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WHY IS LUCAS NOT A HAYEKIAN

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Why Lucas is not a Hayekian[1]

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1. Introduction

In an attempt to clarify their own work economists frequently refer to supposed predecessors. These references often facilitate interpretation, thereby placing the referring economist in a research tradition. However, the interpretation will only be helpful if it is 'correct'.

Recently economists have debated the issue whether the New Classical Macroeconomics and the revived (Neo-)Austrian School share the same roots. This idea was launched by Robert Lucas, a leading New Classical, who claimed that New Classicism embroiders on the work on business cycle theory accomplished during the 1920s and 1930s by one of the leading Austrians of those days, Friedrich A. von Hayek. In the subsequent literature this claim has more or less been confirmed (cf. Kantor (1979), Colander and Guthrie (1980); Laidler (1982); Scheide (1982)). Conversely, Butos (1986, p. 341) thinks that the claim is correct but misleading. He says that Hayek increasingly acknowledged the limitations of general-equilibrium analysis whereas New Classicals strongly favor this form of analysis. He argues that Lucas disregards the possibility that Hayek might have treated general equilibrium merely as a starting point, whereas New Classicals see it as the ultimate form of analysis (Butos (1986, p. 342)).

This paper will argue that Hayek had in his early works (i.e. during the 1920s and 1930s) already developed the nucleus of his ideas concerning the proper ways of analyzing business cycles. Furthermore, it will also be shown that his research programme (i.e. the sequence of problem-situations to be solved) differed substantially from that of the New Classicals. It will be argued that Hayek and Lucas pursue different goals.

The analysis will be limited to those aspects of Hayek's analysis, which are closely interrelated, namely (1) the interaction between individuals, (2) the level of aggregation, (3) the role of 'Knightean' uncertainty, and (4) the 'objectivity' of the underlying economic model. Section 2 studies Hayek's work on business cycle theory of the 1920s and 1930s, whilst that of Lucas is analyzed in section 3. In section 4 the differences between the views of both economists will be analyzed. Section 5 will explain these differences in terms of the respective goals Hayek and Lucas pursued. The paper ends with some conclusions and final remarks.

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[1] This paper is a translated and extended edition of my article 'Hayek and Lucas: een vergelijking', Maandschrift Economie 54 (1990), pp. 128 - 39. It is to be presented at the ISINI Congress, Paris, August 27 - 29, 1990.

2. Hayek: the coordination problem

2.1. Equilibrium in Hayek's analysis

Hayek's main works on business cycle theory are Prices and Production (1931) and Geldtheorie und Konjunkturtheorie (1929, English translation Monetary Theory and the Trade Cycle, 1933), supplemented in 1939 by the bundle of essays Profits, Interest and Investment. Notably in the second book Hayek (1933, p. 42n) explicitly stated that his business cycle theory must be placed in a Walrasian general equilibrium framework. Such framework implies that business cycles can only be caused by exogenous disturbances, for if they are caused endogenously, one cannot maintain that a Walrasian (static) equilibrium already existed. Furthermore, the framework poses a problem: does the economy not react to an exogenous disturbance by forming a new equilibrium (if the equilibrium is a stable one) or by moving away from it (if it is unstable)? In other words, it is impossible to explain recurring cyclical movements endogenously in a Walrasian general equilibrium framework which at best can only analyze the formation of a new equilibrium, that is, which must make use of the 'logic' of equilibrium theory (Hayek (1933, pp. 42 - 43)).

In order to render such explanation possible Hayek had to expand his Walrasian framework. As a pupil of Ludwig von Mises he regarded money as causing the contradiction between general equilibrium and business cycles. Walrasian equilibrium theory had traditionally treated money as just another good. Furthermore, it held that all prices are determined simultaneously by an instantaneous tâtonnement process, which implies the absence of time. Hayek (1928 (1984), p. 72) argued that this was a misconception, in the sense that the existence of money implies time because it allows for the allocation of expenditures in time. In order to overcome this problem Hayek (1928 (1984), p. 76) created a concept of intertemporal equilibrium, in which "... the relations between the particular decisions of the economic subjects, and thus between all the economic processes conducted within the overall time period, must always be basically the same as those which can be derived for an equilibrium system in which time has been assumed away". As economic decisions are based on expectations and (more fundamentally) knowledge, the knowledge of the actors in a Hayekian equilibrium situation must be identical to that of the actors (or auctioneer) in Walrasian equilibrium. This means that Hayekian intertemporal general equilibrium implies that (1) preferences and means of production at each moment in time are known to the individuals when they are planning their actions for the next period, and (2) all goods may be used to satisfy needs at each moment in time (1928 (1984), p. 76 note 6 (p. 114)).

In short, Hayek's business cycle theory must be placed in an 'dynamic' general-equilibrium framework, which incorporates time. This is done by treating money as not just another good, but instead as a means to allocate expenditures intertemporally (i.e. as a store of value). Alternative, non-equilibrium, modes of explanation are heavily criticized by Hayek (1929, 1933). However, these criticisms do not indicate how one can explain business cycles in terms of

general-equilibrium analysis. Such an explanation is possible only if general equilibrium is disturbed. However, such disturbance is not allowed to conflict with the individuals' rationality. The individual is assumed to be a rational agent (which means that he will act to the best of his ability, given his knowledge). Thus Hayek discerns between individual and general equili-brium, that is between optimality for the individual and optimality for the economy as a whole (Butos (1986, p. 334)).[2] This distinction will prove to be essential in Hayek's business cycle theory.

2.2. Individual and general equilibrium: the coordination problem

According to the Hayek, the actions of individuals are based on their plans. Individuals are said to be in equilibrium when they cannot improve their actions, given their knowledge. Thus, in equilibrium individual actions are optimal (with regard to the plan upon which they are based). This optimality is called individual equilibrium. On the other hand, one cannot discern a general plan for society as a whole. Therefore, general equilibrium must refer to the individual plans, or rather, to the multitude of individual equilibria.[3] Individuals are supposed to be in equilibrium if they had no incentive to change their actions. This will be so, Hayek argued, if their plans are fulfilled. But plans will only be fulfilled if the expectations on which the actions are based, are correct. And these expectations must in turn be formed on the basis of correct, that is perfect knowledge and foresight. In Hayek's terms, individual equilibrium exists if and only if 'the subjective data' (that is, objective reality as known by the individuals) is identical to the 'objective data' (that is, 'objective reality' or the model as known to or presupposed by the observer/scientist) (Hayek (1937, pp. 36 - 39)).

General equilibrium is more difficult to define because of the multitude of (conflicting) plans it comprises. This multitude leads to the problem of conflicting plans. What if plans are not consistent in the sense that the fulfilment of his plan by individual A prohibits individual B from fulfilling his? Do we define such a situation as 'general equilibrium'? If so, then all situations may be termed general equilibrium, which renders the concept meaningless. Instead, Hayek (1937, p. 38) defined the concept as the situation in which all individuals are in individual equilibrium and in which their plans do not conflict (that is, the situation in which all plans are interpersonally consistent). The first property of general equilibrium means that individuals act to the best of their ability, given their knowledge. Furthermore, it implies that all plans must come true. This means that the individuals must have perfect knowledge, including perfect foresight. Then they know (1) the 'true' structure of the model, (2) all plans and actions of the other individuals, and (3) the values of all exogenous variables.

In other words, the Hayekian dynamic general equilibrium construct implies that it will be

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[2] Later, Hayek would call an economic subject an 'economy', characterized by its unequivocal ordering of preferences. The economy as a whole would be termed 'catallaxy', being a set of 'economies'. A 'catallaxy' does not have one unambiguous ordering of preferences; rather, it is characterized by the fact that it contains many such orderings which are often conflicting.

[3] Butos (1986, p. 334).

maintained if no unexpected changes occur. Expectations are fundamental to Hayek's equilibrium construct. Moreover, the defining characteristic that all plans must come true implies that none of the plans may be inconsistent in the sense that the fulfillment of the one inevitably leads to the failure fulfilling another. In other words, plans cannot be interpersonally inconsistent in Hayekian general equilibrium; the coordination problem is solved.[4] In contrast, disequilibrium implies that this problem does exist: some individuals' plans are frustrated. These individuals will face unexpected consequences[5] of their actions and will have to adapt their actions in order to avoid further frustrations in future periods. This brings us to the intertemporal characteristics of Hayek's equilibrium concept.

2.3. Intertemporal equilibrium

Suppose that at the end of period 1 individual A changes his preferences, and that all other data remain unchanged. If all other individuals (say B and C) recognize this change immediately (that is, before period 2 has begun and they already have acted), they will change their actions (relative to those in period 1). If individual A's new actions already anticipate the new actions of B and C, none of the three individuals will be disappointed.[6] General dynamic equilibrium in the Hayekian sense thus implies that individuals must have perfect foresight, because they would otherwise be confronted with unexpected circumstances, leading to the frustration of their plans.[7] Hayek's general dynamic equilibrium concept implies that all individuals act optimally, and that the changes in their actions are optimal as well. A precondition then is that all individuals know how to change their actions. Perfect knowledge and perfect foresight therefore are defining characteristics of the Hayekian general dynamic equilibrium. If there are no unexpected (endogenous or exogenous) changes, general equilibrium is maintained. As Hayek (1937, p. 42) concluded, "[i]t appears that the concept of equilibrium merely means that the foresight of the different members of the society is in a special sense correct. It must be correct in the sense that every person's plan is based on the expectation of just those actions of other people which those other people intend to perform and that all these plans are based on the expectation of the same set of external facts, so that under certain conditions nobody will have any reason to change his plans. Correct foresight is then not, as it has sometimes been understood, a precondition which must exist in order that equilibrium may be arrived at. It is rather the

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[4] O'Driscoll (1977, pp. 26 - 28).

[5] Notice that unexpected consequences of actions is not a synonym for unintended consequences. Unexpected consequences may be intended, and unintended consequences may be expected.

[6] If A did not anticipate the change in actions of B and C, he will be disappointed in period 2. He will then start the process of revising actions all over again.

[7] Hayek, 1933c (1939), pp. 139 - 41. Hayek elaborated the relation between equilibrium and knowledge further in his 1937-article 'Economics and Knowledge'.

defining characteristic of a state of equilibrium."

According to Hayek (1937, p. 35), the concept of general equilibrium must be regarded as an instrument of formal, tautological analysis, that is as a 'pure logic of choice'. This formal analysis may be rendered empirically meaningful by adding "... definite statements about how knowledge is acquired and communicated" (Hayek (1937, p. 33)). These empirical statements will determine whether a tendency towards general equilibrium exists. That is, whether the 'subjective data' tends to become identical to the 'objective data'. If so, a tendency towards the solution of the coordination problem exists as well.

2.4. The business cycle as a disequilibrium phenomenon

It may be possible that the plans and actions of the individuals are discoordinated. In this situation knowledge cannot be perfect, for if it were, nobody's plans would have been frustrated. Hayek considers knowledge to be dispersed among all the individuals. This means that the economy will not be in general equilibrium. He interprets the business cycle as a discoordination (and therefore disequilibrium) phenomenon in which individuals are confronted with unexpected outcomes of their actions.

During a business cycle the individuals are faced with unexpected outcomes. That is, they make expectational errors. But more importantly, they do not make these errors at random. Empirical evidence shows that these errors are similar across the various markets. This means that many individuals make similar mistakes. Hayek (1933c (1939, p. 141) acknowledges that his task is to explain why individuals make expectational errors and, moreover, why different individuals, and more specifically entrepreneurs, make similar mistakes. He discerns two reasons why this must be so. The first reason is an exogenous one and refers to some psychological state of mind (e.g. Pareto's 'waves of optimism or pessimism' or Keynes's 'animal spirits'). The second reason, which Hayek considers to be more likely, is that the entrepreneurs are misled by following guidelines and signals which generally have proved reliable. One of these guidelines (and presumably the most important one in market economies) is the price system: "... it may be that the prices existing when they [i.e., the entrepreneurs] made their decisions and on which they had to base their views about the future have created expectations which must necessarily be disappointed" (Hayek (1933c (1939), p. 141)). Prices (including the market rate of interest) on which entrepreneurs base their actions may be distorted. This causes expectational errors on the part of the entrepreneurs, which leads to the creation of a business cycle. The question then is what causes the distortion of the relative price structure.

Before expounding Hayek's business cycle theory, it must be noted that Hayek implicitly views each individual as a unique person with a unique ordering of preferences. This means that each person will demand a unique basket of goods, which differs from the basket demanded by other individuals. This will prove to be essential in Hayek's business cycle theory.

According to Hayek, business cycles are caused by credit expansion. In this sense his theory is a monetary theory. The extra amount of money created by this expansion must enter the economy at a specific point because it cannot be spread out proportionally and immediately over all individuals. As a result, some individuals will receive it sooner than others. They will raise their demand for goods, which leads to the disturbance of relative prices: the prices of the goods demanded will rise increasingly. This implies that real wages (in terms of the goods produced by the labourers in question) will fall. The rise in prices also means that entrepreneurs will base their investment decisions on disequilibrium prices. They will invest in projects which seem to be profitable but which will appear to be unprofitable in due time: the structure ('Aufbau') of production is disturbed. From this effect the term 'malinvestment theory' has been derived. There is another effect caused by the credit expansion. The increase in the supply of money will lead to excess supply on the money market. This leads to a fall in the real rate of interest below the long-run equilibrium level. The latter is also called the 'natural rate of interest', with reference to Wicksell (1898, pp. 93 - 94). The fall in real interest rate will make investment in capital intensive methods of production more profitable, spreading the boom to the investment goods industries. Sooner or later the boom increases the demand for means of production. Real wages and real interest rates must then rise. In Hayek's view this will happen in such a way as to restore the original relationship between the real interest rate and the real wage rate. The new capital-intensive investments are then seen to be unprofitable. The economy must 'recover' by eliminating the malinvestments. During this recovery process credit flows back to the private banks, which will lend them again in due time, thereby creating a new boom.
Fundamental to Hayek's (1931, p. 11) analysis is "... the point where the additional money is injected into circulation (or where the money is withdrawn from circulation)...." Hayek (1931, pp. 3 - 5) severely criticized Irving Fisher's quantity theory of money because it only analyzed the influence money has on the general price level. Monetary influences may have real consequences, even if the general price level does not change. In that case relative prices change, thereby altering the composition of the aggregates while leaving their magnitude unchanged. The changing composition implies that different individuals will experience different influences, which in turn evoke changes in individual knowledge, expectations, plans and actions. These changes disturb the general equilibrium. The interactions between the actions of individuals will then start to play a major role in any equilibrating process.

In sum, the basic features of Hayek's business cycle theory for our purposes are (1) his concept of 'the individual' as a <u>unique</u> human being, (2) the role of money as causing the business cycle, (3) the disturbance of the structure of production as the real phenomenon constituting the cycle, and (4) his desaggregated level of analysis in which the composition of aggregates is seen as more important than their magnitude.

2.5. Criticism on Hayek's analysis

Hayek's analysis may be criticized on at least two accounts. Firstly, Hayek presupposes an objective reality which is independent of the individuals' subjective perceptions. For Hayek the problem was how the subjective data would converge to this objective reality. Caldwell (1988, p. 529) argued that the objective reality is not independent from the subjective perceptions. The actions of the individuals depend on their subjective perceptions of reality. Furthermore, their actions influence the objective reality. If their subjective perceptions change, their actions and therefore objective reality will also change. This will seriously hamper any equilibrating process.
Secondly, the existence of the coordination problem need not imply chaos. It seems that Hayek equates 'order' in any economy with the existence of (or tendency towards) equilibrium. High (1986) claimed that the market process may be seen as an order, whereas at the same time it implies the absence of coordination. It is an order in the sense that equilibrating forces tend to offset disturbing forces. This approach has the advantage that the individuals' end-means-framework need not be considered exogenously given. It may change during the process, not leading towards equilibrium but maintaining a disequilibrium order. Moreover, the existence of the coordination problem may be seen as a driving force behind the market process. The constant frustration of their plans may provide the individuals with the incentive to search for new opportunities to improve their expected future circumstances. It may lead to a competition process in which resources are used more efficiently.

3. Lucas: disregarding coordination

3.1. Introduction

Robert Lucas is one of the founders of New Classicism. This school of thought arose from Monetarism and may be considered as a Walrasian equivalent on Marshallian monetarism, because it employs general equilibrium analysis.[8] Not only did it substitute partial-equilibrium analysis by general-equilibrium analysis, it also replaced Cagan's (1956) Adaptive Expectations Hypothesis by Muth's (1961) Rational Expectations Hypothesis (REH). This eliminated the inconsistency between the process of forming expectations adaptively and the rationality postulate.[9] Furthermore, New Classicism revived interest in business cycle theory.

3.2. Lucas's intertemporal equilibrium

In the late 1950s and in the 1960s most economists became increasingly convinced that the relationship between the rate of inflation and the unemployment rate as found by Phillips (1958)

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[8] Cf. Hoover (1984).

[9] Adaptive expectations are based on the past values of the variable which must be predicted. All other available and relevant information is not used. One might expect that rational individuals do use such information. Therefore, the AEH may be seen as inconsistent with the rationality postulate.

could be regarded as an exploitable tradeoff which governments could use in order to establish the desired combinations between inflation and unemployment. In his presidential address to the American Economic Association Milton Friedman (1968) stated that the Phillips curve in the long run did not constitute such an exploitable tradeoff. He argued that rational individuals do not suffer from money illusion, as is implied by the exploitable-tradeoff interpretation of the Phillips curve. They will take the price level and the rate of inflation into account in their future plans, basing their actions upon the real wage rate. In Friedman's opinion Phillips' analysis "... contains a basic defect - the failure to distinguish between nominal wages and real wages ..." (Friedman (1968, p. 8, italics in original)).[10] Friedman raised another point of critique against Phillips' analysis. He implicitly accused him of confusing the rate of unemployment with the changes in this rate.[11] According to Friedman, "... the Phillips curve should relate the rate of unemployment to changes in the real not the nominal wage rate, and ... the long-run relationship should be between the level of the wage rate and the rate of unemployment and not between the changes in the wage rate and the rate of unemployment."[12] Analogous to Wicksell's 'natural' rate of interest, Friedman calls this long-run relationship the natural rate of unemployment (NRU).[13] The NRU reflects the equilibrium rate of unemployment to which a stable economy tends, once disruptive influences have been removed.[14] In this situation no tradeoff exists between the rate of unemployment and the change in the nominal wage rate. Individuals then do not suffer from money illusion. More importantly, they know whether a given change in a particular price is an absolute or a relative one. This implies that they must know all prices: when the economy is at its NRU, individuals have perfect knowledge. Lucas (among other New Classicals) has adopted the NRU as a long-run perfect knowledge equilibrium. However, this equilibrium is not a static one. Rather, it is a dynamic version of Walras's static equilibrium. As Colander and Guthrie (1980, p. 226 - 27) have argued, Lucas extends the Walrasian equilibrium concept (which holds that all actions are optimal) to an intertemporal framework in which all changes in actions are optimal. Lucas's equilibrium may thus be seen as an 'optimal adjustment path'. As will be shown, the expectations formation process plays a major role in this regard.

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[10] As Hoover argues, Friedman should not have directed his criticisms towards Phillips' analysis but rather to the standard interpretation of the Phillips curve, as initiated by Samuelson and Solow (1960). Cf. Hoover (1988, p. 260, note 6).

[11] Friedman (1968, p. 8) relates the level of unemployment to the level of real wages.

[12] Hoover (1988, pp. 24 - 25, italics in original).

[13] Friedman (1968, p. 8) defines the natural rate of unemployment as "... the level that would be grounded out by the Walrasian system of general equilibrium equations, provided there is embedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the cost of mobility, and so on."

[14] Hoover (1988) p. 25.

Apart from the 'natural rate equilibrium', which is characterized by full information, Lucas (1988, p. 1, italics in original) uses another equilibrium concept, namely Rational Expectations Equilibrium (REE). The REE is defined as a (Nash) equilibrium, which "... does not refer to a system 'at rest', nor does it necessarily mean 'competitive' equilibrium in the sense of price taking agents, nor does it have in general any connection with social optimality properties of any kind. All it does mean is that, in the model, the objectives of each agent and the situation he faces are made explicit, that each agent is doing the best he can in light of the actions taken by others, and that these actions taken together are technologically feasible." This means that Lucas assumed that individuals always optimize successfully, given their knowledge. Therefore, the REE is always maintained. However, it does not mean that this equilibrium is stable, or that individuals have perfect knowledge. As Lucas already stated in the quotation given above, the system need not be at rest. It even allows for quite large fluctuations in real variables, e.g. during business cycles.
Obviously, the REE differs from the 'natural rate equilibrium'. The main difference between both concepts is that the latter presupposes full information (complete knowledge) while the former does not. Both concepts differ due to different assumptions with regard to the individual's information set.

In order to justify the REE New Classicals have analyzed whether it exists in the 'real world'. Or to put it differently (and more correctly) they have analyzed whether the concept may be used to interpret 'real-world' phenomena. It lies beyond the scope of this paper to analyze this problem extensively. All that may be said on the subject is that the results of these studies are rather ambiguous.[15]

3.3. Continuous market clearing

In Lucas's benchmark-world markets are seen as continuously clearing. Nominal wages and prices are then perfectly flexible, equating demand and supply instantaneously and leaving no room for involuntary unemployment. This may seem inconsistent with factual evidence. Keynesians argue that nominal wages and prices are not perfectly flexible. Rather, they exhibit downward rigidity. Keynesians hold that economic theory must therefore take such rigidity into account. In contrast, the New Classicals oppose this position vehemently. Lucas and Sargent (1978, p. 305) argued that "... Keynes took as an unexamined postulate that money wages are sticky, meaning that they are set at a level or by a process that could be taken as uninfluenced by the macroeconomic forces he proposed to analyze." In their opinion, Keynes did not explain

[15] For an analysis concerning the existence of the REE, see e.g. Shiller (1978) and Bray (1983).

such stickiness.[16] As they loathe 'ad-hocness', New Classicals try to supply such an explanation. In doing so they must obviously start from the assumption that nominal wages and prices are completely flexible.[17] This means, of course, that all markets must continuously be in equilibrium. If this is the case, general equilibrium will always exist. This equilibrium may be a REE or a NRU equilibrium, depending on the information set assumed.

3.4. The Lucas supply function

The Natural Rate Hypothesis (NRH) holds that a level of supply and employment exists at which the rate of change in prices remains constant. It implies that individuals' expectations are correct, which is only possible if their knowledge is correct. In this sense Lucas's benchmark may be identified as the equilibrium situation in which output and employment are at their respective natural rates, which are established when all individuals have complete knowledge. The benchmark is dynamic in the sense that real variables remain at their 'natural' rate as long as all (exogenous and endogenous) changes are perceived and their effects are correctly anticipated.

This starting point seems to be contradicted by the Phillips curve. Therefore, Lucas must incorporate one or more features which render the explanation of this curve possible. He found this explanation in the difference between the actual and expected real rates of return.[18] Informational errors cause divergences from the 'natural rate'. This may be shown mathematically by the so-called 'Lucas supply function':[19]

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[16] One might argue that contract theory provides a new rationale for nominal wage and price rigidity. Lucas (1988, pp. 93 - 95, italics in original) argues that this idea "... is similar to the older idea that monopolistic elements can play the same theoretical role. The underlying idea is the not-unreasonable one that since money can often be shown in competitive theoretical models to possess neutrality properties that do not seem to obtain in reality, replacing the assumption of competition with some other assumed form of interaction will yield theories that are closer to reality with respect to their predictions about money and prices." However, this underlying idea "... overlooks the triviality of the standard monetary neutrality theorems, and hence of their insensitivity to the nature of the equilibrium being studied." In Lucas's opinion "[t]he central issue for a theory of nominal price rigidity ... is not the nature of the game agents are assumed to be engaged in, but rather the information agents are assumed to have about the state of the system at each date."

[17] Explaining wage and price rigidity by a theory which already assumes these rigidities resembles pulling oneself up by one's own bootstraps.

[18] Most New Classicals, notably Lucas (1973, 1975), Sargent and Wallace (1973) and Barro (1976), have used the price as the variable about which expectations must be formed. But as Barro (1980) has shown, using the real rate of return enables the NCE to incorporate various (interest-bearing) assets into its analysis, thereby making its analysis more general. Cf. also Lucas and Rapping (1969), McCallum (1978), King (1980).

[19] See e.g. Lucas and Rapping (1969, p. 21 - 22); Lucas (1972b, p. 93); Sargent (1973 (1981), p. 163). As Shiller (1978, p. 9) observes, the Lucas supply function is a representation of the Phillips Curve if there is a linear relationship between the measure of aggregated output and the unemployment rate.

$y = z + \alpha (1-\beta) (r^n - r^e)$

in which y = aggregated level of real output;

z = 'natural rate' of output;

r^n = 'natural' rate of return;

r^e = expected real rate of return;

α = parameter, indicating the extent in which a deviation of the expected real rate of return from the actual rate influences the actual level of aggregated output;

β = parameter, indicating that the higher the changes in real rate of return the lower output deviates from its natural rate.

The Lucas supply function indicates that the real value of aggregated output depends on the natural rate of output and on the difference between real and expected rate of return.[20] In other words, it states that general equilibrium exists if individuals do not make expectational errors, that is if $r^e = r^n$ (assuming that output initially is on its natural rate, i.e. that the system initially is in equilibrium). The deviation of output from its natural rate will be smaller if changes in the real rate of return are higher (if β is higher). This property may be attributed to the assumption that if these changes are larger, individuals will be more inclined to attribute a larger proportion of a given change in the rate of return on their local market to a change in the economy-wide rate of return.

3.5. Rational Expectations Hypothesis

Lucas acknowledges that individuals do not possess perfect knowledge and perfect foresight. They must form expectations in order to be able to make plans. As knowledge is imperfect, these expectations may be wrong. But although they may be wrong, they are not adaptive. Adaptive expectations incorporate only the past values of the variable which has to be predicted. Lucas argues that this may not be rational. Individuals will also make use of other information they possess. Furthermore, adaptive expectations allow the government and monetary authorities to keep unemployment constantly below the NRU if they were to expand the money supply increasingly. Lucas argues that systematic expectational mistakes are easily corrected; therefore individuals will take the accelerating money expansion into account. They will use all the relevant knowledge available. In particular, they will use the knowledge they have on the government's policy. They do not form their expectations adaptively but, rather, 'rationally'. As adaptive expectations do not rule out the possibility of systematically biased expectations, they "... permit both short- and long-run Phillips-like trade-offs between inflation and real output" (Lucas (1972b, p. 95)). Therefore, Lucas substitutes the Rational Expectations Hypothesis for the Adaptive Expectations Hypothesis.

Rational expectations had already been used by John Muth (1961). He advanced the hypothesis

[20] Sargent (1973, pp. 442 - 44).

that expectations are essentially the same as the predictions of the relevant economic theory (Muth (1961, p. 315)). Or, as he formulated more exactly, "... expectations of firms (or, more generally, the subjective probability distributions of outcomes) tend to be distributed, for the same information set, about the prediction of the theory (or the 'objective' probability distributions of outcomes)" (Muth (1961, p. 316)). However, for purposes of analysis Muth (1961, p. 317) used a 'specialized form' of the REH in a partial-equilibrium analysis, in which he assumed that the random disturbances are normally distributed. Lucas also uses this form of the REH, but whereas Muth had applied the hypothesis to a partial-equilibrium situation, Lucas used it in a general-equilibrium framework. Unfortunately, Muth's (and Lucas's) formulation leaves room for at least four interpretations. A taxonomy may be formulated which discerns a strong and a weak form of the REH. The former may be divided in three versions.[21] It will lead us to far astray to go into all versions. Our analysis will be limited to the weak and the strong form.

The strong form of the Rational Expectations Hypothesis (REH) holds that expectations are formed on the basis of all potentially relevant information concerning the structure of the economy as well as the past and current data.[22] Moreover, it holds that this information is used in such a way that all expectations are correct. The strong form may be formulated on a micro- or a macro-level. The former holds that individuals form correct expectations. The latter states that in the aggregate expectations are correct. This means that individuals may make expectational errors, but that these errors cancel each other out. Haltiwanger and Waldman (1989) have shown that the distinction between the micro- and the macro-type versions of the REH is important because both versions may yield rather different equilibria. They conclude that "[o]nly under very special conditions do standard [i.e. micro-type] rational expectations and aggregate rational expectations yield equivalent results. The difference between the two equilibria is larger when: (i) the divergence in expectations under aggregate rational expectations is increased; (ii) in a world which exhibits congestion, the severity of the congestion is decreased; (iii) in a world which exhibits synergism, the severity of the synergism is increased; and (iv) the activities exhibit synergism rather than congestion" (Haltiwanger and Waldman (1989, p. 621)). These results incorporate the effects of an individual's behaviour on the outcome of the actions of other individuals. By contrast, Lucas seems to equate the micro-REH with the macro-REH. This means that he neglects the interactional effects. As will be shown in section 3.6, this is due to his use of the concept of the 'representative agent'.

The weak form of the REH is merely a restatement of the rationality postulate. Individuals are assumed to optimize the information on which they base their decisions. Obviously, the optimal information need not be sufficient to allow for correct expectations. Furthermore, it may not even be possible to determine the optimal amount of information to be gathered. Information

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[21] Fischer (1980), Gomes (1982) and Snippe (1986) have formulated such taxonomies.

[22] Grossman (1980, p. 10); Snippe (1986-87, p. 428).

optimization presupposes expectations on the marginal return and cost of the information. On the other hand, expectations, being informed predictions, presuppose information. In other words, expectations are needed in order to optimize information, while information is needed to form expectations. This may appear to be a problem of circularity, but it is not. It is a problem of infinite regress because the information needed for expectations formation is of a different kind than the information for which the expectations are needed. Thus, optimizing information involves an infinite regress, which renders the weak form of the REH a highly unsatisfactory representation of the individual's information gathering process.

As will be clear, individuals will only attain the full information (natural rate) equilibrium if they use some version of the strong form of the REH. That is, if they have correct expectations and thus perfect foresight and perfect knowledge. This will only be rational if the information can be acquired without incurring costs (Darby, 1976). This is a highly unrealistic assumption, as is shown by explicating the information needed to form correct expectations. This information must incorporate (1) the 'true' structure of the (model) economy, (2) the 'true' values of the parameters in that economy, (3) all relevant past values of the relevant variables, and (4) all exogenous shocks which the economy will undergo during the period under consideration. However, as will be shown later, this lack of realism is not inconsistent with Lucas's views on the goals which economics must achieve as a science.
The REH plays an extremely important role in the adjustment process of the individuals' actions. According to Colander and Guthrie (1980, pp. 226 - 27), "[t]he REH merely extends the Pareto optimality argument to an intertemporal framework: ... [w]ith this assumption, it is intuitively reasonable that a dynamic counterpart to Pareto optimality will be the optimal dynamic adjustment hypothesis: economic agents are optimally adjusting to revealed information and, subject to certain second-order conditions, the economy will be on the optimal adjustment path" (cf. section 3.2).

3.6. The Cournot problem

Hayek's analysis of cyclical fluctuations centered on the interrelations between the actions of individuals. He starts his business cycle theory from the position that a multitude of individuals exist. This means that he cannot model the economy as he sees it. As Cournot (1838 (1927), p. 127) already observed, "... in reality the economic system is a whole of which all the parts are interconnected and react on each other. ... It seems, therefore, as if, for a complete and rigorous solution of the problems relative to some parts of the economic system, it were indispensable to take the entire system into consideration. But this would surpass the powers of mathematical analysis and of our practical methods of calculation, even if the values of all the constants could be assigned to them numerically." One and a half century later, the powers of mathematics, or rather of the human mind, are still insufficient to solve this 'Cournot problem' of modelling the behaviour of all individuals and their interrelations (cf. Hoover (1988, pp. 135, 220)). Moreover,

there are hardly any constants in economics.

In order to model economic activity some abstractions must be made. Lucas (1972a, 1974, 1988) 'solves' the Cournot problem by introducing one or a few 'representative individuals' (defined by their respective utility functions), thus abstracting from the multitude of individuals. In fact, he seems to treat aggregates and index numbers as if they obey the principles of microeconomics (cf. Hoover (1988, p. 242)). But it would appear that this solution to the Cournot problem is not really a solution, because it circumvents the problem. The number of individuals is limited. But the problem was posed by the number of individuals and goods. In other words, Lucas does not solve the problem; he bypasses it as irrelevant. This means that he cannot study the coordination problem. The use of the concept of the 'representative individual' indicates that Hayek and Lucas do not try to solve the same problem. In section 5 this point will be elaborated.

3.7. Lucas's business cycle theory

Lucas's (1972a) business cycle theory starts from Phelps's island parable. The problem Lucas faced was how to model the individuals' short-run imperfect information. This problem had already been solved by Phelps (1967). Not surprisingly, Lucas adopted Phelps's solution. Phelps depicted an economy as a set of islands. Each island represents a labour market. Furthermore, each individual lives on an island of which he possesses all current information. Phelps assumed that information about wages offered on other islands travels slowly. These assumptions amount to an information set of the individual, in which all current local information is included and which contains only lagged (and therefore incomplete) global information. Absence of money illusion implies that individuals must form expectations on real variables. In Phelps's 'island parable' they must do so with incomplete short-run global information. They are then faced with an interpretation problem, namely whether a rise in their local nominal wage is caused by a rise in their real wage or in the general price level. The incomplete information on which the expectations are based, will lead some (or many) individuals to form incorrect interpretations. This means that these individuals respond to nominal changes as if they were real changes. It seems that they suffer from money illusion, while in fact they merely interpret the change in nominal wage wrongly because of lacking information.

In Lucas's business cycle model individuals make identical mistakes. Suppose that the monetary authorities expand the money supply unexpectedly. According to the quantity theory of money, this will lead to a rise in the general price level. This means that individuals are confronted with an increase in their local price. Some individuals will interpret this increase incorrectly. They will expand production. However, the next period the additional global information becomes available. Individuals then realize that they have made a mistake and will correct it. An equilibrating process in the direction of the 'natural rate' equilibrium will be set into motion. It does not mean that this equilibrium will be reached, because of the fact that the incorrect

adaptation of the individuals' production will involve propagation mechanisms.[23] These mechanisms incorporate, for instance, the effects of an expansion of the productive capacity. As Lucas does not consider the structure of production, like Hayek did, the disturbance of the productive capacity of an economy may only be in size. Lucas's business cycle theory is a monetary overinvestment theory. It does not account for distortions of the structure of production because these distortions can only be explained in terms of the inconsistency of individual plans. However, plans may only be inconsistent if several individuals exist. By introducing the 'representative individual' Lucas abstracts from the coordination problem, and therefore from analyzing distortions of the structure of production, because by definition only one such a 'representative individual' exists. Plans cannot be interpersonally inconsistent because there is only one individual and one plan.

3.8. Criticisms

Several points of criticisms have been brought in against Lucas's analysis. These concern (1) the model used, (2) the REH, (3) the informational assumptions, and (4) the modelling strategy.

Firstly, Lucas presupposes an objective reality which is described correctly by his model. Changing actions of individuals do not change the structure of his model (B. Friedman (1979, p. 38)). In other words, Lucas assumes that objective reality is independent of the individuals' actions.

Secondly, the strong form of the REH holds that expectations are correct. The micro-REH assumes that individual expectations are correct. This means that individuals must have perfect knowledge and perfect foresight, which will only be true if information may be obtained costless. Correct aggregate expectations will only yield an equivalent equilibrium to correct individual expectations if we disregard from interactions between the actions of individuals. Lucas achieves such equivalence by adopting a particular modelling strategy, namely the 'representative individual'. Another criticism which has been brought forward against the REH is that the fact that systematic expectational errors are easily correctable does not mean that such errors are successfully avoided (Hahn (1986, p. 281)).

Fourthly, by modelling the economy in terms of 'representative individuals' Lucas is unable to incorporate an analysis of the coordination problem (Frydman en Phelps, 1983, p. 14). By disregarding the distinction between individual and general equilibrium Lucas assumes that the economy as a whole will be most efficient (optimal) if all individuals optimally adapt their actions (Butos, 1986, p. 334). This means that the instability of any model which does incorporate this problem is eliminated. As Buiter (1980, p. 46) noted, Lucas models the individual's actions as a game against nature, instead of a game against other optimizing players. This modelling strategy is misleading in the sense that "[o]nce we cease to model private agents as playing a game against nature - the competitive market - standard optimisation techniques are

[23] Cf. Lucas and Sargent (1978, pp. 312 - 14) and Fischer (1980).

no longer applicable within the private sector" (Buiter, 1980, p. 46, italics in original). Lucas may then not obtain the same results as he does now. Perhaps he would not obtain any determinate results at all. In other words, although this modelling strategy seems rather convenient, it may be extremely misleading. A related point to the use of the representative individual as a modelling strategy is the fact that it implies that the analysis of distributional effects is excluded. Implicitly Lucas assumes that distributional effects are not important. However, these effects may lead to changes in actions, even though the aggregates remain the same. These changes may alter the structure of the economy (Snippe, 1985). Lucas does away with this problem by assuming a representative agent and a 'true and objective' reality.

4. The differences between Hayek's and Lucas's analyses

Both Hayek and Lucas develop an analysis which shows some similarities. Both argue that business cycle theory must start from general equilibrium analysis. But whereas Hayek defines general equilibrium as a situation in which all individuals hold perfect knowledge and perfect foresight, Lucas defines two equilibrium constructs, only one of which implies the knowledge requirements as defined by Hayek (namely the 'natural rate' equilibrium). The other construct, the Rational Expectations Equilibrium, is consistent with imperfect information. Individuals may make mistakes, but the changes in their actions are optimal. The REE is an intertemporal equilibrium, just like the Hayekian equilibrium. But the latter implies that the actions of the individuals are correct, whereas the REE only holds that the changes in these actions are.

Scheide (1986, p. 578) concludes that the differences in the Hayekian and New Classical equilibrium constructs are only semantical in nature. This conclusion seems to be false in the sense that there is a more fundamental difference between the two equilibria. Already in 1928 Hayek focuses attention on the coordination problem. His definition of equilibrium explicitly claims that this problem must be solved. This implies that Hayek cannot restrict his analysis to the 'pure logic of choice': he must indicate the conditions which may lead to the solution of the coordination problem. He depicts these conditions as those in which the subjective data will tend to be identical to the objective data (i.e. objective reality). These conditions will incorporate the individual's expectations. These need not be correct, although they are formed rationally. This leads O'Driscoll (1979, p. 167) and Scheide (1986, p. 581) to conclude that Hayek's expectations formation hypothesis is identical to the weak form of the REH. Lucas, on the other hand, adopts the strong form of the REH. This difference is caused by his interpretation of economics as analyzing recurrent actions (Lucas (1977, p. 224)). It implies that in the social events studied by business cycle theory, there is no need (or, rather, that it is wrong) to incorporate 'Knightean' uncertainty (Knight, 1921, pp. 19 - 20). If such uncertainty is absent, one can describe the economy in terms of probability distributions. Lucas's rational (correct) expectations are the mathematical means of these distributions. Hayek on the other hand allows for uncertainty. Then

human knowledge and expectations are unpredictable. The 'outside observer' cannot determine whether an individual's expectations are correct. This may only become clear after the individual has acted.

By assuming an objective reality Hayek does not account for the fact that the objective reality depends on the subjective perceptions and, therefore, on the subjective data. If the coordination problem exists, individuals will change their actions. This will change the objective reality, which hampers the movement of the subjective data in the direction of the objective data. Lucas circumvents this problem by adopting a 'representative-agent' model. In such a model coordination problems cannot arise because of the fact that there is only one individual (or because all individuals are identical). Lucas also presupposes an objective reality which is independent of the perceptions of the individuals. This enables him to interpret the problem which individuals are facing as an optimizing game against nature instead of a game between optimizing players. By adhering to the strong form of the REH (that is by assuming correct expectations), this game is played optimally in the sense that individuals do not make systematic expectational errors. However, cyclical phenomena must be explained either by systematic errors or by propagation mechanisms. Lucas chooses the latter. Unfortunately, he does not incorporate them into his formal analysis (although in principle such incorporation does seem feasible).

The emphasis on the coordination of individual plans, and the subsequent desaggregated analysis, enables Hayek to pay attention to the nonneutrality of credit expansion and to the resulting distortions in the structure of production. Lucas, on the other hand, uses a highly aggregated form of analysis, which makes it inevitable for him to concentrate on the magnitude of the aggregated variables. In other words, Hayek is able to study distributional effects, whereas Lucas must confine his analysis to the magnitude of the aggregates in his model. This may best be illustrated by saying that Hayek's business cycle theory is a monetary malinvestment theory whereas that of Lucas is a monetary overinvestment theory.

The final difference which may be derived from the above analysis is that Hayek and Lucas differ in their choice of transmission mechanism. Whereas Hayek considers the rate of interest to play a fundamental role during the cycle, Lucas (1977, p. 237 note 15) rejects this transmission mechanism on empirical grounds.

5. The differences explained

The differences stated above can be explained by reference to the goals Hayek and Lucas respectively ascribe to economics as a science. Hayek (1964, pp. 91 - 92) stated that "... the task of economic theory was to explain how an overall order of economic activity was achieved which utilizes a large amount of knowledge which was not concentrated in any one mind but existed as

the separate knowledge of thousand or millions of different individuals." Such explanation involves two elements, as Lachmann (1973, p. 204) has shown. Firstly, economic activity must be interpreted in terms of individual plans which are goal-directed. This methodological individualist position is one of the main tenets of 'Austrianism'. In the Hayekian view, economics must make the world around us intelligible in terms of human action and individual plans on which these actions are based. These plans may be fulfilled, leading to intended and expected consequences of the actions. But they may also fail, which means that the results are unexpected. One of the main reasons Hayek discerns for this unexpectedness is the fact that individuals do not possess perfect knowledge and perfect foresight. More specifically, they are faced with 'Knightean' uncertainty. They will make expectational errors. However, this does not imply that individuals do not act rationally. Given their knowledge, individuals will always act to the best of their abilities. In this sense human action is always rational. In contrast, the economy as a whole need not perform (Pareto-)optimally, because individual plans may not be interpersonally consistent. In other words, the coordination problem may prohibit the simultaneous achievement of individual and general equilibrium. It is this problem which forms the focus of Hayek's analysis. As he indicated in his 1937-article, the empirical content of economics is constituted by propositions concerning the learning process of individuals (Hayek (1937, p. 33)). In other words, the question is whether a tendency towards general equilibrium exists. It means that Hayek tries to establish whether there is a tendency towards the solution of the coordination problem.
In contrast, Lucas's analysis does not allow for a multitude of individuals and their plans. His representative-individual models are not designed for the purpose Hayek ascribed to economic theory. Instead, Lucas (1981, p. 271; 1988, p. 35) holds that economists as 'technicians' must develop models which aim at correct predictions in order to be useful for policy prescriptions.
Therefore, Lucas's models aim for descriptive simplicity and not for descriptive completeness. Their aim is to predict as correctly as possible. In this sense Lucas may be called an instrumentalist à la Friedman. The simplicity is achieved by introducing 'representative individuals'. However, this introduction limits the problems to be analyzed; it does not allow for the analysis of the coordination problem because 'representative-individuals' models cannot differentiate between optimality for the individual and for the economy as a whole.

The differences between Hayek's economic analysis and that of Lucas may now be explained in terms of the different goals both economists pursue. Firstly, Hayek cannot assume that general equilibrium is already attained because this would beg his question if and how such equilibrium would come about (that is, if and how the coordination problem will be solved). Lucas, on the other hand, is not interested in the coordination problem. Therefore, he can assume it away by introducing the 'representative-individual' concept as a modelling device. This device circumvents the 'Cournot problem', thereby allowing for predictions.
Secondly, Hayek tries to explain why there should be a tendency towards general equilibrium when agents have imperfect knowledge and imperfect foresight. He is not interested in

predicting individual actions. Because of this he may incorporate 'Knightean' uncertainty (as this type of uncertainty implies the unknowability of the future). By contrast, Lucas tries to construct models in order to predict. Descriptive completeness and 'realism' are then not needed; all Lucas must do (and does) is to construct models which are as simple as possible and which predict as accurately as possible. Therefore, Lucas's assumptions with regard to the expectations formation process and the coordination problem seem consistent with the goal he tries to achieve. The strong form of the REH and the absence of the coordination problem both amount to a simplification of the analysis. They imply that individuals know the correct structure of the economy, thereby allowing for predictions because 'Knightean' uncertainty is eliminated.

Thirdly, the emphasis on the coordination problem implies that Hayek must analyze the structure of the economy. It is not sufficient to concentrate on aggregates and index numbers, because they disguise whether plans are not coordinated. This leads Hayek to adopt a monetary malinvestment theory of the business cycle. As was already discussed, Lucas simplifies his analysis by introducing 'representative individuals'. This prohibits the analysis of the structure of production. Therefore, Lucas's business cycle theory may best be labelled a monetary overinvestment theory.

Finally, while Hayek accepted the real rate of interest as the transmission mechanism during business cycles, Lucas rejected it. This rejection was founded on empirical grounds. This makes it impossible as well as unnecessary to explain this difference by referring to differences with regard to the goals both authors try to achieve.

6. Conclusion

Butos (1986) concluded that Lucas's claim on the continuation of Hayek's work on business cycle theory is correct though misleading. This conclusion seems to be justified with regard to such issues as the nature of uncertainty and the role played by the knowledge of individuals. Furthermore, Lucas neglects the differences regarding the problem both authors analyze: the coordination problem versus the 'pure logic of choice'. This difference enabled Hayek to concentrate on the distortion of the structure of production, whereas Lucas limits his analysis to the magnitude of aggregated variables. As Butos (1988, p. 337) argues, "... new-classical economists limit their conceptualization by the techniques available, while for Hayek the conceptualization of a problem points to the limitations of the available techniques." Unfortunately, Butos does not indicate why this is so. The analysis in this paper has tried to remedy this gap by studying the goals both authors think economics must try to achieve. Hayek's attention to the coordination problem was seen to follow from his view on the purpose of economics as a science. In his view economics had to explain reality in terms of individual plans. Moreover, it had to indicate whether there is a tendency towards the solution of the coordination problem. This problem implies a multitude of interpersonally inconsistent plans, which cannot be known by the scientist. This rendered prediction of individual behaviour impossible. By contrast, Lucas

is interested in predicting human behaviour, or rather economic activity. Therefore, he must simplify his analysis in order to circumvent the 'Cournot problem'. Furthermore, it allowed him to assume the coordination problem solved by introducing the 'representative-individual' concept as a modelling device.

In conclusion, Lucas cannot be said to elaborate on Hayek's work because both economists try to reach different goals. Whereas Hayek wanted to explain reality in terms of a multitude of individual plans which would presumably be interpersonally inconsistent, Lucas aims at predicting 'representative-individual' behaviour. This difference leads to the analytical differences discussed.

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