Serie Research Memoranda

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Research Memorandum 1990-58
November 1990
NEW CLASSICAL MONETARY BUSINESS CYCLE THEORY

by Rudy van Zijp

1. INTRODUCTION

In the last two decades business cycle theory has been experiencing a remarkable survival. Whereas it seemed as if it had disappeared from the economists' research agenda in the 1960s, it reemerged when New Classical Economics came up with a new explanation of the phenomena under consideration. Although their views on monetary policy evoked much criticism, since the second half of the 1970s New Classicism has nevertheless assumed a prominent place in the profession.

The purpose of this paper is to outline New Classical business cycle theory and to analyze its concepts and assumptions. The analysis will be limited to the monetary version of the theory. As New Classicism builds on some aspects of Monetarism, it is obvious that our analysis will start with the latter. Nevertheless, New Classicism did not copy the Monetarist concepts without some modifications. In particular, it specified a different (outcome of the) expectations formation process. This turned out to have some far-reaching implications for the information sets of individuals. It also had drastic implications for the feasibility of monetary policy.

The paper is organized as follows. Section 2 expounds some hypotheses used by the Monetarists. These provide a link with New Classical Economics. In section 3 the basic assumptions of the latter are described. It turns out that the assumptions concerning the information individuals are presumed to have play a crucial role. Therefore, section 4 addresses the issue of these so-called 'information sets'. It also comprises the New Classical method of solving the problem how to model decentralized market economies, emphasizing the New Classical equilibrium concept, the Rational Expectations Equilibrium (REE). The solution to the problem will prove to be in contradiction with the New Classical tenet of methodological individualism. Furthermore, the informational assumptions play a crucial role in their theory of business cycles. The monetary version of this theory will be analyzed in section 5.

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2. MONETARIST ROOTS: THE PHILLIPS CURVE AND THE NATURAL RATE HYPOTHESIS

2.1. INTRODUCTION

Considering its Monetarist roots, it seems appropriate to start any analysis of New Classicism with a study of Monetarism, and in particular with the Monetarist equilibrium concept. Furthermore, as the Monetarists stressed the importance of individuals' expectations formation processes, some attention must be devoted to this issue.

Monetarism builds on the work of M. Friedman, E.S. Phelps, K. Brunner, A.H. Meltzer, L.C. Andersen and J.L. Jordan. In particular Friedman and Phelps played a major role in what now may be called the 'retreat' of Keynesianism during the 1970s and 1980s. By incorporating the Phillips Curve in their analysis they robbed Keynesianism of its justification for stabilisation policy. They argued that Phillips' tradeoff between unemployment and inflation was merely a temporary one, as in their view the Phillips Curve was a short-run phenomenon, subordinated to the long-run 'Natural Rate'-equilibrium.

This section will concentrate on certain features of Monetarist analysis. These are (1) the treatment of the Phillips Curve as a short-run curve, and of the Natural Rate Hypothesis as implying a vertical long-run Phillips Curve; and (2) the incorporation of the Adaptive Expectations Hypothesis. Both issues will be addressed in this order.

2.2. THE PHILLIPS CURVE

In 1958 A.W. Phillips hypothesized that the tighter the labour market, the more rapidly employers had to increase nominal wages in order to attract new employees and retain the ones they already employed. This led him to study "... the hypothesis that the rate of change of money wage rates in the United Kingdom can be explained by the level of unemployment and the rate of change of unemployment ..." (Phillips (1958, p. 284)). As he presupposed the existence of downward wage rigidity, Phillips (1958, p. 283) assumed a nonlinear relationship between the variables mentioned. He discovered that his empirical data supported the hypothesis and that the (hyperbolical) relationship was remarkably stable over the period analyzed. The relationship was later called the Phillips curve.² It represents stable (constant) combinations of

² The Phillips curve may be represented mathematically as:
\[ dW = W(dU, U), \quad d(dW)/dU > 0, \quad d(dW)/d(dU) < 0, \]
with \[ dW = \text{change in nominal wage rate}, \]
\[ U = \text{unemployment rate}, \]
\[ dU = \text{change in unemployment rate}. \]
the rate of unemployment and the change in nominal wage rate.\textsuperscript{3}

Unfortunately (according to at least some economists) the Phillips curve seemed to lack a theoretical foundation. It was regarded as merely reflecting an empirical relationship, for which no theory was designed as yet. Moreover, it suggested that the level of employment depended on the rate of change in the nominal wage rate. This implies money illusion on the part of the economic agents, which does not accord with the neoclassical rationality postulate.

Despite Phillips' averaging out all cyclical influences, Samuelson and Solow (1960) interpreted the Phillips curve as a short-run relationship.\textsuperscript{4} Moreover, they substituted the rate of change in the nominal wage rate by the rate of change in prices, implying that prices and nominal wages are very closely connected (p. 192). However, they explicitly warned that "[i]t would be wrong, though, to think that our Figure 2 menu [cf. p. 192] that relates obtainable price and unemployment behavior will maintain its shape in the longer run. What we do in a policy way during the next few years might cause it to shift in a definite way" (p. 193). They even mentioned the possibility of moving the Phillips curve to the left by institutional reforms. It seems that Samuelson's and Solow's warning was forgotten when theirs became the standard interpretation of the Phillips curve. This interpretation holds that an exploitable tradeoff between the rate of inflation and the rate of unemployment exists. Governments are faced with "... a menu of choices" (Hoover (1988, p. 24)).\textsuperscript{5} According to this view policymakers are able to set a combination of inflation and unemployment which they regard as desirable. It was thought that this could be done without any repercussions in the longer run. This led to the incorporation of the Phillips curve into macroeconometric models during the 1960s and 1970s. The curve was widely used in the analysis of government macroeconomic policy (Hoover (1988, p. 24)). However, by the end of the 1960s serious doubts were raised against its usefulness for these tasks.

\textsuperscript{3} According to Desai (1975, p. 2, italics in original) "... much of the work done since Phillips' paper has been based on a misunderstanding of the original relationship." He regards the Phillips curve as a long-run relationship between the level of the unemployment rate and the change in nominal wage rates. In his view, the distinction between a short-run and a long-run curve is quite "unnecessary and erroneous".

\textsuperscript{4} Samuelson's and Solow's (1960, p. 193) analysis "... has been phrased in short-run terms, dealing with what will happen in the next few years."

\textsuperscript{5} Hoover (1988) seems to imply that the Samuelson-Solow interpretation of the Phillips curve became the standard interpretation. However, as their warning with regard to the policy to be conducted shows, both economists were aware of the possibility of a shifting curve, thereby implying that the curve is policy-dependent. It seems more correct to conclude that the standard interpretation, as sketched by Hoover, is a rather simplistic version of the Samuelson-Solow interpretation.
2.3. FRIEDMAN'S BENCHMARK: THE NATURAL RATE HYPOTHESIS

In his presidential address to the American Economic Association Milton Friedman (1968) opined that the tradeoff was not exploitable in the long run. He argued that rational individuals do not suffer from money illusion. They will take the price level and the rate of inflation into account when negotiating future wages, and base their actions upon the real wage rate. In Friedman's (1968, p. 8, italics in original) opinion Phillips' analysis "... contains a basic defect - the failure to distinguish between nominal wages and real wages ...". Friedman raised another criticism against Phillips' analysis. He accused him (implicitly) of confusing the rate of unemployment with the changes in this rate. According to Hoover (1988, pp. 24 - 25, italics in original), Friedman argued that "... 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 changes in the wage rate and the rate of unemployment." Analogous to Wicksell's 'natural' rate of interest, Friedman calls this long-run relationship the natural rate of unemployment (NRU). The NRU reflects the equilibrium rate of unemployment to which a stable economy tends, once disruptive influences are removed (Hoover (1988, p. 25)). In this situation no tradeoff exists between the rate of unemployment and the change in nominal wage rate. The long-run Phillips curve is then a

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6 As Hoover argues, Friedman should not have directed his criticisms at Phillips' analysis, but rather at the standard interpretation of the Phillips curve, i.e., the simplified version of Samuelson and Solow's interpretation of the curve. Cf. Hoover (1988, p. 260, note 6).

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

8 It should be noted that Friedman's analogy does not apply completely. After all, whereas the NRU may be seen as the long run (general) equilibrium level of unemployment, Wicksell's 'natural' rate of interest refers merely to monetary equilibrium. Both equilibria need not coincide: monetary equilibrium does not imply general equilibrium. (I owe this point to Mr. Botha from the Centre of Economic Analysis in Pretoria, South Africa).

9 Friedman (1968, p. 8) defines the natural rate of unemployment as "... the level that would be grounded 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." In other words, the NRU gives the level of frictional unemployment in a perfect-competitive market. It is not a fixed level. As Phelps (1968, p. 678a) casually remarks in a footnote, "[a] monetary economy can choose among different levels of frictional unemployment that corresponds to different levels of aggregate demand and job vacancies. In fact, therefore, there is no unique full-employment quantity of frictional unemployment." Unfortunately, Phelps does not elaborate on this, so it remains unclear how he thought this choice can be made. The fact that the NRU need not be a stable rate of unemployment may also be analyzed in terms of hysteresis. Hysteresis is the situation in which the equilibrium value of a variable depends on its value in the past. For instance, a random shock may cause mass unemployment. In turn, this unemployment may lead to a rise in the natural rate of unemployment because (employers think that) the human capital of the unemployed in the form skills and motivation deteriorates. For a detailed treatment of hysteresis, see Cross (ed.) (1988).
vertical line at the equilibrium (or NRU) level. This implies that monetary policy in the long run merely raises the rate of inflation but does not lower the rate of unemployment. This leads Friedman (1968, p. 13) to conclude that such policy should be limited to providing a stable background for the economy. And this objective is best achieved by a steady rate of growth of the money supply (Friedman (1968, p. 16)). The hypothesis concerning the (long-run) attainment of a situation in which a natural rate of unemployment prevails is called the Natural Rate Hypothesis (NRH).

2.4. THE ADAPTIVE EXPECTATIONS HYPOTHESIS

Friedman substituted the nominal wage rate by the real wage rate, because in his view individuals take account of the rate of inflation in forming their expectations about their future wage rate. This means that Friedman should have incorporated an expectations formation process into the Phillips curve. However, this incorporation is due mainly to the work of Phelps (1967), leading to the so-called expectations-augmented Phillips curve. Phelps' conclusions were rather similar to those of Friedman, although the emphases of their arguments differ considerably. Whereas Friedman stressed the macroeconomic concept of the NRU, Phelps tried to establish the microeconomics of labour markets. He studied the problem how these markets operate when information is incomplete and costly.

Individuals do not suffer from money illusion in the case of the NRU. Given perfect information, this means that they correctly distinguish nominal from real shocks. A necessary condition for such correct interpretation of shocks is that individuals must possess complete information. Thus, a defining characteristic of Friedman's NRU is the complete information set of the individuals. As both Friedman and Phelps assumed that information is complete in the long run, the NRU is attained only in the long run. Put another way, the NRU can best be seen as a benchmark, a standard against which the actual performance of an economy can be judged. In contrast, the short-run analysis reveals a quite different picture because then it cannot be maintained that individuals base their expectations and decisions on full information. The analytical problem then is how to model their expectations formation process and the incomplete information used in it. Phelps (1967) solved this problem by assuming that each

10 Hoover (1988, p. 25) states that "[I]f the Phillips curve were plotted with the rate of change of nominal wages on the vertical axes and the rate of unemployment on the horizontal axis, then economic theory demands ... that it be a vertical line at the equilibrium or natural rate of unemployment" (italics in original).

11 Phelps (1968 (1970), p. 124 - 25) argues that "... any actual economy is almost continuously out of equilibrium, so we need also to study wage and price dynamics under arbitrary conditions." He continues by claiming that "[t]he Phillips curve studies of the past decade have done this ..." Thus, the Phillips curve is seen as a disequilibrium phenomenon, while Phillips himself presumably would have argued that it represents long-run stable combinations of the nominal wage rate change and the unemployment rate.
individual lives on an 'island', about which he possesses all current information. He assumed that
information about the 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 but
which contains only lagged (and therefore incomplete) global information. The absence of money
illusion implies that the individuals form expectations about real variables. In this 'island' parable
individuals must do so with incomplete short-run global information. In the case of a change in
their local nominal wages they are faced with an interpretation problem, namely whether this
change should be attributed to a change in their real wage or to a change in the general price
level. The incomplete information on which their expectations are based, will lead some (or
many) individuals to form incorrect estimates of the rate of inflation. This means that they will
respond to nominal changes as if they were real in nature. It may seem that they suffer from
money illusion, whereas in fact they merely interpret the change in nominal wage wrongly
because of insufficient information. This insufficiency then explains the relationship between the
level of unemployment and changes in the nominal wage rate, that is, the negatively sloped
Phillips curve.

Phelps used a rather specific expectations formation process, namely the Adaptive
Expectations Hypothesis (AEH) as used by Koyk (1954) and Cagan (1956). This hypothesis
states that expectations are weighted averages of the past values of the variable in question. These
are known and observable, which is of course quite an advantage for a hypothesis on
expectations formation. However, some problems remain. Firstly, the AEH does not explain
the magnitude of the adjustment parameter \( \alpha \) by an economic theory. It implies that higher
inflation is only gradually fed into the past data which is used in forming expectations. This
means that the AEH allows for systematic expectational errors, which economic agents would
fairly easily correct. It may, therefore, not be consistent with the rationality postulate. Secondly,

Mathematically this may be expressed as (Begg, 1982, p. 23):

\[
\text{Ex}(t) - \text{Ex}(t-1) = \alpha \left[ x(t-1) - \text{Ex}(t-1) \right]
\]

with \( x(t) \) = the value of variable \( x \) at time \( t \),
\( \text{Ex}(t) \) = the individual's expectation of variable \( x(t) \) formed at time \( t-1 \), and
\( 0 < \alpha < 1 \).

Individuals revise their expectation of \( x \) at time \( t \) by some fraction of the forecast error of their
expectation of \( x \) at time \( t-1 \). The same expression must hold during the previous periods. By
recursively substituting the unobservable left hand side by the observable right hand side of the
equation, the expectation \( \text{Ex}(t) \) might be written as

\[
\text{Ex}(t) = \alpha x(t-1) + \alpha(1-\alpha)x(t-2) + \alpha(1-\alpha)^2x(t-3) + ... + \alpha(1-\alpha)^{n}x(t-n-1) + (1-\alpha)^{n+1}\text{Ex}(t-n-1)
\]

When time increases, the latter term approaches to zero because \( 0 < \alpha < 1 \). \( \text{Ex}(t) \) is then
constituted by observable terms and is therefore itself observable; cf. Begg (1982, p. 23).

The problems mentioned here have been discussed more extensively by Begg (1982, p. 25
- 26) and Pesaran (1989, pp. 17 - 19).

Frank Hahn (1986, p. 281) has pointed out that the fact that "... an agent will not persist
in expectations which are systematically disappointed ..." does not lead logically validly to the
conclusion that "... agents have expectations which are not systematically disappointed ..."
the AEH is entirely backward-looking. Expectations are formed by using only the past values of the variable under consideration. However, it is highly implausible and presumably not even rational that other information is excluded.\textsuperscript{15}

In order to overcome these problems theorists have sought a substitute, which they found in Muth’s (1961) 'Rational Expectations Hypothesis' (REH). This hypothesis played a significant part in the emergence of the New Classical Economics.

3. NEW CLASSICAL ECONOMICS: BASIC ASSUMPTIONS

3.1. INTRODUCTION

In the 1970s a new school of thought appeared in the economic profession, the New Classical Economics (NCE). This school centered around economists like Robert E. Lucas, Thomas J. Sargent, Robert J. Barro, Neil Wallace, Finn E. Kydland and Edward C. Prescott.\textsuperscript{16} It holds that every individual is a successful and consistent optimizer, given his information set. In this sense the individuals are assumed to be always in equilibrium. This implies that they do not suffer from money illusion. Only real factors will influence their real economic decisions (Hoover (1988, pp. 13 - 14)). It is in this sense that New Classicism is 'classical'.

The NCE faced severe criticism. Obviously, the assumption concerning man’s rationality could not have raised the various objections against NCE, as 'mainstream economics' is based upon the same fundamental postulate. There must be some other properties which are controversial. The basic New Classical assumptions are:

1) the assumption of continuous market clearing;
2) the Lucas supply function;
3) some version of the Rational Expectations Hypothesis;
4) some version of the NRH; and
5) some assumption about the information set of the individuals.\textsuperscript{17}

These assumptions are not newly introduced by the NCE (with the exception of the Lucas supply function). It is rather their combination which constitutes the 'new' element in New Classicism. As the NRH was already discussed in the previous section, we shall restrict our analysis to the other four assumptions.

\textsuperscript{15} Pesaran (1989, Ch. 9) extends the AEH by taking account of information on other variables than the one to be predicted.


\textsuperscript{17} Cf. Barro (1981), p. 41.
3.2. CONTINUOUS MARKET CLEARING

One of the defining characteristics of the Rational Expectations Equilibrium (REE) is the assumption that markets continuously clear. Nominal wages and prices are perfectly flexible, equating demand and supply instantaneously. New Classical analysis thus leaves no room for involuntary unemployment. This may seem to contradict factual evidence. As (New-)Keynesians argue, nominal wages and prices are not perfectly flexible. Rather, they exhibit downward rigidity. Therefore they argue that one should assume such rigidity in order to make models more realistic. For instance Okun (1981, Chapter 4) has shown that, without full information, it may be rational not to let markets clear, by distinguishing between auction markets and search or customer markets. The former exhibit continuous market clearing, while the latter are characterized by rigid prices. This rigidity is explained by an implicit contract between buyer and seller. It states that the buyer remains true to his seller and that he is rewarded for his loyalty by prices that are kept relatively stable. Another (New-)Keynesian explanation of nominal wage rigidities refers to incomplete information. Greenwald and Stiglitz (1987, pp. 123 - 25) refer to the incomplete information that employers have with regard to prospective employees, together with the costs of hiring and training new personnel. It may then be advantageous to pay relatively high efficiency wages as payment for the relatively higher labour productivity of the existing labour force, even if outsiders are willing to work at a lower wage. Hahn (1980, p. 288) had already pointed out that employees may also contribute to nominal wage rigidities because searching for other jobs may be costly. New Classicals oppose these explanations vehemently. Lucas and Sargent (1978, p. 305) argue 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." Lucas (1988, pp. 93 - 95, italics in original) argues that "[t]he idea that the theory of contracts will provide a new rationale for nominal price rigidities ... 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." In his 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." This difference in research methods between New Classicals and (New-)Keynesians does not seem to have any theoretical reasons. Instead, "[c]leared markets is simply a principle, not verifiable by direct observation, which may or may not be useful in constructing successful hypotheses about the behavior of these [time] series [of employment and wage rates]" (Lucas and Sargent (1978, p. 311)). All this means that New Classicals argue that it is impossible to ascertain by mere observation whether markets clear or not. Nevertheless, one must make a decision on this issue.
if one wants to build mathematical models. This decision is a methodological one. And New Classicals decide in favour of continuously market clearing prices: actual market price behaviour is interpreted as clearing markets continuously. It is a methodological principle, not obtainable from mere observation.

New Classicals not only assume that all markets clear continuously, but they also claim that the individuals observe all current equilibrium prices. This has some important implications for the information the individuals are assumed to have. After all, if all individuals observe current equilibrium prices, they can infer the current non-price information on the markets in question. Such non-price information will concern the market participants’ expectations with regard to future prices, etc. In this case information is homogenous across the individuals in a given market: all individuals observe the current equilibrium price and thus obtain all non-price information which exists on that market. Individuals may (though need not) obtain all such information by merely observing current equilibrium prices. In other words, there is a (potential) informational feedback of these prices. A general equilibrium which takes account of this potential informational feedback from market prices is called a Rational Expectations Equilibrium (REE). By contrast, such a feedback does not exist in an equilibrium in which individuals do not observe current equilibrium prices, or in which the prices observed are disequilibrium prices. In this case information is not homogenous, so that the feedback from prices is not (potential).

In section 4 we shall discuss the Rational Expectations Equilibrium concept more in detail.

3.3. THE LUCAS SUPPLY FUNCTION

As was shown in section 2.3, the Natural Rate Hypothesis holds that there is a level of supply and employment 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 (‘chance hits’ excluded). In this sense one may distinguish a benchmark-economy in which all variables are at their respective natural rates. This economy will emerge when all individuals have perfect knowledge and perfect foresight. This 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. For brevity’s sake we shall call this benchmark the Natural Rate Equilibrium (NRE). The NRE is thus a REE in which individuals have perfect knowledge and perfect foresight.

The NRE seems to be contradicted by the Phillips curve. Not surprisingly, it does not exist in reality because the individuals do not have perfect knowledge and perfect foresight. Therefore, the NCE must incorporate one or more features which render the explanation of the Phillips curve possible. It found this explanation in the difference between expected and actual

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prices (or rates of return). Informational errors cause divergences from the 'natural rate'. This may be shown mathematically by what is called the 'Lucas supply function':

\[(0.1) \quad y = z + \alpha (1 - \beta) (p^e - p^a)\]

in which

- \(y\) = actual aggregated level of real output;
- \(z\) = 'natural rate' of output;
- \(p^a\) = actual general price level;
- \(p^e\) = expected general price level;
- \(\alpha\) = parameter which indicates the extent to which a deviation of the expected general price level from the actual general price level influences the actual level of aggregated output;
- \(\beta\) = parameter which indicates that the higher the volatility of changes in the actual general price level, the lower output deviates from its natural rate.

The Lucas supply function says that the real value of aggregated output depends on the natural rate of output and on the difference between actual and expected prices (Sargent (1973, pp. 442 - 44)). In other words, it states that the NRE is attained if individuals do not make expectational errors (that is, if \(p^e = p^a\)). The deviation of output from its natural rate will be smaller if changes in the actual price level are higher (if \(\beta\) 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 actual price level on their local market to a change in the economy-wide price level. Obviously, the expectations formation process will play a large role in this regard.

3.4. THE RATIONAL EXPECTATIONS HYPOTHESIS

Presumably the most important characteristic of New Classical analysis is the incorporation of Muth's (1961) Rational Expectations Hypothesis (REH). Muth (1961, p. 315) had advanced the hypothesis that expectations are essentially the same as the predictions of the relevant economic theory. Or, as he formulated more exactly, "... expectations of firms (or, more generally, the

\[\text{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).}

\[\text{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 exists a linear relationship between the measure of aggregated output and the unemployment rate.}
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)). He argued that if economic theorists could predict better than the economic agents, they must have superior foreknowledge of the predicted outcome. But if they have, would not some entrepreneur study economics in order to sell his better predictions? After all, it would be rational for optimizing agents to use economic theory if this could lead to (higher) profits. By linking economic theory and economic practice, Muth took a modest stand for economists with regard to the predictive powers of their theories. However, if one wants (as Muth did) to obtain any definite results (predictions), one must specify a ‘correct’ model of the economy. Furthermore, one must make assumptions with regard to the content of the agents’ predictions. Therefore, Muth (1961, p. 317) used (“for purposes of analysis . . .”) a ‘specific form’ of the REH in a partial-equilibrium analysis, in which he assumed that the random disturbances are normally distributed. New Classicals also use this specific form of the REH, although they transpose it to a general-equilibrium context. Obviously, this has some important implication with regard to the individuals’ information sets. In a partial-equilibrium analysis the hypothesis merely means that (in the aggregate) individuals know their local market. By contrast, in a general equilibrium framework it implies that the individuals know the economy as a whole. Whereas the former implication is rather plausible the latter is not, because nobody can reasonably claim to know the correct structure of the economy as a whole. We shall return to this point when discussing the informational assumptions.

Unfortunately the general formulation of the REH 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 into three versions, namely 1) the descriptive, 2) the micro-instrumentalist, and 3) the macro-instrumentalist REH. Each of these versions implies some assumption with regard to the individuals’ information set. This set consists of knowledge concerning (i) the ‘true’ structure of the (model) economy, (ii) the ‘true’ values of the parameters in that economy, (iii) the values of the relevant variables, and (iv) all exogenous shocks which the economy will undergo during the period under consideration. The question to be answered in this section is what knowledge the various versions of the REH imply. (1) The descriptive version of the strong REH assumes that in reality individuals use all potentially relevant information concerning the structure of the economy, as well as the past and

21 In McCloskey’s (1985, p. 88) words, “[t]he claim to know how economic actors predict is a claim to superior foreknowledge of the predicted outcome. It runs up against the American Question, which is always . . . an objection to claims of foreknowledge: If you’re so smart, why ain’t you rich?”

22 The taxonomy used here is that of Snippe (1986-87), which is compatible with Fischer’s (1980).
current data.\textsuperscript{23} It argues that this information is used in such a way that all expectations are in fact correct. In this sense it is an assumption about the individual's expectations formation process and its outcome. It holds that the individuals possess perfect knowledge with regard to the components of the information set given above. However, this will only be rational if information is costless.

(2) The micro-instrumentalist version of the strong form of the REH holds that each individual acts \textit{as if} he has formed correct expectations. It does not say anything about the way in which these expectations are formed; it is merely an assumption on the outcome of the individual's expectations formation process, not on the process itself.\textsuperscript{24} It does not make statements about the individuals' information set.

(3) The macro-instrumentalist version holds that individual expectations (taken separately) may be incorrect, but \textit{in the aggregate} they are correct. In this version expectational errors cancel out, presumably due to the 'Law of Large Numbers'. This means that it does not say anything about the formation process (and its outcome) of a particular individual's expectations. Therefore the macro-instrumentalist version is neither an assumption about this process nor about its outcome. Additionally, it does not say anything about the information used by individuals in the expectations formation process. As Muth (1961, p. 316 - 17) allowed individuals to be subject to greater error than the model, implying that their expectational errors would cancel out, his version of the REH may best be represented as macro-instrumentalist.

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 different equilibria. Their analysis will be discussed in subsection 4.4.1.

(4) 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. However, the optimal information need not be sufficient to allow for correct (i.e., rational) expectations. Therefore it is perfectly consistent with a situation in which information is \textit{not} costless. At the same time, however, it cannot be determined what information is optimal to gather and process, and what information is not. Any informational assumption which is combined with the weak form of the REH does not follow from the rationality postulate and in that sense is \textit{ad hoc}. Furthermore, the weak form even suffers from an indeterminacy, in the sense that it is impossible to determine the optimal amount of information to be gathered. Information optimization presupposes expectations about the marginal return and cost of the information. On the other hand, expectations (being informed predictions) presuppose information. In other


\textsuperscript{24} Snippe (1986-87, p. 430). It is hardly conceivable that the outcome of the individual's expectations formation process will be correct if it is based on incorrect information. Therefore, it seems inevitable to infer that the micro-instrumentalist version implies the same information set as does the descriptive version, although the former does not intend to make such claims about the process.
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. In fact, 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 infinite regress, leaving the optimality of the information gathered by the individuals unexplained and therefore undetermined.

The REH is not only important because it allows New Classicals to predict, but it also has a fundamental implication for econometric policy evaluation. Lucas (1976) argued that if individuals consider information relevant, they will use it in their expectations formation process. This also applies to information concerning the government’s policies. It means that they will change their expectations and their actions if the government changes its policies. Model simulations in order to determine the effects of such a change in policy should take the individuals’ reactions into account. In other words, one cannot use models for policy evaluation which disregard this change in the individuals' actions. This criticism on policy evaluation is called the Lucas critique.

3.5. CONCLUDING REMARKS

The basic New Classical assumptions stress man's rationality, not only as regards his actions but also as regards his formation of expectations. Unfortunately expectations cannot be observed, neither can the information upon which they are based. Ideally, one would want to express them in terms of observable variables. At the same time, one must specify an expectations formation process. As was shown, New Classicals use such a process, namely the REH. However, in order to determine which form or version they have used, we must look at the informational assumptions used in New Classical analysis. And this analysis starts in the Rational Expectations Equilibrium.

4. THE RATIONAL EXPECTATIONS EQUILIBRIUM

4.1. INTRODUCTION

In the New Classical benchmark-world individuals have perfect knowledge and perfect foresight. This means that the economy will always be in its Natural Rate Equilibrium. The individuals then do not make expectational errors and all plans will come true. Obviously this is not a very realistic situation. Moreover, it does not allow for an explanation of such phenomena as business cycles. In order to render such an explanation possible New Classicals must specify which assumptions underlying the NRE are not fulfilled. In actual fact, they relax the assumption of
perfect knowledge and perfect foresight. However, such a relaxation does not suffice. The individuals' information set includes information on (1) the structure of the true model, (2) the parameters of that model, and (3) the past and/or current values of the relevant variables. The question is which part of the information set the New Classicals assume incomplete.

New Classical analysis is a general equilibrium analysis in the sense that in principle all markets clear. Taking account of the potential informational feedback from market (equilibrium) prices leads us to the concept of the Rational Expectations Equilibrium (REE). Despite its description in section 3.2, it remains a rather vague concept, as its content depends very much on its informational assumptions. Lucas (1988) has provided a description of the concept in game-theoretic terms, which will be considered in section 4.2. However, this explanation does not suffice as New Classical business cycle theorists do not engage in game-theoretical analysis. We must take a closer look at the way in which incomplete information is built into New Classical models. Incomplete information implies uncertainty, but that notion is rather ambiguous. Therefore a study of several types of 'uncertainty' is made in section 4.3. Some of these types are neglected by New Classicals, which will prove to have some consequences for New Classical analysis (section 4.4). Finally, the New Classical way of incorporating the assumptions of incomplete information in their models is given (section 4.5).

4.2. A GAME-THEORETICAL APPROXIMATION OF THE REE

In the REE expectations need not be identical to actual outcomes, because individuals do not possess complete information. As a matter of fact, the equilibrium concept even allows for sharp fluctuations in the individuals' actions and for large differences between expectations and outcomes. This has resulted in some confusion as to what is equilibrated in the REE. It seems to be a rather vague concept.

Lucas (1988, pp. 15 - 16) has tried to make the concept of the REE intelligible by presenting it in game-theoretic terms. He defined it 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." However, Lucas's attempt to provide his macroeconomics with a game-theoretic microfoundation does not suffice, because he does not explicate the information the individuals are presumed to have. As Kreps (1989, p. 174) has argued, "[i]n a Nash equilibrium, it is (essentially)
presumed that players are all aware of the strategies their opponents are selecting.\textsuperscript{25} This is necessary because otherwise individuals would be unable to choose their optimal strategy in the light of the actions of the other individuals. In addition Kreps (1989, p. 176, my italics) argues that "[i]n a Nash equilibrium, the players are presumed to select their strategies \textit{independently} of one another." This independency of individual choices is needed in order to avoid infinite regresses in strategic deliberations.\textsuperscript{26} Furthermore, individuals will only engage in transactions if they think that their goals may be achieved. This means that (given their knowledge about their opponents' actions and goals) the individuals' choices must be mutually consistent, in the sense that all goals can be attained simultaneously. In other words, all goals attained are 'interpersonally consistent'. This raises some questions, which will be addressed later.

As the other New Classicals do not engage in game-theoretic analyses, Lucas's exposition does not seem to shed any light on New Classical practice. It does not seem to give a correct account of the microeconomic framework they use in modelling economies. What is needed is a description of the New Classical modelling strategies.

However, first we must deal with another problem. Imperfect knowledge and imperfect foresight imply uncertainty. Unfortunately, the concept of 'uncertainty' is ambiguous. It is, therefore, necessary to look at some types of uncertainty before describing 'how New Classicals really model'.

### 4.3. IMPERFECT KNOWLEDGE AND IMPERFECT FORESIGHT

In the literature on uncertainty, one may distinguish several approaches to the concept. We shall restrict our analysis to two important ones, namely that of Knight (and more or less of J.M.

\textsuperscript{25} Nash (1950, p. 155) assumed "... that the two individuals [playing the game] are highly rational, that each can accurately compare his desires for various things, that they are equal in bargaining skill, and that each has full knowledge of the tastes and preferences of the other." In order to act optimally in the light of the actions undertaken by others the individual under consideration must know these actions (strategies). This seems possible only if he also knows their goals, their optimal strategies, and the actual outcome of these strategies. To put it in game-theoretic terms, the individual is assumed to know the outcome matrix (and the way in which his opponents' strategies are derived). Cf. also Nash (1953, p. 130).

\textsuperscript{26} Such indeterminacy may arise in situations which allow beliefs about beliefs (about beliefs, etc.) to play a role in the individuals' decision process. Obviously, this may lead to infinite regress. Game theory cuts this regress short by assuming the existence of a solution, that is, a Nash equilibrium. However, this implies that individuals must decide independently from each other. Nash (1953, pp. 130 - 31) identified four stages in which any game can be divided. Firstly, players choose a 'threat strategy', to be used if his demands are incompatible with those of his opponent. Secondly, the players inform each other about their threats. Thirdly, they act \textit{independently and without communication}. Fourthly, the pay-offs are determined (as is the question of whether each player gets what he wants, or whether the threats must be carried out). Therefore, Nash assumes independency between actions in the third stage, in which the players really (decide how to) act (p. 131). For a more detailed description of problems in game theory, see Binmore (1990, especially pp. 78 - 79).
Keynes) and that of Pesaran, among others. Knight (1921 (1948)) distinguished between risk and uncertainty. He argued that "[t]he practical difference between the two categories, risk and uncertainty, is that in the former the distribution of the outcome in a group of instances is known (either through calculation a priori or from statistics of past experience), while in the case of uncertainty this is not true, the reason being in general that it is impossible to form a group of instances, because the situation dealt with is in a high degree unique" (p. 233, italics in original). This means that an uncertain future is unknowable and unpredictable, while a risky future situation might be predicted and therefore be known to some degree. A phenomenon dominated by uncertainty is unique to a high degree. Were it to occur in the future, we could not predict its outcome. Conversely, the outcome of a 'risky' phenomenon may be predicted by using the 'true' probability distribution, if known.

New Classical models are stochastic in nature. This means that they attribute probability functions to the variables under consideration. As Lucas (1977, pp. 223 - 24) acknowledged, these models disregard Knightean uncertainty. They can only study phenomena which are characterized by risk, that is, which have sufficient characteristics in common to be grouped together as instances of a recurrent event. New Classical also regard expectational errors as such similar and recurrent events by attributing probability distributions to them. Of course, this approach to expectational errors does not imply that they are zero on average. In the aggregate the individuals need not know the correct probability distributions of the data generating process. In addition, they may suffer from a lack of data, even if they know these distributions. In either case the aggregate of individuals will make expectational errors. However, in the REE these errors are presumed not to be systematic, that is, they are serially uncorrelated. The reason is that such systematic is seen as easily detectable and correctable.

A second distinction between types of uncertainty is that of Pesaran (1989, p. 12). He distinguishes between what he calls *exogenous uncertainty* and *endogenous* or *behavioural uncertainty*. It should be noted that Pesaran's use of the word 'uncertainty' encompasses both Knightean 'risk' and 'uncertainty'. Pesaran argues that they may both be caused by endogenous (behavioural) or exogenous causes. Endogenous uncertainty exists if the actions of the individual in question set adaptative and reactive processes on the part of the other individuals in motion.

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27 Of course, this does not mean that an uncertain future is unimaginable.

28 Note, as Knight himself already did, that it is possible for uncertainty to become risk. This will be the case when over time sufficient instances of the phenomenon under consideration have occurred to enable an individual to draw up a probability distribution.

29 Lucas (1977, p. 224) even argues that "[i]n cases of uncertainty, economic reasoning will be of no value." This means that "... the analysis will be restricted to the situation in which the relevant distributions have settled down to stationary values and can thus be 'known' by traders" (Lucas (1975, p. 1121). This view may be attributed to Lucas's view on prediction being the goal for economics. Cf. Lucas (1980, pp. 271 - 72, 288), Van Zijp (1990).
that is, if the individuals' actions are interdependent. For instance, the outcome of a game of chess is endogenously uncertain, because the opponent's actions will depend on the actions of the individual under consideration. In contrast, such interdependency between the actions of an individual and the uncertainty of their outcome does not exist in case of exogenous uncertainty.

If we combine the two distinctions we get a taxonomy which entails endogenous risk, endogenous uncertainty, exogenous risk and exogenous uncertainty. As New Classicals disregard Knightean uncertainty, we shall concentrate on exogenous risk and endogenous (or behavioural) risk. In the latter case the probability of the occurrence of a given event depends on the actions of the individual under consideration. This type of risk (in the Knightean sense) arises when individuals adapt and react to one another. Conversely, exogenous risk is caused by exogenous disturbances, independent from the individual's behaviour.

4.4. SOLUTIONS TO THE 'COURNOT PROBLEM'

One of the severest problems in building economic models was already discerned by August Cournot (1838 (1927), p. 127). He stated that "... in reality the economic system is a whole of which all the parts are connected 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." There are too many individuals and too many goods to be handled by direct modelling. The economy is too complex to be fully described. Therefore, economists have sought to build models which abstract from reality. This problem of modelling the behaviour of all individuals and their interrelations is called the Cournot problem (Hoover (1988, pp. 135, 220)).

New Classicals acknowledge the existence of the Cournot problem. In their view (as in Cournot's) partial equilibrium analysis is not a legitimate way of analyzing problems because it neglects the interrelations between all parts and markets of an economy. This leads them to choose general equilibrium analysis (Hoover (1988, p. 222)). New Classicals must also provide a solution to the Cournot problem as they want to provide macroeconomics with microfoundations. However, according to Hoover (1988, p. 242) they do not solve the problem at all. In fact, one may discern two ways in which they circumvent the problem, namely the 'representative-individual approach' and the 'islands-model approach'.

\[ \text{Cf. also Lucas (1977, 1980).} \]
4.4.1. The representative-individual approach

Some New Classicals, for instance Sargent (1978, 1987) and Hansen and Sargent (1980), have used the concept of the *representative individual*. This concept is a hypostatisation in the sense that it treats aggregates and index numbers as if they obey the principles of microeconomics. By introducing the concept New Classicals implicitly assume that all individuals belonging to the same 'class' have the same preferences, technology, knowledge, etc. The representative individual is defined implicitly as the mathematical mean of the group (subsystem) as a whole. This means that it does not allow the analysis of distributional effects, so that the NCE can only analyze aggregate income effects. New Classicals concentrate on the magnitude of aggregates, disregarding their composition and its changes. Of course the Cournot problem must be solved by abstracting from less relevant features of an economy. The New Classical solution implies that redistributions between economic agents fall outside the scope of this type of analysis. However, one may wonder whether such redistributions do not have important effects. One may therefore query this New Classical abstraction.

An important consequence of introducing the concept of the representative individual is that it does not allow an unambiguous distinction between the micro and macro versions of the strong form of the REH. The representative individual by definition forms rational expectations which equal (the mean of) the aggregate expectations. This means that the micro version of the strong form of the REH must be identical to the macro version. New Classicals explain this property by arguing that the expectational deviations will cancel out. However, this need not be the case. According to Haltiwanger and Waldman (1989, p. 619), New Classicals (and their commentators) believe "... that if expectations are rational in the aggregate, then expectational deviations across agents will tend to cancel out" (presumably because of the Law of Large Numbers). But in Haltiwanger and Waldman's opinion this will only hold under very special circumstances which concern the nature and intensity of the interrelations between the actions of the individuals. In their analysis they do not presuppose a representative individual and they leave room for differences between individuals. Moreover, the individuals' actions will influence those of others. These influences are called *congestion* (if the influence is negative, in the sense that the incentive for agent i to engage in an activity will be lower if the number of participants is higher) or *synergism* (if the influence is positive, in the sense that the incentive

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31 The concept of the representative entity was first used by Marshall (1890 (1947), pp. 317 - 18, italics in original) who used the 'average firm', although not in a mathematical sense. In his view, "... a Representative firm is that particular average sort of firm, at which we need to look in order to see how far the economies, internal and external, of production on a large scale have extended generally in the industry and country in question." It is not a fictitious entity as "... we can see it fairly well by selecting, after a broad survey, a firm ... (or better still, more than one), that represents, to the best of our judgment, this particular average."

will be higher).\textsuperscript{33} Haltiwanger and Waldman model agent i's costs and benefits of participating in an activity as a function of the number of participants. In case of congestion the benefit of participating declines when the number of participants rises; in case of synergism the opposite applies. By incorporating these costs and benefits into their analysis, they model the interdependence between individuals' actions and hence the interactional effects. Their analysis comes to the conclusion that "[o]nly under very special conditions do standard [i.e. micro-type] rational expectations and aggregate rational expectations yield equivalent results" (1989, p. 631). It turns out that "[t]he size of the difference [between the two equilibria] will be larger (i) the larger is the divergence in expectations under aggregate rational expectations, and (ii) the more synergistic is the environment" (p. 631). They conclude that it is not permitted to assume that the expectational deviations cancel out. New Classical models implicitly make this assumption by introducing the concept of the representative individual.

Another reason why expectational deviations may not cancel out concerns (1) the individuals' abilities to gather and process information, and/or (2) their forecast functions.\textsuperscript{34} Some individuals may not be able to gather and process information as efficiently as others, or (given their information) they may not be able to predict as accurately as others. Their expectational errors will then be larger than those of others. Moreover, there seems to be no reason why these errors should cancel out. The New Classical models under consideration do not allow individuals to have such different abilities and/or functions, because their analysis does not consider the micro level. They cannot discriminate between individual and aggregate expectations and behaviour. Therefore their models are unsuited for analyzing divergent expectations. They merely allow for statements concerning the expectational errors on aggregate. This means that those New Classical models who follow Sargent's (1978, 1987) and Hansen and Sargent's (1980) strategy of using the concept of the representative individual, must abandon their claim to have provided macroeconomics with microfoundations. As Klausinger (1989a, p. 182; 1989b, pp. 9 - 10) correctly observes, methodological individualism requires the specification of (1) individual optimizing behaviour, and (2) an interaction mechanism. After all, the economic system as a whole consists of the individuals and their interrelations (interactions).

\textsuperscript{33} Haltiwanger and Waldman (1989, p. 620) depict these incentives as follows: "[a] crucial factor in determining the relationship between standard [micro] and aggregate [macro] rational expectations equilibria is the nature of the interactions among agents. This interaction is characterized as being either of two types. First, activities can exhibit congestion, i.e., the larger is the total number of agents who choose to participate in a given activity, the lower is the incentive for agent i to choose that activity. ... Second, the activities can exhibit synergism, i.e., the larger is the total number of agents who choose to participate in a given activity, the higher is the incentive for agent i to choose that activity." For instance, the problem of career choice involves congestion, as does the problem of choosing between different roads which lead to the same final destination. On the other hand, using a particular currency in international trade exhibits synergism because it will be more profitable for a particular trader if more traders accept it.

\textsuperscript{34} Cf. Runde and Torr (1985, p. 220) and Bray (1985, p. 168).
Classicals disregard the interrelations by equating the system as a whole with the individuals' behaviour. Therefore they have not provided macroeconomics with microfoundations in the usual sense of this term. It does not even give an account of 'real individual' behaviour, as the representative individual is merely another way of depicting the system as a whole. The importance of this point was also stressed by Runde and Torr (1985, p. 217), who argued that the rational expectations approach (that is, the NCE) does not analyze individual, but rather the market's behaviour (Runde and Torr (1985, p. 217)).

4.4.2. The islands-model approach
A second, apparently more sophisticated, way in which New Classicals circumvented the problem of Cournot is to model markets as islands, as Phelps (1970) did. In the 'islands' models a single good is traded on several markets which are "imperfectly linked both physically and informationally" (Lucas (1975, p. 1114). Information is thus assumed to be homogeneous across individuals in a given market, but heterogeneous across markets. The 'islands' parabel implies that in a given market an individual's output decisions are perfectly known by the other market participants. It means that there is no endogenous risk: the individual in question knows what the other participants on his market will do, and their decisions will not disturb the fulfilment of his plans.

Another way of expressing the fact that New Classicals merely analyze exogenous risk is to say that they neglect the coordination problem. This means that they neglect the heterogeneity of the individuals' plans and knowledge. In reality these plans may not be mutually compatible, in the sense that the realization of one plan prevents the realization of another (i.e. the plans are interpersonally inconsistent). This inconsistency may give rise to disappointments, learning processes and changing (and adapting) behaviour. The latter will change the social environment of all other individuals, whose expectations will not come true anymore. The interpersonal inconsistency of plans causes endogenous uncertainty. It may lead to a possible instability of the 'true' model. Lucas (1977 (1981), p. 223) defends this neglect by arguing that in order "[t]o practise economics, we need some way (...) of understanding which decision problem.
agents are solving. Therefore he assumes the strong form of the REH. However, as Buiter (1980) noted, as a corollary New Classical do not model individual behaviour as a 'game between optimizing players' but as a 'game against nature', that is, against an unchanging social environment. Taking interpersonal inconsistency of plans into account will influence New Classical analysis to a great extent because "[o]nce we cease to model private agents as playing a game against nature - the competitive market - standard optimization techniques are no longer applicable within the private sector" (Buiter (1980, p. 46), italics in original). Modelling individual behaviour as a game between optimizing players means that it becomes less likely (or more improbable) that learning will lead to the attainment of the REE, because the 'true' structure of the economy continuously changes. The New Classical argument that systematic expectation errors are easily detectable and correctable then does not suffice to make the strong form of the REH plausible. McCallum (1980b, p. 718) and Hahn (1986, p. 281) pointed out that in a changing environment individuals may continue to make (other) systematic errors. According to the former, "... the existence of some detectable departure from pure randomness in past errors does not provide any good reason from believing that the same departure - or any other particular departure - will occur in the future." This may even lead to the situation in which individuals use different models (Maclup (1983)). Then there is no reason why these expectations will continue to come true (Hahn (1980)). The heterogeneity of information may thus concern the structure of the economy.

According to Pesaran (1989, p. 57), New Classical solve the problem of heterogeneity across markets. He says that they make two assumptions. Firstly, "[a]ll firms [or individuals] observe current equilibrium prices in their local markets." Prices clear all markets, thus conveying all information on that market. By observing the current price on their market, individuals obtain all knowledge on that market. This ensures the homogeneity of information across individuals in a given market. As was shown above, this means that there is no endogenous risk. However, in the REE the strong form of the REH must also apply. This leads to the second assumption, namely that "[a]ll firms [or individuals] know the true distribution of the disparity between the equilibrium prices in the local markets and the economy-wide average current equilibrium price level." The assumption implies that on the average individuals form correct expectations (in a probabilistic sense) concerning the economy-wide average price level. This seems possible only if they know the prices on all other local markets, which will give them the same information as the individuals on those markets. Thus, for the strong REH to apply, it

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38 However, he acknowledges that the REH "... will not be of value in understanding psychotic behavior. Neither will it be applicable in situations in which one cannot guess which, if any, observable frequencies are relevant: situations which Knight called 'uncertainty'". (Lucas (1977 (1981), p. 223).

39 New Classical justify the REH by stating that the individuals know the relevant stationary distributions (Lucas (1975, p. 1121). By forming their expectations according to the REH, individuals know the rational expectations equilibrium ('correct') forecast function.
must be assumed that information across markets is homogeneous. The problem of the heterogeneity of information across markets in the 'islands' models is circumvented by assuming it away. As Frydman (1983, p. 115) concluded, "the assumption that agents form rational expectations appears to conflict with the fact that the economy is decentralized."

4.4.3. Conclusions

The REE implies that there are no endogenous reasons for expectational errors, that is, there is no endogenous risk. The coordination problem is assumed away. However, this does not mean that there is no risk at all. Its source may be an exogenous one. New Classicals argue that business cycles are indeed caused by such exogenous risk, as will be shown in section 5. However, before addressing this issue we must first complete our analysis of the REE. The question which must still be answered is whether individuals may learn in such a way as to bring about a REE. In other words, is convergence towards the REE possible or perhaps even plausible?

4.5. CONVERGENCE TOWARDS THE REE AND THE STRONG REH

New Classicals have tried to analyze whether the strong form of the REH is a plausible expectations formation process. They have studied the circumstances under which individuals will learn to form expectations 'rationally' (i.e. correctly). Or to put it more correctly, they have analyzed whether individuals who do not form their expectations rationally, will learn in such a way with regard to their expectations formation process as to change this process in the direction of the strong form of the REH. The results of the studies are rather ambiguous. As Blume, Bray and Easley (1982) have shown, two approaches exist in economic literature, the one yielding convergence to rational expectations and the other concluding that the formation process of rational expectations may not be stable because of agents having incorrectly specified likelihood functions. In the latter case the stability of the formation process depends (among others) on the specific learning process. For instance, Bray (1982, pp. 329 - 30) suggests that a learning procedure may eventually lead to rational expectations, albeit under very stringent conditions (such as correct knowledge concerning the data generating process, i.e., the true

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40 Cf. Shiller (1978), DeCanio (1979), Blume, Bray and Easley (1982), Bray (1982), and Frydman (1982), among others. McCallum (1983, p. 139), on the other hand, argues that the convergence problem is a problem which "... is not properly attributable to the rationality hypothesis but, instead, is a general feature of dynamic models involving expectations."

41 Pesaran (1989, Ch. 3) discusses several types of learning models.

42 Blume, Bray and Easley (1982) use the term 'rational expectations' in the sense of 'correct expectations'. In other words, they hold the term to mean a strong form of the REH.

43 Cf. DeCanio (1979), Blume and Easley (1982) and Bray (1982).
structure of the economy). She concludes that rational expectations and the NRE are at best long-run phenomena. Other economists disagree with this. Shiller (1978) holds that even if we assume that in the future agents know the correct model and behave accordingly, there is no guarantee that the individuals today will behave according to it. Moreover, as there may be a variety of future REEs (i.e., the future equilibrium economy may be organized in several different ways), individuals must determine which equilibrium will come about. According to Shiller (1978) we cannot know which of the possible REEs they will choose. It means that we cannot know which path the economy will follow. The choice of REE by the economic model-builder will then depend on ad-hoc assumptions with regard to "initial expectations mechanisms and the way people revise these mechanisms" (Shiller (1978, p. 38)). It might be added that in the case of initial non-Rational Expectations formation processes there is no need for people to use identical expectations formation mechanisms, nor to revise them in an identical manner. This means that any convergence of the individuals' expectations formation process towards Rational Expectations hinges on ad-hoc assumptions with regard to the initial learning functions of the individuals.

4.6. CRITICISMS OF NEW CLASSICAL EQUILIBRIUM ANALYSIS

The assumptions underlying the New Classical analysis have been extensively criticized. These criticisms are directed at the New Classical model per se and at the knowledge the individuals must possess in order to be able to form rational expectations.

B. Friedman (1979) and DeCanio (1979) argued that the model described by the NCE need not be the correct one. The economy may also be described by other (non-market clearing) models. In other words, there may be more 'correct' models. New Classicals have agreed with this criticism, but as Sargent (1976) has shown, it is not as devastating as the critics argued. He showed that the reduced form of New Classical models may also be derived from models which exhibit price rigidity. This phenomenon is called observational equivalence. The choice of model is then 'merely' a methodological matter. The New Classicals choose to adhere to general equilibrium analysis.

Secondly, suppose that the New Classical model is correct and that the agents perceive it correctly. Then one might object that the computational exercises required to form rational expectations are too difficult to be carried out by individuals. Begg (1982, p. 62 - 63) argues that not every individual needs to form expectations. Some spend a lot of effort in predicting and in publishing these predictions (like governments and profit-motivated firms) and others may simply adopt these expectations. However, they will often be different, which makes it necessary for individuals to choose between them. Such choices will only lead to rational expectations if and only if individuals are capable of deciding which alternative predictions are closer to the 'truth'. This means that they must know the correct predictions. However, rational expectations may still be saved by referring to the billiard player, who does not need to perform difficult mathematical
calculations in order to make a 'cannon' (this leads to a so-called as if version of the REH; cf. Snippe (1986 - 87)).

Thirdly, Burmeister (1980) argues that New Classical models are confronted with so-called non-uniqueness problems. This means that the rational expectations equilibrium path may prove to be 'too stable', in the sense that any disturbance may give rise to several convergent paths. The adjustment path is non-unique. As a result the model is then incapable of describing this path. In Burmeister's view, the occurrence of a 'Saddlepoint', that is, a unique convergence path, is too unlikely to render New Classical models practically useful. Begg (1982, p. 64) rejects this criticism by claiming that "... a wide range of models do generate the Saddlepoint property." This unresolved issue has been extensively discussed by Shiller (1978), Fischer (1988), Diamond and Fudenberg (1989), Pesaran (1989) and McCallum (1989a). As opinions continue to differ in this respect, the conclusion must be that the issue remains unresolved.

Fourthly, New Classical models imply that the individuals know the correct model and the relevant distributions of the variables. However, the acquisition of such information will not be rational if information costs exist. As Darby (1976) has shown, costly information may explain systematic errors in expectations in markets, even if individuals know the correct model. Moreover, if arbitrage is too costly, differences in systematic errors may occur between markets. New Classicals would not deny this. As a matter of fact, they even argue that expectational errors, due to a lack of information, cause business cycles. However, they continue to assume that individuals know the correct model. The lack of information merely concerns knowledge about the current values of some economy-wide variables.

4.7. CONCLUSIONS

New Classicals assume in one way or another that information is homogeneous across markets. At least this assumption is rather stringent. It seems in flagrant contradiction with everyday practice in decentralized market economies, because uncertainty in New Classical analysis is merely of the type of exogenous risk. This means that individuals do not react upon the actions of other individuals. Stated differently, the NCE does not solve the so-called coordination problem. This contradicts the New Classical methodological-individualist claim of having provided macroeconomics with microfoundations. Methodological individualism argues that one should specify (1) the behaviour of all individuals, and (2) the (interaction) mechanism which coordinates their actions. As the strong form of the REH assumes away the latter, it seems appropriate to conclude that New Classical Economics must either abandon the strong form of the REH or give up its claim to have provided macroeconomics with microfoundations.
5. THE EXPLANATION OF BUSINESS CYCLES

5.1. INTRODUCTION

Leijonhufvud (1984, p. 187) created a taxonomy which defines four types of business cycle theories. These types are identified in terms of (1) the nature of the cause of the cycle, and (2) the nature of the phenomena which constitute it. He considered these natures either 'real' (R) or 'nominal' (N). This approach leads to the following taxonomy of business cycles: N/N, N/R, R/N, and R/R. As will become clear, the New Classical theory is a N/R theory: the cause of the cycle is a monetary (i.e. nominal) one; whereas the phenomena constituting the cycle are real in nature. The exogenous disturbance causing the cycle is a (random) increase in the rate of monetary expansion, whereas the real phenomena constituting the cycle are overinvestments. Therefore, the New Classical monetary business cycle theory is also called a monetary overinvestment theory.45

5.2. MONETARY SHOCKS AND THE INTERPRETATION PROBLEM

New Classical monetary business cycle models are 'islands' models, in which each individual can only operate in one (local) market, and in which one good is produced. As this good is a non-durable, some store of value must be presupposed. New Classicals introduce fiat money. They also assume that trade can only take place by using this money. In addition, the money supply fluctuates randomly, which is caused by governmental spending. These random shocks are evenly spread throughout the economy, in the sense that the deviations of the monetary shocks in the local market from the economy-wide average shock are assumed to be normally distributed. Money is then evenly distributed across all markets. Furthermore, the distribution of the deviations is assumed to be constant and known by individuals (cf. Lucas (1975, p. 1122)). And finally, at the end of each trading period individuals select randomly a new market. This latter

44 The term 'nominal', however, seems to be somewhat misleading: 'monetary' seems to express Leijonhufvud's intention more clearly; cf. also Garrison (1989, p. 5).

45 During the 1980s, some New Classicals have also developed business cycle models in which both the causes and the constituting phenomena are real in nature. For a comprehensive overview, see McCallum (1989b).

46 Cf. Lucas (1972, p. 68).

47 This means that the distribution of additional money across markets will not cause prices to vary between them.
property of the islands model is also assumed to be known among individuals.\footnote{48}

Given complete information on the values of the relevant variables, individuals know that the increase in their money balances is due to an economy-wide monetary shock.\footnote{49} However, in New Classical business cycle models they do not have such complete information. In fact, their information sets have a one-period lag with regard to the current values of economy-wide variables. The economy-wide monetary shock then unexpectedly raises the individuals' money balances. It will change the nominal price level (i.e., the average rate of exchange between money and goods) via a real cash-balances effect (cf. Lucas (1972, p. 66)). This implies that local prices will change. Individuals are then faced with an \textit{interpretation problem}, namely whether the price movements are caused by relative demand shifts or by economy-wide monetary changes. Unaware of the additional increase in the money stock, they are bound to underestimate the nominal component of the rise in prices and will increase their production. In other words, in the short run (i.e., in the period in which the monetary disturbance takes place) a purely monetary change will lead to a change in real variables. This relationship can be represented by a Phillips curve. However, as soon as new information with regard to the general price level becomes available, the individuals will discover that they have interpreted the price increases wrongly. They will then adjust their production to the 'natural rate' level, thereby restoring the neutrality of money in the longer run.\footnote{50} This means that (given serially uncorrelated economy-wide monetary disturbances) there will not be any serial correlation in the fluctuations of output. However, a business cycle is characterized by the fact that the consequences of expectational errors are serially correlated. This led many critics to argue that New Classicals cannot maintain that a business cycle exists.\footnote{51} As Lucas and Sargent (1978, p. 65) pointed out, this criticism fails to distinguish between the sources of disturbances (impulses) and the propagation mechanisms (which will make the impulses have lasting effects). A cycle will only come about if the shocks are serially correlated, or if propagation mechanisms transmit the

48 This assumption ensures that not all shocks are monetary in nature. For instance, suppose a given market experiences a rise in demand. If individuals would not select new markets (and all other individuals would know this), the rise could only be ascribed either to monetary expansion, or to changes in the individuals' preferences. In economics the latter are usually taken to be constant. This means that the shocks must be monetary in nature. As the monetary expansion is permanent, it is not profitable for individuals to increase their current labour input. In the aggregate there would not be any expectational error, hence no business cycle.

49 For instance, see Sargent and Wallace (1975, p. 221 - 24).


51 E.g., Hall (1975, pp. 311 - 14). Tobin (1977) and Modigliani (1977) have raised similar objections.
consequences of the expectational errors to other periods.

5.3. THE PROPAGATION MECHANISMS

Several New Classical models incorporate propagation mechanisms. For instance, Lucas's 1975 model exhibits persistence effects by incorporating physical capital.\(^52\) Blinder and Fischer (1981) use the gradual adjustment of inventory stocks of finished goods in order to make a basic New Classical model produce business cycles. Fischer (1979), among others, introduced capacity effects, caused by real-balance effects, in order to show that monetary policy will have persistent real effects on the economy. In general, these mechanisms are instances of what Barro (1983b, p. 48) calls 'adjustment-cost explanations' for the persistence of the real effects of the shocks. He observes that these explanations imply that investment will initially rise sharply after the unexpected disturbance, but would thereafter decline gradually. However, this does not correspond with empirical evidence, which indicates that investment and output rise during several periods before declining. Two explanations may be given for this. Firstly, information lags may be longer than one period, that is, they may prevent even the past values of the relevant variables from being known (Lucas (1975, p. 1114)). However, this explanation seems to be somewhat ad hoc, in the sense that information with regard to aggregated variables usually becomes available during the next period. It may not be consistent with the rationality postulate for the individuals to disregard this new information. Secondly, Kydland and Prescott (1980, pp. 175ff) argue that investment projects involve planning. In their model increases in real output are lagged because "... there are long lags from the time when changes in its determinants call for an increase in the capital stock until the time when the new capital starts yielding services."\(^53\)

5.4. NEW CLASSICAL VIEWS ON MONETARY POLICY

The question to be answered now is whether New Classicals envisage any role for monetary policy. Not surprisingly, their views on its effectiveness will depend on the assumptions made as regards information. Firstly, the effectiveness of monetary policy in the NRE will be discussed. In this situation monetary policy will prove to be ineffective: it does not influence real variables. This position is called the neutrality proposition. Secondly, attention will be paid to more realistic

\(^{52}\) In Lucas's model a once-and-for-all increase in the money supply will merely lead to a rise in the general price level as soon as the information concerning the monetary shock becomes available. Thus, money is neutral in the longer run. However, money will not be superneutral: a change in the growth rate of the money supply will not lead to a proportional change in the rate of inflation. This effect operates by changing the real yield on money. For a analysis of this effect, cf. Tobin (1965).

situations in which information is imperfect. Monetary policy will not turn out to be completely ineffective, but New Classical remain sceptical about its use.

5.4.1. The neutrality proposition
Sargent and Wallace (1975) have shown that in the NRE monetary policy is neutral in the sense that it does not affect real variables. If all individuals have perfect knowledge and perfect foresight in a probabilistic sense, they will make expectational errors only at random. In other words, if there is certainty equivalence, individuals will not make expectational errors. Obviously, the perfect knowledge and perfect foresight presupposed in the NRE must (by definition) also concern the government's future policy. Individuals will then know what the government and/or the monetary authorities intend to do, which enables them to anticipate the policy measures correctly (again in a probabilistic sense). As New Classical adopt Friedman's quantity theory of money, this renders monetary policy ineffective. A monetary expansion will merely raise the price level, but leaves real output unaffected. This proposition is called the neutrality proposition. As it merely holds for the NRE, it implies that all preconditions for the existence of the benchmark world must be fulfilled. Furthermore, the New Classical models under consideration must be linear ones, as non-linearity of the equations also leads to policy-effectiveness (cf. Shiller (1978), Snower (1984)). Finally, monetary policy will also be effective in the case of an open economy (cf. Montiel (1987)); or if individuals hold different assets (cf. Minford (1986)).

5.4.2. Nonneutrality: prevention of the cycle
Not surprisingly, government policy will have real effects if the government indeed has informational advantages. However, the duration of these effects will depend on the length of

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54 Most New Classical would not deny that changes in fiscal policy will have real effects. It is hard to deny that a rise in income tax rates will provide individuals with an incentive to reduce their labour supply, which obviously is a real effect. On the other hand, Barro (1978) has argued that (under certain conditions) the way in which a government finances its expenditures does not influence the economy in any real sense. A tax reduction without a reduction in expenditures will merely lead to the individuals' expectation that taxes must rise in the future in order to pay off the government's increasing debt. They will discount the expected tax rise and therefore will not increase their consumption. Rational individuals will not feel better off. This position is called the Ricardian Equivalence Theorem. It should be noted that the circumstances under which it is valid are even less realistic than those of the (monetary) policy-neutrality proposition. For instance, it is necessary that taxes are lump-sum, because otherwise the changes in policy will have distributional effects. In addition, the individuals must act as if they live forever. Furthermore, they must discount the expected tax increase at the correct rate of interest. And they must even correctly estimate their future needs (which presumably are more often underestimated, due to time preference).

55 Shiller (1978, p. 13) concludes that "in practice, the monetary authority will always have some form of information advantage, because it has greater resources to evaluate data than do many individuals in the economy." On the other hand, this will only be true for economy-wide variables. It is more likely that individuals will know more about conditions in their local markets than governments and monetary authorities do. Cf. Hayek's (1945) notion of the
the informational advantage. If the advantage is temporary, so will the effects be. Governments
are then incapable of reducing unemployment below its 'natural rate' level forever: they cannot
even 'fool some people all the time'. As expectations are formed rationally, the aggregate of the
individuals will take inflationary policies into account, leading them to expect higher inflation.
The suppression of unemployment below the NRU then needs a higher rate of monetary
expansion. However, during the next period the individuals will also take this higher rate into
account. Therefore, in order to suppress unemployment below the NRU systematic monetary
policy will only lead to hyperinflation, without unemployment being lowered. However, one might
argue that although governments do not have an informational advantage in the long run, they
do possess such an advantage in the short run. As business cycles are short-run phenomena, one
might argue that they can be combated by adopting the right policy. The question then is:
which policy must be selected? This will of course depend on the criterion used. Two criteria
have been identified in New Classical literature. Firstly, Sargent and Wallace (1975, p. 5) have
proposed the stabilization of some measure for aggregate output (or, in a growing economy, for
the rate of growth of aggregate output). Secondly, Barro (1976, pp. 15, 93) has proposed to use
the gap between actual and full information output as a criterion. Theoretically, the latter
criterion seems to be more correct than that of Sargent and Wallace. Their steady-growth
criterion does not take unexpected exogenous disturbances (such as steep increases in oil prices)
into account, whereas Barro's NRE-criterion does. Furthermore, New Classicals have adopted
the NRE as their theoretical benchmark, so why not as a policy-benchmark? However, Barro's
criterion encounters an inherent difficulty: ex ante (and presumably also ex post, as perfect
knowledge concerning an economic system runs counter to the Cournot problem) we do not
know the full information output of the present period, so how can we minimize the gap
mentioned? Sargent and Wallace's criterion therefore seems to be more 'practical'.

However, even if governments have informational advantages, they need not exploit
them. They could provide the private sector with the missing information, letting it decide for
itself how to act.56 Whether this will be more efficient than carrying out a monetary policy,
depends on (1) the costs of transmitting the lacking information,57 and/or (2) the information
processing abilities of the private and the public sector respectively.

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56 When interpreted in a public-choice framework, politicians and civil servants will try to
attain their own personal objectives. Presumably this will lead them to favour monetary policy
over transferring information. However, as New Classicals do not reduce aggregates to their
constituting parts (and their interrelations), they cannot consider this aspect.

57 Given modern means of mass communication, these costs will presumably not be
prohibitive.
6. CONCLUSIONS AND FINAL REMARKS

New Classical (monetary) business cycle theory is a so-called N/R theory. It identifies an unexpected increase in the money supply as the cause of the cycle. By contrast, the phenomena constituting the cycle are real in nature. These mainly include overinvestment, either in productive capacity or in inventories. Therefore the New Classical theory may best be called a monetary overinvestment theory (Lucas (1975, section 12). It presupposes that the individuals form their expectations according to some version of the strong REH (or according to the weak form, if information gathering and processing is costless). This prevents government policy from having any lasting effects.

New Classical analysis either sidesteps the issue of the coordination problem by making use of the concept of a representative individual, or assumes the problem to be nonexistent (by assuming information concerning endogenous variables to be homogeneous and correct across markets). In both cases there are no microfoundations for New Classical (Macro) Economics.

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