, presence, and protention must be equivalent in primordial structure. We may say that human existence as such ecstacies are made possible because human consciousness has its own ecstacies of integrating two directional intentionalities into a unified stream of experiences. Equally, human consciousness may be said to have two directional intentionalities because human existence is characterized by the ecstacies of tempolized temporality, driven by angst (the feeling of anguish mixed with hopes to find a meaning for the thrown being), and mobilizes all its power including consciousness to make one's life as complete and meaningful as it can be. If all objects we perceived are temporal in nature and cast in the horizon of primal consciousness, retention, and protention, so are our actions, which are cast with temporal distinctions and integration of past, present, and future. But, such distinctions are not something that is given from the outset. Rather, they come out because human consciousness and existence are animated by something deeper, which may be called the will to perceive in the case of consciousness and the will to make one's life complete and meaningful in the case of human existence.

In our perception and action, we anticipate what will be perceived next and fulfilled and what will be done next and fulfilled. Such perceptions form unities of memories in the background of the internal temporal order and one's daily living, and such actions form unities of experiences in the background of the thrownness of being and the desire to make one's life complete and meaningful. If we cannot be conscious of the past without our intentions directed at its fulfillment, and if we cannot compose any action without our intentions directed at its fulfillment and further actions to take, it is not possible to think of any perception, experience, or action as an isolated event.

The phenomenologies of Husserl and Heidegger have much to bear on how to look at decision making of human beings in this world. We have seen that both consciousness and existence are guided by two directional intentions and mobilized by expectations-anticipations of what is to come and to be fulfilled. At the same time, all of the perceived objects and the planned actions, as foreground, are possible only in the background of the surroundings: "a unitary intention of a multitude of interconnected objectivities and coming to fulfillment in the gradual, separate, and multifarious givenness of those objectivities" (PCIT, pp.56-57). In particular, all our actions are composed and implemented against the background of a multitude of interconnections with other people. No human being can exist without the help of other individuals. Thus, our intentionalities include not only temporal ones with respect to our own constituting of temporal objects but also another one, which is directed at a multitude of other individuals, past, present, and future. Any intentional act will not be fulfilled unless there are other individuals living and supporting

each other through an extensive web of interconnected activities, not only in the present but also in the future. In making a plan of actions, we are counting on this fact as the background in which our existence as a life-project is embedded.

Consciousness and existence are dual to each other. If the ecstacies of temporalized temporality run through them, all of the decisions made by human beings (as to which actions to take and which choices to make) are made with the same temporalized temporality universally across time. This implies that they must be connected intertemporally so as to fulfill an intended project, individual or communal. The consequences of those actions taken in the past cumulate (in terms of knowledge and skills and assets) and define the initial condition from which to start a new series of actions, always subject to the feasibility conditions across time.

Husserl's and Heidegger's phenomenologies preceded the revolutionary shift that took place in economics in the 1960s and 1970s by several decades. Had we given more thought to the fact that our consciousness has dual intentions and that our existence consists in ecstacies of temporalized temporality, our modeling of the decision making modes of economic agents would have been different and would have achieved something closer to this fact. Why then did it take so long before economics finally came to reckon with the temporality of our consciousness and existence? Keynes's theory almost totally abstracted from this temporality, and based its epistemology on a certain set of presumptions that ignored the normative nature of decision making as well as the role of the environment with which our decision making modes are intimately intertwined. The gap finally began to close through the effort made by Friedman, Muth, and Lucas among others. Far-stretched as it may sound, are we allowed to say that economics had finally come to cope with the temporality of decision making two centuries after Aristotle spoke on the ethical nature of human existence as a life of actions in ancient Greece?

Now, we turn to the theory of intertemporal optimization and rational expectations, so as to see the close affinity between the theory and the phenomenologies of Husserl and Heidegger. The theory is known today as the New Classicism as opposed to the Keynesianism.

5. The rational expectations equilibrium theory

The New Classicism is based on three closely-related ideas: (1) Individual agents' decisions are intertemporally motivated; (2) the expectations that agents hold about the future environment are formed endogenously within an economic system in which decisions are made, in a manner consistent with the formation of market prices; (3) the market clears (the demand and the supply are equilibrated continuously over time). Intertemporal planning calls for knowledge of the future economic environment in which planned actions are pursued, and market clearing calls for consistency of all planned actions of all agents in all periods. That is, market clearing must foresee an equilibrium price path into the future. The idea of intertemporal optimization itself was introduced to economics by Ramsey (1928), Koopmans (1963), and Cass (1965) in the context of growth theory, but it was Friedman's (1957) theory of permanent income that started a heated debate between Keynesians and Monetarists in the 1960s and in the early part of the 1970s over the issue of the intertemporal rationality as the fundamental cause of economic behavior.

The central question addressed and answered in Friedman's theory of consumption concerned which optimal consumption path would be the best plan against an expected future income stream. While this stream is a stochastic process, an agent determines his consumption path that will maximize his expected intertemporal utility. Friedman saw a close relationship between this optimal consumption path and permanent income, which is the annuity value of one's wealth, where this wealth is defined as the present discounted value of an expected stream of income. This theory is only part of a more general view that Friedman held, that is, all decisions made by rational agents, be it consumption-saving or demand for assets (financial or physical), are related to this measure of wealth. In his theory, none of our decisions should be treated as isolated decisions. This view is consistent with Aristotle's ethics, in which all decisions and deliberations are governed by the virtue of intellect, *phronesis* (practical wisdom).

Friedman's theory of permanent income is derived from the forward-looking nature of individual agents. But, because the future income is yet to be fulfilled, Friedman attempted to estimate this income from the observed income in the past, i.e., as an exponentially weighted sum of the past income, but without demonstrating which stochastic process of income generation makes this distributed lag estimation optimal. Later, Muth (1960) addressed this question in his paper "Optimal Properties of Exponentially Weighted Forecasts", showing that the optimality of Friedman's distributed lag estimation requires that an underlying stochastic process be such that the first difference of income is a first order moving average process (which is the case if income has an error component which is the sum of a random walk and a white noise). Interestingly, by answering this question, he helped the profession shift its attention to the role of the environment in which economic decisions are made. That is, rational decision making modes make sense only when it is paired with the environment in which such modes take specific forms. This new awareness is particularly important in the light of the fact that prior to Friedman's theory, Keynesians held a view that the structure of the economy can be described by a set of the so-called structural equations which are assumed to remain invariant to the environment that economic policies affect one way or another. Muth's demonstration also had a very important implication that remained hidden for some time. The contrapositive statement of Muth's proposition, which has the same truth value, can be stated as: If the stochastic income generation process is such that the first difference of income is not a first order moving average process, then the permanent income as estimated by Friedman in an distributed lag form is not an optimal estimate of the real interest return from the present discounted value of an expected income stream. More generally, the optimal modes of decision making hinge critically on an underlying stochastic process, so that if this process is altered by economic policies, the decision making modes themselves will change. It is this proposition that Lucas (1976) demonstrated in his critique of econometric policy evaluation over a decade later. That is, if the word "policy regime" is used for the environment, we are now allowed to say that the decision making modes of rational agents are policy-regime specific. Such dependence of decision making modes on policy regimes is known today as the Lucas critique. This critique is a denouncement of the Keynesian premise that the structural equations are invariant against economic policy regimes.

Following his 1960 paper, Muth (1961) wrote another path-breaking paper, "Rational Expectations and the Theory of Price Movements," and suggested, as a powerful way of endogenizing expectations, that a subjective probability distribution held by economic agents as expectations be identified with an objective probability distribution of the variables for which expectations are formed. The idea was given the name of rational expectations. Thus, this paper formalized the idea that expectations are formed endogenously from an objective distribution of the variables in question. But, the notion of rational expectations is not entirely Muth's patent since Mills (1957a, 1957b, 1959) introduced a similar idea, i.e., *implicit expectations*, under a different assumption on the predicted vs the actualized variable. At any rate, both ideas contrast with the notion of adaptive expectations introduced by Cagan (1954) and Nerlove (1956). Despite the potential power of Muth's rational expectations or Mill's implicit expectations, many prominent economists including even Friedman, Phelps, Lucas and Rapping, and many others, still carried their researches in the 1960s with the idea of adaptive expectations. Muth's idea had to wait for a decade before its power was fully recognized as a way of building a consistent intertemporal equilibrium model.

The decade of the 1960s was dominated by the Phillips curve controversy, that is, by the question as to whether this curve is stable enough for policy makers to rely upon in prescribing stabilization policies. The curve was first discovered by Phillips (1958), who plotted the unemployment rate and the rate of change of nominal money wage rates in the United Kingdom for the period of 1861-1957, and observed a negative relation between the two. Many economists conjectured from this and other similar studies that a stable relation might exist between the unemployment rate and the inflation rate, and, with a belief that it does, used it to underpin the tradeoff between the two rates. Friedman (1968) and Phelps (1967, 1968), on the other hand, argued that the Phillips curve is not a permanent relation and does not offer a stable tradeoff in the long-run. While Friedman and Phelps came to a similar conclusion, their theories are different; see the Nobel memorial lectures by Friedman (1977) and Phelps (2006) for their differences. Friedman (1968) argued: When an unanticipated change in nominal demand (money supply) is injected, the prices of goods rise. Firms measure the marginal value product of labor under the prices of the goods they produce; hence they would employ more labor with a fall in the real wage rate. Workers, on the other hand, base their consumption-leisure decisions on the average price, or, more precisely, on the expected price level, for they care about the real purchasing power of income they earn. Therefore, the higher wages that the firms would be willing to pay will be perceived as the higher expected real wages by the workers, given their expectations. This leads to higher employment and production. Thus, if, in the short-run, the unemployment rate falls below the natural rate due to a shock in nominal demand, the actual inflation rate must be exceeding the expected one. Such conditions cannot persist as the workers, becoming aware of a gap between the expected and the actual inflation rate, adapt their expectations toward the actual. When this adaptation has fully caught up with the actual, the unemployment rate must return to its natural rate. Thus, this argument was termed the natural rate theory, or the augmented Phillips curve theory. If a nominal shock is fully anticipated, that is, if an increase in money supply is announced ahead of time and is known to every agent, the real wages the firms are willing to pay will be identical to the real wages the workers

demand, leaving the employment of labor unchanged. It was already clear in the theory of Friedman and Phelps that it is unanticipated nominal shocks that can have real effects on employment and production; anticipated nominal shocks are neutral to real economic activities.

The concept of adaptive expectations was an important component of the natural rate theory. In the face of unanticipated shocks, agents cannot foresee perfectly where the economy will settle after such shocks, hence have no choice but to revise their expectations by an error-learning process, i.e., by closing some of the gap between what they anticipated and what they have actually observed. The basic problem of adaptive expectations, however, is that such expectations are essentially determined by the prices in the past. That is, by tracing adaptive expectations recursively into the past, whatever expectations agents may hold now for the coming year, for example, can be shown to be determined completely, in a distributed lag form, by the actual prices now and of the past. If so, such expectations cannot accommodate agents' foresight into the future. It is too restrictive to confine expectations in this manner, without allowing them to accommodate what may be expected to happen in the future and the impact of such expectations on the market. Lucas & Rapping (1969a, 1969b) presented an alternative theory to explain why the short-run unemployment rate falls below its long-run rate when the prices are above their normal levels, by invoking the idea of intertemporal substitution of labor with leisure. Again, the dynamic mechanism of this process was not fundamentally different from the idea of adaptive expectations, although the notion of the normal level is related to the long-run market equilibrium.

Adaptive expectations had to be overcome in a more fundamental way, by relating expectations to market equilibrium of the present and the future somehow. If we recall that Muth's theory of rational expectations was a theory of endogenous expectations with respect to market equilibrium from which is obtained an objective probability distribution of a variable for which expectations are formed, it was inevitable that the idea of adaptive expectations had to be overcome by referring to such objective distributions. Once expectations are formed from a probability distribution of the market equilibrium price, economic agents must foresee not only equilibrium this period but also equilibrium in all future periods, because equilibrium this period would not be attained without equilibrium in all later periods when the agents' decisions are intertemporal. Thus, Muth's notion of rational expectations, when applied to the context of intertemporal optimization, entails that the rational expectation equilibrium is *a rational expectation equilibrium path* extending from the present to the indefinite future. The idea of adaptive expectations had to be overcome, and the urgency was shared by many in the profession at the time. To get ahead with this new idea, Lucas & Prescott (1971) published a paper, "Investment under Uncertainty", in which they showed how investment, output, and prices move over time in a competitive environment under a stochastic demand while the expected prices are held to have the same probability distribution as the actual prices after Muth (1971).

What has come out of the development in the 1960s was a realization that economic agents' decision making should be modeled as intertemporal optimization and that the expectations, which are necessary for such optimization, should be modeled as endogenous expectations derived from an

objective probability distribution of the market equilibrium prices that would come about under this optimization. Any other theory of expectations leaves the relationship between formation of expectations and the probability distribution of market equilibrium prices unaccounted for, hence cannot answer the question of whether expectations are optimal or not in any meaningful way. In the light of such optimality, the theory of rational expectations fares well, since what is anticipated in terms of expected prices has the highest objective chance of being actualized in the market given stochastic disturbances. At any rate, in retrospect, the New Classicism was destined to join two ideas: intertemporal optimization on the one hand and rational expectations on the other (by integrating the two into the notion of the rational expectations market equilibrium, which has an objective distribution on which expectations are based). If *intertemporal optimization* is the name given to the rationality of decision making of economic agents, *rational expectations* must be the name given to the way agents form their expectations that are equally intertemporal (since expectations must be formed for all future prices in order for the market equilibrium to be attained in the present) and consistent with intertemporal optimization. That is why Lucas & Prescott (1971) integrated Muth's theory of rational expectations into their model. When the idea of intertemporal optimization was combined with Muth's concept of rational expectations, the result was a powerful way of operationalizing the way economic agents make intertemporal plans with the help of endogenized expectations. Such expectations are now allowed to take into account the probabilities of anticipated future events and their impact on the market equilibrium prices, which leads to still another insight on the intimate relationship between decision rules of rational agents and the nature of the economic environment including a politico-economic policy regime.

A few more words are warranted on rational expectations. Before Muth (1961) introduced the idea of rational expectations, we did not have any formal theory of expectations formation; the idea of adaptive expectations was a practical halfway house when economists were grappling with the problem of information and the problem of uncertainty caused by innovations and other shocks. As noted above, this scheme, if traced recursively into the past, shows that the expectations are completely past-driven, which is inconsistent with the idea of expectations as foresight. If we know beforehand that certain events are likely to happen in the future and if such events are likely to change the economic environment that bears on what can be achieved by our actions, such events should be taken into account in our formation of expectations. If economic policies affect the probabilities of future events and the future utilities or payoffs, our expectations should reflect such probabilities, and our plans of action should be adjusted in accordance with how our payoffs will be affected. The theory of rational expectations meets this criterion, by replacing subjective expectations with objective ones. This is the insight of Muth's 1961 paper. It showed us a way to combining intertemporal optimization with endogenously formed expectations so as to get an objective distribution of the market equilibrium price path, from which such expectations are formed, although, admittedly, it is not easy to determine this price path.

The state of the economy is represented by a whole complex of market prices (the prices of final goods and services, the prices of raw material and intermediate goods, the prices of factors of production, etc.). Such prices not only make intertemporal planning possible but also perform the task of

coordinating diverse activities of a multitude of agents with different preferences and technologies (Hayek, 1945). But, in order for such coordination to be tenable, it is necessary to forecast a whole complex of future prices starting with the present. If intertemporal optimization requires foreseeing of the future environment in which agents' planned actions are to be carried out, and if what this environment offers is captured by a complex of market prices, then forming rational expectations, paired with intertemporal optimization, amounts to forming expectations about all future prices that are likely to prevail in the market. But, we know that the future prices will change by what agents plan to do in the future as well. Hence, forecasting of future equilibrium prices must be consistent with agents' plans themselves, which requires that the expected prices be consistent with the equilibrium prices that will actualize when agents' demand and supply plans are implemented as planned from the present to the indefinite future. If expectations are rationally formed, the future and the current market prices become connected through intertemporal plans. That is, the future prices are the prices that will prevail in the future as a consequence of agents' planned actions, and the present prices are the prices that prevail in the current market as a consequence of agents' plans extending from the present to the future. The current market equilibrium prices, therefore, are not just a consequence of agents' current actions isolated from what they plan to do in the future. Thus, rational expectations are possible only as an expected equilibrium price path from the present to the future, with all agents' planned actions taken into account. You can no longer isolate any particular period from the rest of the periods and talk about agents' expectations for that particular period independently of what is expected to happen in the rest of the periods. Once the difference is understood between rational expectations and adaptive expectations, we should be able to see why the idea of rational expectations revolutionized the way we conceive our planned actions as an optimal path that is consistent with an equilibrium price path extending from the present to the future. If market prices change today, it is not simply because something happened unexpectedly today. Even if something unexpected happened today, agents will try to guess what the implications of such events will be for their future and adjust their optimal plans accordingly, which in turn feeds back to what they do today. Likewise, if what is expected to happen in the future changes, so do our planned paths of actions from the present onward. Thus, the idea of rational expectations changed fundamentally our way of thinking about the decision making of rational agents; the market price today is an equilibrium phenomenon that is connected to all future market equilibrium. Thus, the present and the future become intimately connected through rational expectations.

Friedman's notion of human wealth as the present discounted value of all expected future income and permanent income as the real interest return on this wealth (i.e., the annuity value of the wealth) was ahead of the thinking at the time, because it was rooted in the forward-looking nature of the decision maker, who does not decide what to do now only by looking at what means he or she has today, but rather makes a plan of actions by taking into account what is feasible now and in the future and how this feasibility is connected across time. The idea of rational expectations was implicit in his notion of wealth and permanent income in the sense that one has to form expectations about future income in order to know where one stands in terms of what is

expendable without jeopardizing one's wealth position. Since it is goods and services that income buys that give rise to utility, we need to reformulate Friedman's theory in terms of an explicit intertemporal utility maximization subject to an intertemporal budget constraint. When this is done, it is necessary to introduce prices and price expectations, so that intertemporal planning may be made possible. Muth's theory of rational expectations led to a jump in thinking, and Lucas explored the implications of intertemporal optimization and rational expectations on the questions of the neutrality of money and the inseparability between decision making modes and the economic environment in general.

All of this development, when viewed in relation to the phenomenology of the consciousness of internal time and human existence, can be appreciated as an attempt to make economic theory more consistent with the way human beings mobilize their consciousness and actions in making their life as complete and meaningful as it can be. Husserl's retention-presence-protention and two-way intentionality of time consciousness, (one directed toward the past and the other toward the future) tells that our consciousness is an activity which is temporal all the way. If so, choice decisions made by economic agents must be consistent with this intentionality. That is, it is not possible to mobilize consciousness and action without foreseeing what is to be expected and fulfilled. If there is no retention without protention, and no protention without retention, this should be the core feature of human decision making. In much the same way, Heidegger's analytics of Dasein brought forth to our awareness that the essence of human existence consits in ecstacies of temporalized temporality with anticipatory resoluteness in making projections into our ownmost potentialities. If so, we must be standing outside of ourselves in our decisions to make our life complete and meaningful, that is, in our intertemporal decisions that connect our actions over time. Protention and anticipation are inherent in this decision making, in that decision makers foresee what is to come and fulfilled, for without such foreseeing no planning of actions is possible. The idea dates back to Aristotle who says: "The man who is without qualification good at deliberating is the man who is capable of aiming in accordance with calculation at the best for man of things attainable by action" (*Nicomachean Ethics*, Book VI, section 7). In fact, Aristotle identifies the practical wisdom with the power of foresight in regard to one's life as he said: "This is why we say that some even of the lower animals have practical wisdom, viz. those which are found to have a power of foresight with regard to their own life" (op. cit. section 7). Aristotle related ethics to the project of living a good life of actions by cultivating our virtues, both of character and intellect, and mobilizing the overseeing virtue of practical wisdom in all decisions. It is this normative character of human beings that is brought back to economics by those who shared the insight behind rational expectations and intertemporal optimization. In this regard, we may say that the age-old wisdom of Aristotle has come through in our time, in a new form.

6. The concept of policy regimes and econometric policy evaluation

With this understanding of the role of rational expectations in modeling intertemporally motivated agents, I return to the two papers of Lucas:

"Econometric Policy Evaluation: A Critique" and "Expectations and the Neutrality of Money", to discuss their significance in bringing our thinking closer to the ethical nature of human beings. In the former paper, Lucas showed why agents' decision making cannot be isolated from policies that will change the decision making environment. To make this point, Lucas starts with Tinbergen's theory of economic policy. Jan Tinbergen (the first Nobel Laureate in 1969, who shared the Prize with Ragnar Frisch), in his book *On the Theory of Economic Policy* (1952), put forth a theory of economic policy, which was based on the idea that the dynamic movement of the state of an economy (summarized by a set of state variables) can be represented by a difference equation, which describes the state of the economy one period ahead as a function of three sets of variables: the variables that comprise the state of the economy of the current period, the forcing variables that are assumed to be exogenous to the system, and error terms. Selecting a workable form of this function and estimating its parameters from the past data, one obtains a first approximation of this dynamic movement, which, because of the presence of error terms, traces a stochastic sequence over time. Using this estimated function, we are in a position to simulate how an economy will move over time for a give path of economic policies (as forcing variables). In order to evaluate this simulated path, we need to define a certain functional (as a criterion) on the three paths: a stochastic movement of the state of the economy, a sequence of the forcing variables over time, and a sequence of error terms. The value of this functional being a random variable, its moments may be used to discriminate alternative policies for their effectiveness.

Lucas thought that this seemingly innocuous way of conducting econometric policy evaluation is imbued with a fatal problem that cannot be overcome by technical refinements alone, for the method itself is counter to the way decisions are made by intertemporally motivated agents. An economy evolves with innovations and fluctuates, and policy making always faces a new challenge. Each business cycle is different. In a regime in which the policies are rule-based and fiscal management is disciplined, agents will be able to make their intertemporal plans with better foresight. If, on the other hand, agents find themselves in a regime in which policies are discretionary and the authorities often renege their commitment, they will be forced to take this into account in their decision making and hedge against the unpredictability of the authorities. Thus, a politico-economic regime cannot be neutral to the way agents make their decisions. This implies that if a regime is altered, the parameters of the behavioral equations must also change. These parameters, in practice, were estimated from the past data, but these data reflect a mixture of decisions made under different policy regimes, hence, in theory, the parameters of behavioral equations cannot be uncovered through such estimation. We may simply assume that the structural parameters are stable enough to be relied upon in conducting policy evaluation, but such evaluation falls short of being an indisputable art of policy making. The reason why the decision modes of agents cannot be separated from policy regimes is that agents are intertemporally motivated. Agents simply do not let the past dictate their decisions and plans into the future. They make their plans as their optimal responses to the present and future environment defined by a politico-economic policy regime.

When a policy regime is examined, fiscal and monetary policies should not be discussed in sweeping terms. The government prescribes economic policies

of various kinds, but economic agents also pay attention to how responsive the government is to problems at hand, how uncertain its commitment is, what type of policies it is prone to choose, how often and in what way it surprises the public, and so forth. Economic policies come, therefore, with a whole set of these characrteristics. Agents' guesses on the probabilities, uncertainties, and risks in regard to a multitude of events differ from one regime to another, and it is only natural for them to take these regime-specific uncertainties and risks into account in their decision making. Therefore, how to respond to the environment cannot be captured by a fixed rule that applies to all possible regimes that come with different probabilities, uncertainties, and risks. The essence of the Lucas critique is that the best decision modes are the ones that take into account regime-specific features of the environment. The reason is simple: The rewards from such modes, at least in their minds, are higher than those that ignore them.

The meaning of Lucas's critique can also be elucidated by the recursive structure of dynamic programming, in which an agent maximizes an objective functional defined on the space of all possible plans, subject to transition equations, one for each period, and the initial condition. An optimal plan of actions, called an optimal path of control variables in this context, is determined sequentially, in a backward manner from the last to the first period. Hence, what an agent does as part of his optimal plan in any period reflects all future transition equations. This means that if certain policies are designed now to be put into effect at a future period, they will affect the transition equation of that period, hence all decisions before and after that period. That is, any change in the future environment, as reflected in transition equations, affects an agent's optimal plan of actions over the entire planning horizon, not simply the actions after the change. The dynamic programming shows that the current and the future decisions, constituting an optimal path of controls, are all connected. If so, all those policies that change the policy regime in the future, hence shape the transition equations of the new regime, will affect what an agent does in the present even before the regime undergoes a change as long as this change is anticipated. The concept of the optimality of action plans is a forward-looking concept, hence how an agent reacts to any prospect of a policy change in the future cannot be uncovered by looking at how the same agent reacted to past policy changes. Incidentally, the idea of the dynamic programming and the backward induction makes it possible to conceive individual agents and the government authorities as the players of a dynamic game, in which the latter, knowing how the agents respond to policy changes, may choose a policy plan that is designed to bring about some desirable outcome. The agents, on the other hand, try to meet the strategy of the authorities by choosing their best strategies, knowing how the authorities react to them. Such possibilities of dynamic game playing brings another element to the argument that the way individual agents make their decisions cannot be independent of the strategies of the government. Individual agents and the government are the players with different payoff criteria. In such game playing, there is always a possibility that the government may change their strategies any time in the future when a desirable outcome is achieved. That is, if the government is committed to a certain strategy for a while and reneges its commitment later, agents face another complication of how best to prepare them selves for this reversal. Such possibilities are the source of time inconsistency of government policies, and

the issue complicates the optimal strategy on the part of individual agents (Kydland & Prescott 1977).

To sum up, what Lucas showed in this paper has changed economists' way of understanding and formulating the fundamental tenets of the decision making modes of individual agents. Since such modes are intertemporally motivated, they cannot avoid being influenced by a policy regime (i.e., by the decision making environment), in which many relevant events happen with regime-specific probabilities, uncertainties, and risks. If so, it no longer makes sense to assume that the macroeconomic structures are based on stable behavioral equations whose parameters are invariant to policy regime differences. It is not a coincidence that large macroeconometric models that had been developed for the purpose of policy evaluation and economic forecasting yielded the center stage to more process-oriented models rooted in intertemporal optimization and rational expectations. Lucas' critique shifted our attention away from the structural to the process view, with the recognition that individual agents' modes of decision making are joint products of utility and profit maximization and economic policies. Sargent expresses, in the paper cited above, how stunned macroeconomists were to read Lucas's 1976 paper.

> It took us longer than we like to recall to understand how thoroughly the idea of rational expectations would cause us to change the way we did macroeconomics. Neil Wallace and I had already written several papers about rational expectations in 1969-1972, and had read drafts of Lucas's JET paper as well as two key papers by Lucas and Prescott. But we didn't understand what was going on until, upon reading Lucas's 'Econometric Policy Evaluation: A Critique' in Spring of 1973, we were stunned into terminating our long standing Minneapolis Fed research project to design, estimate, and optimally control a Keynesian macroeconometric model. We realized then that Kareken, Muench, and Wallace's (1973) defense of the 'look-at-everything' feedback rule for monetary policy which was thoroughly based on 'best responses' for the monetary authority exploiting a 'no response' private sector – could not be the foundation of a sensible research program, but was better viewed as a memorial plaque to the Keynesian tradition in which we had been trained to work. (Sargent, 1995: 539)

Lucas' econometric policy evaluation has brought us to reckon with the fact that, in terms of the phenomenology of human consciousness and human existence, the background is as important as the foreground, and that the future, the present, and the past are the triad constituting the temporality of our decision making. While Keynesians, in forecasting the future, relied on the structural equations whose parameters are estimated from the past data, the phenomenology of the temporality of human existence informs that without anticipating what is coming, agents will not be able to capture what presences in the present including actions that might be contemplated on. More fundamentally, without expectations-protentions, human beings neither will be able to conceive anything as a temporal object nor will be able to capture anything that is coming, including any future actions, and to bring it to its fulfillment which is then recorded in memory. But, such expectations-anticipations, in the context of economic decision making, will not be possible without having some idea as to what the future environment will be like when new economic policies are introduced. Lucas' critique of econometric policy evaluation is far more than being a critique against the conventional art of

econometric policy evaluation. It is a critique about how our life of actions unfolds in the midst of an environment shaped by the policies and the laws of the time. This critique, therefore, reminds us of what Aristotle, in *Nicomachean Ethics* (Book X, section 9) and *Politics*, said regarding the laws of *polis*; that is, the laws must be written in such a way as to guide individuals in their pursuit of the private goods and to make them good. Individuals act in the foreground by choosing actions to achieve their end, but, at the same time, always in the background of the laws and policies. Because human beings are teleological in their actions, the future environment in which their actions will be carried out is as important as the current environment in which their plans are made. In fact, without expectations as to what the future environment will be in relation to the current environment, intertemporal optimization is not possible. In this sense, Lucas reawakened the profession, under the influence of Friedman and, more fundamentally we would say, of Aristotle, on how teleological agents make their rational decisions, with respect to the policy regime environment.

7. Monetary theory from Friedman to Lucas

Lucas wrote another stunning paper, "Expectations and the Neutrality of Money," which changed the course of economics sciences since then. The central question Lucas addressed was: How can money be nonneutral when changes in the supply of money are unanticipated or not known with certainty while it is neutral when such changes are anticipated or known with certainty, within the tradition of the quantity theory of money. Or, in terms of a possible relationship between inflation and the unemployment rate, this question can be rephrased as: How is it possible to obtain a downward-sloping Phillips curve empirically, when there are in fact no real tradeoffs between the two? The quantity theory of money dates back to Nicolaus Copernicus (1526), Martin de Azpilcueta (Salamanca School), Jean Boden (1568), David Hume (1952), John Stuart Mill (1848), among others, and was elaborated by Irving Fisher (1911); see Granbill (2007) for late-scholastic monetary theory. The crux of the theory is that if the quantity of money is doubled, the prices of all goods double with no change in real output, since the relative prices, determined by demand and supply, remain unchanged. Hence, the theory asserts that money is neutral to real output. In this sense, money is a veil. But, Hume and others were aware that depending on the way the quantity of money is increased, money can have real effects before it regains its neutrality. Lucas, in his Nobel Memorial Lecture (1995, pp.246-247), goes back to Hume's conception on the neutrality of money, quoting from Hume's essays of 1952, *Of Money* and *Of Interest*. It is useful to recall what Lucas quoted from these essays on the issue of the neutrality of money and on the issue of possible short-run effects of money on employment and production. These quotes show what Lucas attempted to accomplish in his paper by addressing essentially the same questions but with an advantage of a mathematically formulated model that can answer many of the questions that were left unanswered in Hume's essays. Here are the quotations:

> It is indeed evident that money is nothing but the representation of labour and commodities, and serves only as a method of rating or estimating them. Where coin is in greater plenty, as a greater quantity of it is required to represent the same quantity of goods, it can have no effect, either good or bad ...any more than it would make an alteration

on a merchant's books, if, instead of the Arabian method of notation, which requires few characters, he should make use of the Roman, which requires a great many (*Of Money*, p.28).

Were all the gold in England annihilated at once, and one and twenty shillings substituted in place of every guinea, would money be more plentiful or interest lower? No surely: We should only use silver instead of gold. Were gold rendered as common as silver, and, and silver as common as copper, would money be more plentiful or interest lower? We may assuredly give the same answer. Our shillings would then be yellow, and our halfpence white, and we should have no guineas. No other difference would ever be observed, no alteration on commerce, manufactures, navigation, or interest, unless we imagine that the color of money is of any consequence (*Of Interest*, p.47).

When any quantity of money is imported into a nation, it is not at first dispersed into many hands but is confined to the coffers of a few persons, who immediately seek to employ it to advantage. Here are a set of manufacturers or merchants, we shall suppose, who have received returns of gold and silver for goods they have sent to Cadiz. They are thereby enabled to employ more workmen than formerly, who never dream of demanding higher wages, but are glad of employment from such good paymasters. [The artisan] ...carries his money to the market, where he finds every thing at the same price as formerly, but returns with greater quantity and of better kinds for the use of his family. The farmer and gardener, finding that all their commodities are taken off, apply themselves with alacrity to raising more... It is easy to trace the money in its progress through the whole commonwealth, where we shall find that it must first quicken the diligence of every individual before it increases the price of labor (*Of Money*, p.38).

There is always an interval before matters be adjusted to their new situations, and this interval is as pernicious to industry when gold and silver are diminishing as it is advantageous when these metals are increasing. The workman has not the same employment from the manufacturer or merchant though he pays the same price for everything in the market. The farmer cannot dispose of his corn and cattle, though he must pay the same rent to his landlord. The poverty, and beggary, and sloth which must ensue are easily foreseen (*Of Money*, p.40).

With these quotes, Lucas asks specific questions that need to be answered. These questions ask what the central issues are when we discuss the neutrality or the nonneutrality of money. He writes:

Humes makes it clear that he does not view his opinions about the initial effects of monetary expansions as major qualifications to the quantity theory, to his view that "it is of no manner of consequence, with regard to the domestic happiness of a state, whether money be in a greater or less quantity." Perhaps he simply did not see that the irrelevance of units changes from which he deduces the long run neutrality of money has simpler implications for the initial reaction to money changes as well. Why, for example, does an early recipient of the new money "find every thing at the same price as formerly." If everyone understands that prices will ultimately increase in proportion to the increase in money, what force stops this from happening right away? Are people committed, perhaps even contractually, to continue to offer goods at the old prices for a time? If so, Hume does not mention it. Are sellers ignorant of the fact that money has increased and a general inflation is inevitable? But Hume claims that the real consequences of money changes are "easy to trace" and "easily foreseen." If so, why do these consequences occur at all?

> These questions do not involve mere matters of detail. Hume has deduced the quantity theory of money by purely theoretical reasoning from "that principle of reason" that people act rationally and that this fact is reflected in market-determined quantities and prices. Consistency surely requires at least an attempt to apply these same principles to the analysis of the initial effects of a monetary expansion or contraction. I think the fact is that this is just too difficult a problem for an economist equipped with only verbal methods, even someone of Hume's remarkable powers (Lucas, 1995: 247-249).

In the 1960s and the 1970s, the Keynesians and the monetarists were engaged in a heated debate on the effect of money or nominal demand on output. We know that the central banks in developed countries control the supply of money with the intent of stabilizing the economy. In those days, the issue of the real effects of money was controversial. How can a change in nominal demand, through a mere increase in the supply of money, affect employment and production? Keynesians, following the Hicks IS-LM paradigm (Hicks, 1937), divided the economy into two sectors: the real sector involving consumption, saving, and investment decisions, and the monetary-financial sector involving portfolio decisions of paper assets. Three elements constituted their theory: the marginal propensity to consume, the marginal efficiency of investment, and the liquidity preferences. In a nutshell, this theory implies that an increase in money supply first lowers the interest rate as an excess supply of money is used to acquire bonds, causing their prices to rise, hence their interest rates to fall, which, in turn, increases investment to the point where the marginal efficiency of investment matches the interest rate. The effect of investment on production is then amplified by the multiplier process, which is dampened as the rise in income feeds back to the market interest rate by raising the demand for money. Money is, therefore, nonneutral to employment and production.

But, the Monetarists of the day, whose theories were based on the quantity theory of money, were developing a theory that can show that money can have real effects in the short-run while holding on to the neutrality of money in the long-run. Milton Friedman was the leading figure of the Monetarist camp. Reviving the age-old quantity theory of money and placing it under the light of theoretical and empirical monetarism, he considered agents as maximizers of utility from owning wealth, hence proposed a theory of the demand for money which treats money as one form of assets among many others, that is, as only one way of holding wealth. He also viewed money as one kind of capital for productive enterprises. For wealth-owning units, the demand for money cannot be separated from consumption and saving demand, nor from the demand for durable goods and human capital, not to mention other financial instruments such as bonds and equities; and for business firms, it is not separable from the demand for capital. Thus, the demand for money is a function of the rates of return of all assets that are alternative to holding money. In such theory, any excess money caused by an increase in money supply will be used not only to purchase various financial assets but also to buy consumption goods as well as durable goods. Production is thus affected more directly by this change, but the multiplier effect will be of a limited size since consumption is determined, according to Friedman, by permanent income (an income measure of wealth) rather than by current income. As the prices of assets and durable goods rise through an increase in money supply, their rates of return fall including the rate of return from holding capital goods

(including the marginal efficiency of investment in Keynesian terms). Thus, in Friedman's theory, an increase in the quantity of money supply will spread over all financial and real assets (including durable goods and human capital) and reduce their rates of return across the board. In his theory, an increase in money supply causes the demand for durable goods (as part of the demand for all assets) to rise, hence reducing their marginal efficiency as a result, rather than lowering the interest rates in the financial market first and increasing, thereby, the demand for investment with a consequent fall in the marginal efficiency of investment.

Friedman did not dichotomize the economy into the real sector and the monetary-financial sector as in the Hicks-Hansen IS-LM paradigm. With the stability of the market system as well as with the stability of the demand for money, which is based on wealth in the long-run, short-run changes in the money supply can cause the economy to flutter in terms of real output, but such changes dissipate in the long-run when the rates of return on all assets are adjusted. If money supply is increased on a perpetual basis, it will lead to higher inflation (with possible adverse effects on the economy to the extent the future is made more uncertain); if increases in money supply are fully anticipated with no added uncertainty into the future, there will be no real effects of money in the long-run, where real forces of the economy determine the whereabouts of equilibrium although such equilibrium is not an ideal one captured by the Walrasian equilibrium. Friedman's monetarism is related to his theory of the natural rate of unemployment. If an increase in the quantity of money supply is to have some positive effect on employment and output, the equilibrium in the labor market requires that the real wages paid by firms be made lower while the expected real wages the workers anticipate be made higher. But, such conditions cannot be met unless the price level is allowed to change. If the price level changes in response to an increase in money supply, and if a gap is created between the actual inflation (which determines the real wage offer by firms) and the expected inflation (which enters the calculation of the expected wages conceived by workers), then there will be a temporary increase in employment and output. Such an increase is short-lived as the expected inflation catches up with the actual one. The unemployment rate and production, therefore, return to their natural rates. Such was Friedman's theory of the Phillips curve. Whatever changes are caused by money supply in employment and output (which is possible under Friedman's expanded theory of the demand for money), such changes will be nullified in the long-run as the equilibrium of the economy is restored at the natural rate of unemployment.

Before leaving this debate between the Keynesians and the Monetarists, it is useful to review the quantity theory of money and Friedman's monetary theory since they occupy the central place in Lucas's theory of expectations and the neutrality of money. The quantity theory has been expressed in different forms, but we trace it through Friedman's formulation. The transactions version (Fisher, 1911), which became popular, was expressed as follows:

$$MV = PT \tag{1}$$

where P is a suitably chosen average price; T is again a suitably chosen aggregate volume of transactions per unit time; M is the stock of money; V is

the velocity of circulation of money (the number of turnovers per unit time). The right side PT measures the total nominal value of the payments per unit time, and the left side MV measures the total nominal value of the turnovers per unit time (how many times the stock of money turned over per unit time). This equation is also written in the income form as

$$MV = Py \tag{2}$$

where P is the implicit GDP deflator; y is real GDP. Py, therefore, is nominal GDP. The left side measures the nominal value of the stock of money turned over V times. While the transactions version includes all transactions including those involving intermediate goods and existing financial and real assets, such transactions are excluded from the income version. Also, while the transactions version focuses on money transferred from one hand to another in all transactions, the income version focuses on the amount of money held by agents as a whole.

The quantity theory of money has also taken a form after the Cambridge cash-balance approach, which emphasizes money as an abode of the purchasing power held in between the sale and the purchase of goods and services. This approach, therefore, writes how much agents (households and firms) want to hold of this purchasing power as

$$M = kPy. \tag{3}$$

Written this way, k stands for the ratio of the stock of money to nominal GDP. This k can be interpreted either as the ratio that is calculated from the stock of money and nominal income, so that (3) holds as an identity, or as the desired ratio, in which case M is the stock of money that agents want to hold. If form (2) is compared with form (3), it is seen that $k = 1/V$, where if k denotes the desired ratio, V must denote the desired velocity (how many times agents want to turn over their money stock). See Friedman (1970, pp.195-202) for the difference between the transactions approach and the cash-balance approach.

Friedman lists a number of factors that affect the demand for money of wealth holders: (1) total wealth, which is divided into various forms of assets, where income as a surrogate of this wealth is better served by the concept of permanent income since this income is, by definition, the interest return on wealth, (2) the division of wealth between human and nonhuman forms, where the fraction of total wealth in the form of nonhuman wealth can be an important factor, (3) the expected rates of return on money and other assets (interest rates on bonds, dividends on equities, storage costs on physical capital, and changes in their nominal prices due to inflation or deflation), and (4) other variables that determine the utility of the services that money renders, i.e., the utility value of the liquidity that money provides. With these factors taken into account, Friedman (1970) writes the demand for money by an individual wealth holder as

$$\frac{M}{P} = f\left(y, w; r_m, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; u\right) \tag{4}$$

where M/Pstands for the money stock in real terms; y is real income; w is the

fraction of wealth in non-human form; r_m is the expected nominal rate of return of money; r_b is the expected nominal rate of return of fixed-value securities (that includes expected changes in their prices); $r_e$is the expected nominal rate of return on equities (the includes expected changes in their prices); $(1/P)(dP/dt)$ is the expected rate of change of the prices of goods (hence, the expected nominal rate of return of real assets); u is a portmanteau term for all other variables that affect the utility services of money (Friedman 1970, pp.202-205). The money demanded by business enterprises is affected by another set of factors. While some are shared by the money demanded by individual wealth holders, others are specific to enterprises. Instead of wealth, some scale factor reflecting the productive value of different quantities of money may be important for enterprises, although data on such factor are difficult to obtain; the division of wealth between human and nonhuman wealth is of little relevance for enterprises; rates of return on money and alternative assets, particularly the interest rates on bank loans, are important; the portmanteau term u includes again all other variables other than the scale factor but including expectations about the economic stability. With such modifications, the demand function (4) with w excluded may be viewed as representing the demand for enterprises (Friedman 1970, pp.205-206). When the two demand functions are aggregated, the aggregate demand for money is obtained.

If the demand for money is expressed in nominal terms as

$$M = g(P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; Y; u), \tag{5}$$

and if this function is homogenous of degree one in P and Y, (5) can be written in real terms as

$$\frac{M}{P} = g(r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; \frac{Y}{P}; u). \tag{6}$$

This is essentially the real demand for money specified in (4). The same homogeneity also gives

$$g(\frac{P}{Y}, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; 1; u) = \frac{1}{Y}g(P, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; Y; u). \tag{7}$$

With the right side written as M/Y, (7) gives

$$\frac{M}{Y} = g(\frac{P}{Y}, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; u) \tag{8}$$

where $Y = 1$ is subsumed. If (8) is written as

$$\frac{M}{Y} = g(\frac{1}{y}, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; u) = \frac{1}{v(y, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; u)} \tag{9}$$

where $1/y$ in $g(.)$ is replaced by y in $v(.)$, we have

$$Y = v(y, r_b, r_e, \frac{1}{P}\frac{dP}{dt}; w; u) \cdot M. \tag{10}$$

This shows that writing the real demand for money as in (6) is essentially

identical to writing the income velocity of circulation as depending on the same variables. Friedman held that the demand for money function is stable because it is part of long-run considerations focused on wealth. This stability then translates into the stability of the income velocity of circulation. The stability of the demand for money implies that any money in excess supply will affect the demand for all assets (not just the demand for financial assets) and physical goods, hence production of goods. All of the variables that enter into the demand for money are endogenously determined in the asset market, although how expectations are formed with respect to the market equilibrium remained unsettled in his theory despite the fact that expectations play a vitally important role in the demand behavior of wealth-owners and enterprises. Friedman considered the demand for goods and assets, (i.e., demand for whatever is relevant for economic activities) as different phases of the same decision making in contrast to a segmented approach taken by the Keynesians. In Friedman's view, all decisions brought to the foreground are made in the background of interrelated decisions pertaining to all goods and assets, and this view has set a stage for the role of expectations to be played in all decisions of economic agents. Furthermore, his theory called for a certain rule of money supply so that future prices will be stable enough to allow agents to form reliable expectations they need for their planning purposes. The rule is known as the *k*-percent rule (Friedman 1959, 1962, 1968).

The quantity theory of money is based on the idea that elementary events in the economy are transactions. If all transactions are recorded as payments and receipts, we should be able to get the nominal value of all transactions. If money changes hands in such transactions, the question is how many times money changes hands per unit time, which gives the velocity of circulation. Whether this is expressed in terms of transactions or income, the idea is the same, although, in the case of income, we are focused on how many times money changes hands in transactions involving only final goods rather than all goods (final and intermediate) and all assets (physical and financial).

On top of this function of money as a medium of exchange, money performs another function, as a store of value. Money serves as a contrivance like a social security, that makes it possible for agents to carry their savings, stored as money, from their productive years to the future when they are no longer working. The idea of money as a store of value was already recognized by Aristotle in *Nicomachean Ethics* (Book V, 1133b). Samuelson (1958) wrote an influential paper on how the overlapped generations of the young and the old can trade to get an optimal lifetime consumption when goods produced are perishables. The young produce goods, part of which are sold to the old in exchange for the money they hold, and money acquired is then taken to the future, when this money is used to buy goods produced by the young then. In this paper, Samuelson showed that if money is introduced, the non-optimal negative-interest-rate configuration (of a free market) can be restored to the optimal biological-interest-rate configuration, without requiring any social security scheme or any other social compact. Thus, money serves as a contrivance that brings about the socially optimum configuration in a free market. It goes without saying that money serves as a store of value because it is accepted as a medium of exchange. Lucas, in his paper on expectations and the neutrality of money, modeled a monetary economy inhabited by the overlapped generations of the young and the old after Samuelson's paper.

Lucas, in the same paper, also analyzes a fixed growth rate rule of money

supply called the *k-percent* rule, which was proposed by Milton Friedman (1959, 1962, 1968). Friedman, with Anna Schwartz, studied the monetary history of the United States, which culminated in a magnificent piece of work, *A Monetary History of the United States, 1867-1960* (1963). In this work, they examined how monetary expansion or contraction was related to economic expansion or contraction, and showed the cases of misguided monetary policies. See, in particular, chapter 7 of the book titled The Great Contraction, for an episode, and also Timberlake (2008). With this track record of the policies of the Federal Reserve in view, Friedman advocated that money supply be guided by a fixed rule that is consistent with the growth rate of the economy. Whether the Fed's policy should be guided by a fixed rule or a discretionary policy is a matter of great controversy, but the fact remains that Friedman's *k-percent* rule was the first serious suggestion as a rule-based policy. There has been a burgeoning literature on monetary policy rules, particularly after 1990s. John Taylor (1993) introduced what has come to be known as the Taylor rule; Henderson & McKibbin (1993) also introduced a similar one. The Taylor rule is a feedback rule on the interest rate, which requires that the interest rate be adjusted, partly by a fraction of the deviation of the actual inflation from the target level and partly by a fraction of the deviation of actual real GDP from its trend level. In the United States, the Federal Open Market Committee (FOMC) of the Federal Reserve, through open market operations, adjusts the federal funds rate. Taylor, having observed the Fed's actions for several years, noted that they can be approximated by the rule:

$$\begin{aligned} r &= p + 0.5y + 0.5(p - p^*) + r^* \\ &= p + 0.5y + 0.5(p - 2) + 2 \end{aligned} \tag{11}$$

where r is the federal funds rate (the interest rate that banks charge each other for overnight loans to meet the reserve requirement); p is the inflation rate and p^* is the target inflation rate; y is the percentage deviation of real GDP from its trend; $r^*$is the steady state equilibrium real federal funds rate. Taylor sets $p^* = 2$ and $r^* = 2$. Under this rule, if the inflation rate deviates one percent from the desired rate, the federal funds rate is set higher by 50% of this deviation; if the real GDP deviates from the potential GDP by one percent, again the federal funds rate is set higher by 50% of the deviation. With such adjustment, the Fed tries to keep the economy growing along the long-run trend (the steady state growth path) and with the inflation close to the target rate. The Taylor rule may not be completely rule-based, since how much the policy interest rate should be adjusted and when to do so are still left to the discretion of the monetary authorities. See Taylor (1998) for a history of monetary policy rules. As long as the authorities are vested with discretionary power, there always is some possibility for economic agents to end up paying a high cost of adjustment as well as for the fluctuations of the economy to worsen, because of mismanaged monetary policies. We need to keep in mind that the Taylor rule is not a rule derived from optimality considerations; it is a rule that is based on the observation of what the monetary authorities actually pursued. Friedman's rule, on the other hand, does not leave much room for discretion except when the *k-percent* itself is revised because the long-run growth rate is changed. Rather it is derived from the optimality considerations in the sense that mismanaged monetary policies have created

unnecessary swings in the economy and that such swings have been costly to economic agents in general. Lucas took this rule and showed that there does not exist any other feasible allocation that is Pareto-superior to the one obtained under the rule. In summary, at the time Lucas wrote his 1972 paper, many questions were awaiting answers. Some of these questions were: (1) how to incorporate rational expectations into intertemporal equilibrium models in order to endogenize expectations through such models; (2) how to analyze the neutrality or the nonneutrality of money from the perspective of the quantity theory of money; (3) how to model intertemporally motivated agents and relate their real decisions (production, consumption, saving, investment, etc.) to their decisions on asset holdings (in particular, how to integrate the demand for money with the demand for consumption and saving); (4) how to model a monetary economy in which monetary disturbances and real disturbances (i.e., innovations of all kinds) coexist and are mixed, and in which a Phillips curve type relation may be observed in appearance between the unemployment rate and the rate of inflation despite the fact that there are no tradeoffs between the two; and (5) how to evaluate monetary policies including Friedman's *k-percent* rule from optimality considerations. All of these questions, as well as Friedman's innovative approach to the decision making of economic agents, make so much more sense in relation to the phenomenologies of Husserl and Heidegger. The temporality of the inner time consciousness and the temporalized temporality of human existence disclose the truth that we are conceiving any thing or any action not only in the horizon of past, present, and future but also in the continuous unities of all temporal objects and decisions. Aristotle's ethics, with all its phenomenological implications, is equally very much alive in the normative approaches taken by Friedman and Lucas and in the trust they placed on free decisions made by individual agents and the market system.

Lucas attempted to answer these questions by constructing a parable economy in which agents, observing equilibrium market prices, cannot separate monetary from real disturbances as long as they are mixed. The model is based on the idea that while the general equilibrium of the economy is determined by relative prices, the absolute price level depends on the quantity of money supplied. If no real shocks occur, we will expect that the greater is the quantity of money supplied, the higher will be the prices in the market, but with relative prices remaining unchanged, hence with no change in the equilibrium of the economy. This is the neutrality proposition of the quantity theory of money. But, if real shocks are added, the relative prices of goods can change under a fixed growth rate of money supply, hence the equilibrium is affected. If monetary disturbances are added on top of real shocks, agents, who are observing market prices, will not be able to separate relative from absolute price changes. If so, agents will be forced to hedge against the possibility that the market price changes may have been caused by real shocks. Such hedging will result in producing more output as market prices rise, since agents can now exchange the goods they produce for more money to be taken to their future periods for consumption purposes. If agents know that money supply is fixed or grows at a fixed rate, then any change in market prices can be attributed to real shocks. But, if agents observe the market prices alone and if information on the amount of money supplied is disclosed with a time lag, then they will not be able to isolate real from nominal shocks while they are making decisions in the short-run, hence will

be forced to hedge against the possibility that the observed price rises are due to real shocks. This is basically the story of the Lucas's parable model. In constructing his model, Lucas integrated decisions on the demand for money with the decisions on production, consumption, and saving, and allowed the equilibrium in the money market to emerge with the equilibrium in the goods market. His model, in this sense, is very much in accord with Friedman's insight that monetary and real decisions cannot be separated from each other. Now we turn to Lucas's theory of expectations and the neutrality of money, and elucidate his contributions in more precise terms.

8. Lucas's theory of expectations and the neutrality of money

To model how hedging can occur when the market equilibrium prices are confounded, Lucas constructed a model of a monetary economy which is inhabited by two overlapping generations in each period, the young and the old. Money is a fiat money issued by the government, and serves as a contrivance to carry one's saving into the future when goods produced are all perishables.

It is assumed that in each period, a new generation is born and lives for two periods, and that there are N individuals in each generation. Hence, two generations of the same population size coexist in each period. The young work and the old do not. The young do not have money but the old have. The young consume a portion of what they produce and sell the rest to the old in exchange for the money they have, and carry this money into their second period when they no longer work. The old only consume, buying a portion of the goods that the young produce, with the money they acquired when they were young. In per-capita terms, the young decide on how much to work (denoted n), consume (denoted c), and save (denoted s). What the young save is purchased by the old, exchanged with the money they have. The amount of money that the young desire to carry to their second period (denoted λ), must be equal to the saving s, so that the demand for money by the young and their saving are equal, i.e., $\lambda = ps$ where p is the market price of the goods in the first period. This equality follows Friedman's theory of the demand for money; namely, the decisions on demand for money and the decisions on saving and consumption are derived from the same optimization decisions. The young take this money to their second period and spend it in exchange for consumption goods produced by the young then under the market price that prevails then (denoted p').

The young generation is divided randomly into two groups, one group sent to Island 1 and the other to Island 2; $\theta/2$and $1-\theta/2$ are the factions of this generation going to Island 1 and Island 2, respectively, where θ is a random variable defined on the domain [0, 2]. The stock of money that the old generation has per capita at the beginning of each period is given by m, so that the total stock of money that the old have as a whole amounts to Nm. One half of the old generation is sent to Island 1 and the remaining half is sent to Island 2, so that the total stock of money in each island at the beginning of the period equals $Nm/2$. The demand for money by the young is determined by the equi-marginal principle that the marginal utility of acquiring a dollar in terms of the forgone utility of consumption in the first period is balanced with the expected marginal utility of this money when spent in the next period, in

terms of the utility of consumption in the second period.

In Lucas's model, there are two types of shocks. One is shocks in the form of a randomly selected distribution of the newly born generation (the young generation) between the two islands, captured by θ, and the other is nominal shocks in the form of a randomly selected gross rate of money supply, x for the first period and x' for the second. At the beginning of each period, the nominal stock of money that the old possess per-capita is assumed known (that is, m is known), but, the intra-period amount of money (how much money there is actually in each period in the market) is not known perfectly since this stock is changed randomly by x (in gross rate terms) during the period and this x is not announced at the beginning of the period. Hence, the actual stock of money in the market (per capita of the old) this period equals mx. This quantity can only be guessed by observing market equilibrium prices. Unrealistic as Lucas' model may appear at first sight, it does capture the essence of the real economy, in which agents are producing in their own industries facing specific real shocks. As profit maximizers, they are guided by relative prices determined by the demand and the supply, but the quantity of money the central bank provides determines the general price level across industries. Hence, the prices in the industries reflect both the quantity of money supplied by the central bank and real shocks that are industry-specific (that is, real changes in the demand or in the supply). When producing agents find their prices rising, they may not be able to tell immediately whether such changes are relative price changes (relative to the prices of other industries) or overall price changes caused by an increase in money supply. When relative prices of the goods produced in specific industries rise, profit maximization requires that more output be produced, but if all prices change more or less proportionately across all industries, there should be no change in the amount produced in each industry. Thus, Lucas's model, as a fable, captures the confounded nature of market equilibrium prices in a monetary economy, that is, confounded of relative and absolute prices; the changes in the former are caused by either supply or demand shocks (i.e., technological innovations or preference changes), and the changes in the latter are caused by the supply of money injected by the central bank.

Lucas formulates the decisions of a newly born agent as an intertemporal optimization problem over two periods. In his first period, the agent works n hours, each hour producing one unit of output. The total output (n) is partially consumed (c) and partially saved (s). The saving is exchanged with money that the old have under market price p, so that the demand for money (λ) by the young is equated to their saving by $\lambda = ps$. The young, when they get old, consume c'. The objective functional (the utility functional) is, therefore, defined on a triplet $\{c, c', n\}$, and this functional is, by assumption, broken down into two components; one is the utility that depends on consumption and labor in the first period, denoted $U(c, n)$, and the other is the expected utility from consumption in the second period, denoted $EV(c')$ (where E stands for the expected value). Since c' equals the amount of consumption that the young can afford with their money balances carried to the second period, it must hold that $c' = x'\lambda/p'$. Variables $x'$and $p'$are random variables, but the young knows the stock of money m at the beginning of the first period and can observe the market price p in the same period. Hence, what we need in order to compute $EV(c')$ is a probability distribution of x' and p' conditional on m and p. Let this conditional probability distribution be

written as $F(x',p'|m,p)$. With this distribution, $EV(c')$ is calculated as

$$EV(c') = \int V\left(\frac{x'\lambda}{p'}\right) dF(x',p'|m,p) \tag{12}$$

where the right side is integrated over the domain of x' and p'.

A newly born agent then maximizes $U(c,n) + EV(c')$ subject to the budget constraint $p(n-c) \geq \lambda$. That is, this optimization problem can be written as

$$\max_{c,n,\lambda} U(c,n) + \int V\left(\frac{x'\lambda}{p'}\right) dF(x',p'|m,p) \tag{13}$$
subject to: $p(n-c) \geq \lambda$.

Assuming that the solutions of c, n, and λ are interior, and letting $h(\lambda/p)$ represent the marginal utility of consumption this period, i.e., $U_c(c(\lambda/p), n(\lambda/p))$, where c and n are written as functions of λ/p (because for each level of λ/p there corresponds a unique combination of c and n that maximizes $U(c,n)$), the following optimality condition is obtained.

$$\frac{1}{p}h(\lambda/p) = \int V'\left(\frac{x'\lambda}{p'}\right)\frac{x'}{p'} dF(x',p'|m,p) \tag{14}$$

The marginal utility of one dollar spent on consumption this period is equated with the marginal utility of this dollar brought to the next period and spent on consumption then. This is the equi-marginal principle holding in this model.

On the other hand, the equilibrium condition of money demand and money supply is given by

$$\lambda = mx/\theta$$

where the right side is money supply per capita of the young in island 1, which is obtained by dividing the total money supply $Nmx/2$ by the population of the young in island 1, $N\theta/2$. The equi-marginal principle (14), under this market equilibrium condition, can, therefore, be written as

$$h\left(\frac{mx}{\theta p}\right)\frac{1}{p} = \int V'\left(\frac{x'mx}{\theta p'}\right)\frac{x'}{p'} dF(x',p'|m,p). \tag{15}$$

Lucas assumes that the market equilibrium price in the first period (a random variable) is given as an objective function of the state of the economy (m,x,θ), and write it as

$$p = p(m,x,\theta). \tag{16}$$

Likewise, the market equilibrium price in the second period should be given as

$$p' = p(m',x',\theta') = p(mx,x',\theta'). \tag{17}$$

This is also a random variable with an objective distribution of x, x', and θ, conditional on the price observed this period, $p(m,x,\theta)$, and m. Write this distribution as $G(x,x',\theta|m,p(m,x,\theta))$.

The idea of rational expectations consists in assuming that the price is determined by $p = p(m,x,\theta)$ and in replacing $F(x',p'|m,p)$ with an objective distribution $G(x,x',\theta|m,p(m,x,\theta))$. The quantity theory of money, on the other hand, suggests that the equilibrium price in the first period be determined by the per capita stock of money mx/θ. Hence, the solution $p = p(m,x,\theta)$, under rational expectations, is expected to take a general form of $\phi(m,x/\theta)$. One particular form of this function considered by Lucas is $\phi(m,x/\theta) = m\varphi(x/\theta)$. The per capital stock of real balances at equilibrium will then be $(x/\theta)/\phi(x/\theta)$ (since $mx/\theta p = (x/\theta)/\varphi(x/\theta)$). Hence, with both sides multiplied by mx/θ, and by letting $z = x/\theta$ and $z' = x'/\theta'$, (15) can be written as (with m subsumed).

$$h\left(\frac{z}{\varphi(z)}\right)\frac{z}{\varphi(z)} = \int V'\left(\frac{\theta'}{\theta}\frac{z'}{\varphi(z')}\right)\frac{\theta'}{\theta}\frac{z'}{\varphi(z')}dG(\xi,x',\theta'|x/\theta) \tag{18}$$

Writing the joint density function of z and θ as $H(z,\theta)$ and the density function of θ conditional on z as $\widetilde{H}(z,\theta)$ allows (18) to be written as:

$$h\left(\frac{z}{\varphi(z)}\right)\frac{z}{\varphi(z)} = \int V'\left(\frac{\theta'}{\theta}\frac{z'}{\varphi(z')}\right)\frac{\theta'}{\theta}\frac{z'}{\varphi(z')}\widetilde{H}(z,\theta)\,H(z',\theta')\,d\theta dz'd\theta' \tag{19}$$

Then, Lucas proved that (19) has exactly one continuous solution $\varphi(z)$on $(0,\infty)$ such that the stock of real balances $z/\varphi(z)$ is bounded, strictly positive, and continuously differentiable, and that $p(m,x,\theta) = m\varphi(x/\theta)$ is the unique equilibrium price function, which is a unique rational expectations equilibrium function; see his Theorem 1.

If the equilibrium price function is given by $\phi(m,x/\theta) = m\varphi(x/\theta)$, then, the young agent, having observed the per-capita stock of money m should be able to tell that an increase in the market price must have been caused by an increase in either m or x/θ or both. But, the effect of x/θ cannot be separated into two isolated effects, one attributed to x and the other to θ. If so, the agent is forced to hedge against the price change that may have been caused by a change in θ. If agents know that the price change is entirely due to an increase in money supply (x), then their decisions on how many hours to work and how much to consume and save will remain the same as before the price change. That is, if the young, with this knowledge, have decided to save a certain amount for their second period, then this saving will inflate at the same rate as the price, hence, there is no reason for them to change the amount to be saved. If the saving does not change, neither do labor and consumption. Thus, the neutrality of money comes through as long as x is known with certainty. But, if the young do not know whether the price inflation was caused by an increase in money supply (a change in x) or by a real shock (a change in θ), they end up increasing their working hours, reducing consumption, and increasing saving to take advantage of the higher price (but not as much as when they know that a price increase is caused entirely by a real shock). Or, in more general terms, depending on what they know or do not know about what is causing the price increase, the decisions of the young will be affected or not affected. All this suggests that the monetary authorities are not in a position to influence the decisions of the young in favor of more output on a consistent basis because it is only through the confounding of the real and nominal shocks that the young produce more and because such confounding will disappear if the authorities engage in an inflationary policy on a persistent

basis. No authorities will rely on such confounded information to affect the level of production.

On the issue of whether a Phillips curve offers a trade off between inflation and unemployment in the long-run, Milton Friedman proposed a theory that the unemployment rate returns to its natural rate when adaptive expectations catch up with the actual inflation rate (the natural rate hypothesis). If a short-run Phillips curve is drawn with the expected inflation rate fixed, it shows that any reduction in the unemployment rate below the natural rate, caused by expansionary monetary shocks, is accompanied by the actual inflation rate exceeding the expected one. Therefore, under adaptive expectations, the short-run Phillips curve shifts upward, causing the actual inflation to get ahead of the expected once again. When the latter catches up with the actual, the unemployment rate returns to its natural rate with no gains in employment. If the unemployment is to be kept below its natural rate, an ever expansionary money supply is needed, but that implies that the gap between the actual and the expected inflation rate will never close, hence accelerating the inflation rate. Thus, any persistent attempt to reduce the unemployment rate below its natural rate will not succeed; it only causes inflation to accelerate. This is Friedman's view of the Phillips curve (Friedman 1968). His theory warns that any expansionary policy that is not consistent with the natural rate of unemployment will only end up with an accelerating inflation with no gains in employment or output. In contrast, Lucas, in this paper, constructed an equilibrium model under rational expectations, in which randomized monetary shocks can have real effects in the short-run through hedging on the part of producing agents who observe market equilibrium prices that are confounded. Such effects dissipate as the producing agents get hold of enough information that informs them of the exact state of money supply. Notice that the notion of rational expectations does not negate the effects of an unanticipated increase in money supply. It is possible for money to be no neutral under rational expectations in Lucas's island model, when agents, even with rational expectations, cannot isolate real from nominal price changes. In Lucas' model as well as in Friedman's theory, the effectiveness of monetary policies to reduce the employment rate below its natural rate, or, equivalently, to raise the level of real GDP above its natural output, is seriously compromised.

Lucas considered two special cases, Case 1: $\theta = 1$, i.e., when the young generation is divided equally between the two islands, and Case 2: $x = 1$, i.e., when the money supply remains fixed. In the first case, there exists the amount of money balances $y*$ such that the marginal utility of consumption as a function of real balances is equalized between the two periods, i.e.,$h(y*) = V'(y*)$ (because $h(\lambda/p)$ is an increasing function starting with $h(0) > 0$, and because $V'(\lambda'/p')$ is a decreasing function with $V'(0) = \infty$.) It can be shown that the equilibrium price function $p(m, x, \theta = 1) = m\varphi(x/y*) = mx/y*$ makes $y*$ a feasible choice in both periods because it holds that $mx/p = m'x'/p' = y*$, and that this equilibrium price function also satisfies the equi-marginal principle, hence is unique. The same equilibrium function also implies that the real balances that the young take to the second period equals $y*$. If so, labor (production) and consumption remain the same. Thus, if $\theta = 1$, a change in $x$changes the equilibrium price function proportionally, i.e., $\Delta p = (m/y*)\Delta x$, and labor (production), consumption, saving, and real balances (taken to the second period) all remain constant. That is, monetary

shocks (x) remain neutral to the young agents' real decisions.

The other special case that Lucas considers is the case in which $x = 1$, i.e., when the money supply remains fixed. There the equilibrium price function takes the form of

$$p(m, x, \theta) = m\varphi(1/\theta). \tag{20}$$

Since m is known, this market price informs the agents about the true value of θ. The real balances that the young agent takes to the second period equals

$$\frac{\lambda}{p} = \frac{mx/\theta}{m\varphi(x/\theta)} = \frac{a}{\varphi(a)} \text{ where } a \equiv 1/\theta, \tag{21}$$

so that how this amount changes in response to a change in θ depends on the elasticity of $\varphi(a)$. In Lucas's model, this elasticity lies between 0 and 1, so that the amount carried falls with a rise in θ, which implies that labor (production) decreases and consumption rises. What happens in Lucas's model is that as the number of the young sent to Island 1 increases, the price of consumption of the first period falls in Island 1, which implies that it takes more units of consumption of the first period to get a unit of consumption of the second period. With this rise in the price of the second period consumption, there will be less incentives for production and saving; that is, labor (production) falls, consumption increases, and saving falls in the first period: i.e., $n'(\theta) < 0, c'(\theta) > 0,$ and $s'(\theta) < 0$ where the prime denotes the derivatives.

Such responses of labor, consumption, and saving to productivity shocks θ are not what we expect from real shocks in an actual economy, for such shocks make it possible to produce more income, which can be allocated to raise consumption over the planning horizon. This rather counter intuitive outcome in Lucas's model results from a particular feature of Lucas's model. In fact, if more universal productivity shocks are allowed in Lucas's model which apply to both islands, then the agents in each island respond positivity to them by raising production, consumption, and saving, and will be able to attain the higher level of lifetime utility.

Friedman's k-percent rule is a special case, in which the gross rate of change in money supply x remains fixed at a prefixed value, say, at $\bar{x}$, so that in the context of Lucas's model the real balances carried to the next period by the young equals

$$\frac{\lambda}{p} = \frac{m\bar{x}/\theta}{m\varphi(\bar{x}/\theta)} = \frac{\bar{x}}{\varphi(\bar{x}/\theta)}. \tag{22}$$

Again, how this amount changes with θ depends on the elasticity of $\varphi(\bar{x}/\theta)$. As long as this elasticity lies between 0 and 1, we get the same results as when $\bar{x} = 1$; i.e., $n'(\bar{x}/\theta) < 0$, $c'(\bar{x}/\theta) > 0$, and $s'(\bar{x}/\theta) < 0$.

The major point made by Lucas is that if x and θ random variables, the market equilibrium price function $p(m, x, \theta) = m\varphi(x/\theta)$ cannot fully inform the young about what is really causing the price changes observed in the market. Such confounded information causes hedging on the part of the young; that is, the young increase labor (production) and saving and reduce consumption in the first period. That is, the young attempt to balance the marginal utility of consumption across the two periods under this mixed

information. If the market equilibrium price is imperfect in this sense, the economy of Island 1 produces more output when prices rise and less output when prices fall. We note that when θ increases so that a larger fraction of the young is sent to Island 1, Island 2 receives a smaller fraction of these agents. Output increases in Island 1 but falls in Island 2. If x stays constant at 1, the price falls in Island 1 with labor (production) and saving decreasing and with consumption increasing. On the other hand, the price increases in Island 2 with labor (production) and saving increasing and with consumption decreasing. In general, the combined aggregate output of the two islands, $\Pi(\theta)$, amounts to

$$\Pi(\theta) = \frac{\theta}{2} N(n(\theta) + \left(1 - \frac{\theta}{2}\right) N\hat{n}(\theta)$$

where $\hat{n}$ is labor in Island 2. This indicates that whether the aggregate output increases or decreases with a change in θ depends on the relative magnitudes of the derivatives of the two terms on the right side with respect to θ .

If we extend Lucas's model to a Phillips curve type relationship, we would observe there will be an inverse relationship between inflation and output growth. It should be noted that in Lucas's model it is not possible to relate the inflation to the unemployment rate simply because every agent is engaged in production in the first period. At any rate, such a hypothetical Phillips curve does not offer us any sustainable tradeoff between inflation and output that policy makers can rely on, even if the monetary authorities keep the information of money supply secret from the public. In fact, Lucas's island model can generate data that will confirm the existence of a Phillips curve type relationship, but this relationship is elusive, for it is not possible to increase output by running inflation in the long-run. The augmented Phillips curve theory of Friedman and Phelps negated the existence of a long-run tradeoff between inflation and output under adaptive expectations. Lucas equally negated the existence of a similar tradeoff under rational expectations. In the former theory, output rises above its natural level provided that adaptive expectations lag behind the actual inflation rate, but output returns to its natural level when expectations are fully caught up. If expectations were formed rationally in the Friedman-Phelps model, it would not be possible for expectations to lag behind the actual inflation rate, because the real wages that firms are willing to pay match the real wages that workers expect. This implies that output remains at its natural level under rational expectations in their context. In Lucas's model, production also returns to its natural level, if this is defined as the level of output that would obtain when monetary disturbances are completely known to the agents. Output can differ from this natural level as long as monetary disturbances are not fully known. In both models, it is only unanticipated price changes that can cause the economy to deviate from its natural output.

Because Lucas's model made it explicit how output changes in response to shocks θ under rational expectations, his model was the beginning of a series of subsequent efforts that attempted to capture the movement of the economy as a stochastic process that is driven by shocks, real or monetary. These efforts culminated in real business cycle theory, particularly after the publication of Kydland & Prescott's seminal paper (1982) as well as in time-series studies testing the presence of a unit root in aggregated variables such as aggregate

consumption and even the gross domestic product (Hall, 1978; Nelson & Plosser, 1982).

Lucas also addressed an important normative question on whether or not Friedman's *k-percent* rule is Pareto optimal. If the monetary authorities follow a rule, agents know ahead of time what policies will be pursued in the future, hence can make intertemporal plans without the risk of being surprised. On the other hand, if the authorities change their policies at their discretion, agents will be forced to revise their plans every time such changes are made, and the cost of this revising will not be negligible. More importantly, discretionary policies increase the uncertainty of the decision making environment, thereby making the agents' planning unnecessarily difficult. As pointed out above, Friedman & Schwartz (1963), through their extensive study on the monetary history of the United States, gave episodes of misguided monetary policies. Lucas's proof of the optimality of the *k-percent* rule proceeded by showing that if there were any feasible allocation, say a triplet $(n(\theta), c(\theta), c'(\theta))$ (where $c'(\theta)$ is the consumption per capita of the old), which is assumed to be Pareto superior to the optimal solution $(\bar{n}(\theta), \bar{c}(\theta), \bar{c}'(\theta))$ that obtains when the *k-percent* rule (i.e., $\bar{x} = 1 + k$) is followed, such an allocation necessarily contradicts the Pareto optimality condition itself.

Lucas's proof suggests that discretionary policies of any sort will not bring about an equilibrium allocation that is Pareto-superior to what obtains under a fixed rule. Such policies always disorient economic agents as the authorities flutter on their previous commitment and start something new. Faced with unforeseen policy changes, agents must protect themselves against unpredictable changes. To make the matter worse, while the authorities are held accountable for their policies, it is not clear how effective their new policies will be for the situation at hand. In the case of monetary policies, there is always a lag before their effect shows up one way or another. In the face of such difficulties, the monetary authorities may be wise to adopt a rule by looking at the growth trend of the economy and supplying money at a rate consistent with this trend. Friedman's *k-percent* rule is intended to eliminate the uncertainty that the monetary policies may create. Elimination of such uncertainty allows agents to focus on real shocks or changes in relative prices. As Schumpeter (1942) has convincingly argued, innovations are the sources of the dynamic growth of capitalist economies. Because capitalist economies use money as a medium of exchange, the most important task of the monetary authorities is to supply money without creating unnecessary disturbances, so that the decisions made by individual agents in response to real innovations may be close to being optimal. In the case of Lucas's model, this amounts to eliminating the confusion between nominal and relative prices.

9. Further discussion of Lucas's contributions in relation to the phenomenologies of consciousness and existence

We have examined the rational expectations equilibrium theory in relation to Husserl's phenomenology of the internal time consciousness and Heidegger's phenomenology of human existence, that preceded it by several decades, as well as to Aristotle's ethics. This theory, as we traced through Friedman, Muth, and Lucas, is founded on three ideas: (1) the notion of intertemporal optimization as a principle that permeates through all decisions

made by economic agents; (2) the idea of expectations that are formed endogenously in relation to the market equilibrium in getting foresight as to what will be the most likely state of the market that results from decisions made by individual agents; and (3) the idea that the decision making modes are intertwined with the economic environment, particularly with a politico-economic policy regime. The notion of intertemporal optimization is based on the fact that human actions at different points in time are interconnected as a plan of actions that is designed to achieve an end. Because of such linkages, the current and future economic environment as foreseen by agents will be reflected in decision plans made, and there will be intertemporal substitution of leisure, consumption, or even investment depending on what is anticipated as coming in the future in terms of the market determined cost or reward of various actions that will be open to agents. Thus, the idea makes it necessary to view the current state of the economy from two aspects, one as the cumulated outcome of the past decisions that defines the initial condition of planning, and the other from the plan of actions over the planning horizon. It also makes it necessary to examine whether the fluctuations of the economy can be caused by what is anticipated to happen in the future, for such anticipations can cause a discrete jump in the action plans of agents. Thus, for the first time in economic theorizing, we have come to cope with the phenomena of reverse causation (i.e., what is expected to happen in the future affects our behavior today) and with the fact that economic fluctuations are not necessarily caused by the decisions made in the past alone; anticipations of what is expected to happen in the future are just as important as what was done in the past.

The second component, namely, the idea of endogenous expectations as foresight, follows from the notion of intertemporal optimization, for this optimization requires that the future economic conditions in which planned actions will be carried out be taken into account before such actions are thought out. For economic decisions, it is the entire array of the market prices that characterizes the economic conditions. Since the market prices can only be guessed as equilibrium prices (it is impossible to guess the market prices when the market itself is out of equilibrium), any effort at intertemporal optimization must be accompanied by the foresight on the future market equilibrium prices. But, this foresight must be compatible with the plans made by agents under the same foresight; that is, endogenous expectations must be compatible with the market equilibrium that results from the planned actions of agents under the same expectations. Thus, the idea of rational expectations arose as consistent equilibrium expectations. Many objections have been raised against the idea of rational expectations because the conditions required for such consistency are two stringent in the face of the information falling short of what is required to even guess where the rational expectations equilibrium path might lie. Despite such objections, the theory of rational expectations stands as a viable theory to meet the fundamental requirement for intertemporal optimization.

The third component, i.e., the idea of economic decisions intertwined with the economic environment including a politico-economic policy regime, follows from the first two components. If agents' economic decisions are based on intertemporal optimization, and if this optimization requires that the future economic environment be forecast, then, an economic policy that changes the policy regime in the future will show up in the planned actions of

agents, for a newly created policy regime changes the cost and the benefit of various actions taken therein and because agents proact, rather than react, to such changes. Such intertwining of economic decisions with a policy regime reminds us of the danger of extrapolating the past behavior into the future when a new policy regime is introduced. After the insight first conceived by Muth, it was Lucas who examined the basic question of how to model the decision making modes of intertemporally motivated agents in relation to the environment in which their decisions are made, and how to analyze the interdependence of the two in a consistent way. Today, in foreseeing the effect of economic policies, we consider how such policies will affect the cost and the benefit of alternative actions, hence the decision making modes, rather than assuming that the agents simply react to new economic policies in the same way they have reacted in the past. In demonstrating that the decisions are an integral part of a politico-economic regime environment, Lucas has brought back what Aristotle invited us to think at the close of *Nicomachean Ethics* (Book X), that is, to think about the influences of legislation of laws and constitution, which define the public good and guide individuals in the *polis* in the pursuit of their private goods. By defining what is allowed or not allowed legally, as well as what is costly or not costly to individual agents, in the decision making space, a politico-economic policy regime affects the way individual agents pursue their goals.

It was the intent of this paper to relate all of these tenets of the theory of rational expectations to the phenomenological movement in philosophy, which was initiated by Husserl and Heidegger in the early part of the 20th century. In particular, we wanted to relate the theory to Husserl's phenomenology of the consciousness of internal time and Heidegger's phenomenology of human existence as Dasein. These phenomenologies penetrated into the truth of our being, whether in inner time consciousness or in existence, and elucidated it as temporality in the primordial sense. Through our inner time consciousness, we perceive an object as a temporal object by protending what is coming, capturing it, fulfilling it in the present, and inserting it into our memory to retain it, and this memory flows continuously with the constant insertion of new objects. Similarly, in our existence we are set in a perpetual self-motion as ecstacies of temporalized temporality, which essentially consists in anticipating what is coming, fulfilling it in the present, and retaining it as the history that has been made, to which we undestandably come back for the meaning of our life. If our inner time consciousness and existence have such intentionalities, one directed to what is coming and the other directed to what has been fulfilled, our decision making must be done with the same intentionalities. These intentionalities are also joined by another one, which is directed at the environing world in which we encounter what presences therein including people, past and present. Because our life of actions is forward-looking in nature, and because all of our actions are interconnected over the horizon and concerted toward the principle of living well, our decision making should be modeled as such. In *Metaphysica* (Book IX), Aristotle said that "we do not see in order that we may have sight, but have sight in order that we may see." That is, in the context of human existence, we can say we make decisions not simply because we have the capacity to do so, but more importantly because we desire to make our life complete by making good decisions. In much the same way, in *Nicomachean Ethics*, Aristotle defined our life as a life of teleological actions, which has its

destiny in making it a good life by cultivating and directing all of our virtues, of intellect and character, to the first principle of our life, which is to live an active life well. Husserl and Heidegger delved into the vision that Aristotle had, and characterized the activity of our consciousness and existence as the intentionalities that are temporal.

The theory of rational expectations as started by Friedman, elaborated by Muth, and thought through by Lucas, revolutionized our view on the decision making modes of economic agents by returning our thinking to the ethical or normative nature of human beings and by translating this nature into a theory of rational decision making that is intertemporal, optimal, and foresightful of the future market equilibrium conditions. The theory, in this sense, is a return to the age-old ethicality of human beings as well as a venture into a radically different way of looking at the decision making modes of individual agents and the economy, that is, as a process rather than as a structure, just as our consciousness and living are a process rather than a prefixed structure. By returning to the consciousness and existence as they are, Husserl and Heidegger awakened us on the primordial importance of our daily living and warned against the presuppositions or prejudices that keep us from seeing things as they are. In much the same way, the theory of intertemporal optimization and rational expectations has helped bring economics home by awakening us on the primary importance of how we are making our intertemporal decisions in our daily living with anticipations as to what is coming or to be fulfilled by our actions. Nobody denies that the first principle of our life is to be happy, that is, to be as active as we can be with what we are endowed with as our potentialities. Despite all the difficulties that surround the formation of rational expectations, it would not be too far from the truth to say that the theory of rational expectations, by bringing to the forefront the ethical nature of human existence and decision making rooted therein, has caught up with the way we exist as rational decision makers to live through our life as a project.

References

Aristotle. (1984). Nicomachean ethics (W. D. Ross, Trans.). In J. Barnes (Ed.), *The complete works of Aristotle* (Vol. 2). Princeton University Press.

Aristotle. (1984). Metaphysics (W. D. Ross, Trans.). In J. Barnes (Ed.), *The complete works of Aristotle* (Vol. 1). Princeton University Press.

Bodin, J. (1947). *Response of Jean Bodin to the paradoxes of Malestroit* (Original work published 1568). Country Dollar Press.

Bowen, H. R., & Hansen, A. H. (1953). A guide to Keynes. *Econometrica*, *21*(4), 620. https://doi.org/10.2307/1907931

Cagan, P. (1956). The monetary dynamics of inflation. In M. Friedman (Ed.), *Studies in the quantity theory of money* (pp. 25–117). University of Chicago Press.

Cass, D. (1965). Optimum growth in an aggregative model of capital accumulation. *The Review of Economic Studies*, *32*(3), 233–240. https://doi.org/10.2307/2295827

Copernicus, N. (1926). *Monetae cudendae ratio*. Orijinal: 1526.

Deaton, A. S. (2005). Franco Modigliani and the life cycle theory of consumption. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.686475

Debreu, G. (1959). *Theory of value: An axiomatic analysis of economic equilibrium*. Yale University Press.

Fisher, I. (1911). *The purchasing power of money: Its determination and relation to credit, interest, and crises*. Macmillan.

Friedman, M. (1956). The quantity theory of money: A restatement. In M. Friedman (Ed.), *Studies in the quantity theory of money* (pp. 3–24). The University of Chicago Press.

Friedman, M. (1957). *A theory of the consumption function*. Princeton University Press.

Friedman, M. (1959). *A program for monetary stability*. Fordham University Press.

Friedman, M. (1962). *Capitalism and freedom*. The University of Chicago Press.

Friedman, M. (1968). The role of monetary policy. *American Economic Review*, *58*(1), 1–17. https://doi.org/10.2307/1813136

Friedman, M. (1970). A theoretical framework for monetary analysis. *Journal of Political Economy*, *78*(2), 193–238. https://doi.org/10.1086/259623

Friedman, M. (1971). A monetary theory of nominal income. *Journal of Political Economy*, *79*(2), 323–337. https://doi.org/10.1086/259746

Friedman, M. (1977). Nobel lecture: Inflation and unemployment. *Journal of Political Economy*, *85*(3), 451–472. https://doi.org/10.1086/260579

Friedman, M., & Schwartz, A. J. (1963). *A monetary history of the United States, 1867-1960*. Princeton University Press.

Gordon, R. J. (2009). The history of the Phillips curve: Consensus and bifurcation. *Economica*, *78*(309), 10–50. https://doi.org/10.1111/j.1468-0335.2009.00815.x

Grabill, S. J. (2007). *Sourcebook in late-scholastic monetary theory: The contributions of Martin de Azpilcueta, Luis de Molina, S.J., Juan de Mariana, S. J.* Lexington Books.

Hall, R. E. (1978). Stochastic implications of the life-cycle/permanent income hypothesis: Theory and evidence. *Journal of Political Economy*, *86*(6), 971–987. https://doi.org/10.1086/260724

Hansen, A. H. (1949). *Monetary theory and fiscal policy*. McGraw-Hill.

Hansen, A. H. (1953). *A guide to Keynes*. McGraw-Hill.

Hayek, F. (1945). The use of knowledge in society. *The American Economic Review*, *35*(4), 519–530. https://doi.org/10.2307/1805937

Heidegger, M. (1996). *Being and time* (J. Stambaugh, Trans.). State University of New York Press. (Original work published 1927).

Henderson, D. W., & McKibbin, W. J. (1993). A comparison of some basic monetary policy regimes for open economies: Implications of different degrees of instrument adjustment and wage persistence. *Carnegie-Rochester Conference Series on Public Policy*, *39*, 221–317. https://doi.org/10.1016/0167-2231(93)90011-k

Hicks, J. R. (1937). Mr. Keynes and the "Classics"; A suggested interpretation. *Econometrica*, *5*(2), 147–159. https://doi.org/10.2307/1907242

Hume, D. (1987). Of money (Part II, Essay III); Of interest (Part II, Essay IV). In E. F. Miller (Ed. & Trans.), *Essays, moral, political, and literary* (pp. 281–308). Liberty Fund, Inc. (Original work published 1742).

Husserl, E. (1991). *On the phenomenology of the consciousness of internal time (1893–1917)* (J. B. Brough, Trans.). Kluwer Academic Publishers. (Original work published 1928).

Kant, I. (1998). *Critique of pure reason* (P. Guyer & A. W. Wood, Eds. & Trans.). Cambridge University Press. (Original work published 1781).

Kareken, J. A., Muench, T., & Wallace, N. (1973). Optimal open market strategy: The use of information variables. *American Economic Review*, *63*(1), 156–172. https://doi.org/10.2307/1817552

Keynes, J. M. (1936). *The general theory of employment, interest and money*. Macmillan Cambridge University Press.

Koopmans, T. C. (1963). *On the concept of optimal growth* (Cowles Foundation Discussion Paper No. 163). Cowles Foundation for Research in Economics, Yale University.

Kydland, F. E., & Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *Journal of Political Economy*, *85*(3), 473–491. https://doi.org/10.1086/260580

Kydland, F. E., & Prescott, E. C. (1982). Time to build and aggregate fluctuations. *Econometrica*, *50*(6), 1345–1370. https://doi.org/10.2307/1913386

Lucas, R. E. (1972). Expectations and the neutrality of money. *Journal of Economic Theory*, *4*(2), 103–124. https://doi.org/10.1016/0022-0531(72)90142-1

Lucas, R. E. (1976). Econometric policy evaluation: A critique. *Carnegie-Rochester Conference Series on Public Policy*, *1*, 19–46. https://doi.org/10.1016/s0167-2231(76)80003-6

Lucas, R. E. (1978). Asset prices in an exchange economy. *Econometrica*, *46*(6), 1429–1445. https://doi.org/10.2307/1913837

Lucas, R. E. (1980a). Equilibrium in a pure currency. *Economic Inquiry*, *18*(2), 203–220. https://doi.org/10.1111/j.1465-7295.1980.tb00570.x

Lucas, R. E. (1980b). Methods and problems in business cycle theory. *Journal of Money, Credit and Banking*, *12*(4), 696–715. https://doi.org/10.2307/1992030

Lucas, R. E. (1981). *Studies in business-cycle theory*. The MIT Press.

Lucas, R. E. (1982). Interest rates and currency prices in a two-country world. *Journal of Monetary Economics*, *10*(3), 335–359. https://doi.org/10.1016/0304-3932(82)90032-0

Lucas, R. E. (1987). *Models of business cycles*. Basil Blackwell.

Lucas, R. E. (1988). On the mechanics of economic development. *Journal of Monetary Economics*, *22*(1), 3–42. https://doi.org/10.1016/0304-3932(88)90168-7

Lucas, R. E. (1995). Monetary neutrality. *American Economic Review*, *86*(4), 661–682. https://doi.org/10.4337/9781845426897.00034

Lucas, R. E. (1995). *Robert E. Lucas, Jr. - Biographical*. Nobel Foundation.

Lucas, R. E., & Prescott, E. C. (1971). Investment under uncertainty. *Econometrica*, *39*(5), 659–681. https://doi.org/10.2307/1909571

Lucas, R. E., & Rapping, L. A. (1969a). Real wages, employment, and inflation. *Journal of Political Economy*, *77*(5), 721–754. https://doi.org/10.1086/259559

Lucas, R. E., & Rapping, L. A. (1969b). Price expectations and the Phillips curve. *American Economic Review*, *59*(3), 342–350. https://doi.org/10.2307/1806364

Lucas, R. E., & Stokey, N. L. (1983). Optimal fiscal and monetary policy in an economy without capital. *Journal of Monetary Economics*, *12*(1), 55–93. https://doi.org/10.1016/0304-3932(83)90049-1

Lucas, R. E., & Stokey, N. L. (1987). Money and interest in a cash-in-advance economy. *Econometrica*, *55*(3), 491–514. https://doi.org/10.2307/1913597

Martin de Azpilcueta. (2007). Commentary on the resolution of money. In S. J. Grabill, *Sourcebook in late-scholastic monetary theory* (pp. 11–26). Lexington Books. (Original work published 1556).

Mill, J. S. (1909). *Principles of political economy*. (W. J. Ashley, Ed.). Longmans, Green, and Co. (Original work published 1848).

Mills, E. S. (1954). Expectations, uncertainty and inventory fluctuations. *The Review of Economic Studies*, *22*(1), 15–23. https://doi.org/10.2307/2296220

Mills, E. S. (1957a). The theory of inventory decisions. *Econometrica*, *25*(2), 222–248. https://doi.org/10.2307/1910251

Mills, E. S. (1957b). Expectations and undesired inventory. *Management Science*, *4*(1), 105–109. https://doi.org/10.1287/mnsc.4.1.105

Muth, J. F. (1960). Optimal properties of exponentially weighted forecasts. *Journal of the American Statistical Association*, *55*(290), 299–306. https://doi.org/10.2307/2281742

Muth, J. F. (1961). Rational expectations and the theory of price movements. *Econometrica*, *29*(3), 315–335. https://doi.org/10.2307/1909635

Nelson, C. R., & Plosser, C. R. (1982). Trends and random walks in macroeconomic time series. *Journal of Monetary Economics*, *10*(2), 139–162. https://doi.org/10.1016/0304-3932(82)90012-5

Nerlove, M. (1958). Adaptive expectations and cobweb phenomena. *The Quarterly Journal of Economics*, *72*(2), 227–240. https://doi.org/10.2307/1880597

Phelps, E. S. (1967). Phillips curves, expectations of inflation and optimal unemployment over time. *Economica*, *34*(135), 254–281. https://doi.org/10.2307/2552025

Phelps, E. S. (1968). Money-wage dynamics and labor-market equilibrium. *Journal of Political Economy*, *76*(4, Part 2), 678–711. https://doi.org/10.1086/259438

Phelps, E. S. (2007). Macroeconomics for a modern economy. *American Economic Review*, *97*(3), 543–561. https://doi.org/10.1257/aer.97.3.543

Phillips, A. W. (1958). The relation between unemployment and the rate of change of money wage rates in the United Kingdom, 1861–1957. *Economica*, *25*(100), 283–299. https://doi.org/10.2307/2550759

Ramsey, F. P. (1928). A mathematical theory of saving. *The Economic Journal*, *38*(152), 543–559. https://doi.org/10.2307/2224098

Samuelson, P. A. (1958). An exact consumption-loan model of interest with or without the social contrivance of money. *Journal of Political Economy*, *66*(6), 467–482. https://doi.org/10.1086/258100

Sargent, T. J. (1987). *Some of Milton Friedman's scientific contributions to macroeconomics* (Working Paper). Hoover Institution, Stanford University.

Sargent, T. J. (1996). Expectations and the nonneutrality of Lucas. *Journal of Monetary Economics*, *37*(3), 535–548. https://doi.org/10.1016/0304-3932(96)01256-1

Schumpeter, J. A. (1939). *Business cycles: A theoretical, historical, and statistical analysis of the capitalist process*. McGraw-Hill.

Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. Harper Perennial.

Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Conference Series on Public Policy*, *39*, 195–214. https://doi.org/10.1016/0167-2231(93)90009-l

Taylor, J. B. (1998). *A historical analysis of monetary policy rules* (NBER Working Paper No. 6768). National Bureau of Economic Research. https://doi.org/10.3386/w6768

Timberlake, R. (2008). The Federal Reserve's role in the great contraction and the subprime crisis. *Cato Journal*, *28*(2), 303–312. https://doi.org/10.36009/CJ.28.2.9

Tinbergen, J. (1952). *On the theory of economic policy*. North-Holland.

Wicksell, K. (1936). *Interest and prices* (R. F. Kahn, Trans.). Macmillan. (Original work published 1898).

SCAN ME

Open Access This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's CreativeCommons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit: http://creativecommons.org/licenses/by-nc-nd/4.0/