UNIT 5 RATIONAL EXPECTATIONS AND ECONOMIC THEORY

Structure

5.0 OBJECTIVES

After going through this Unit you should be in a position to:

- explain the nature of expectations in Keynes' theory;
- explain the rational expectations hypothesis;
- identify the implications of rational expectations in macroeconomic policy- making; and
- contrast rational expectations with alternative theories of expectations formations.

5.1 INTRODUCTION

Much of undergraduate macroeconomic theory is discussed on the assumption that, in the short run, the expectations of economic agents about the future values of macroeconomic variables are given. The rationale for this treatment of expectations in macroeconomic theory can be derived from Keynes' views on the nature of expectations, including his discussion in the General Theory. While Keynes' views on the nature of uncertainty and expectations form the basis for the writings of many Post-Keynesian economists, most of modern macroeconomic theory treats uncertainty and expectations in a radically different manner. This latter approach is characterised in economic theory by the assumption that economic agents

(housheholds, business firms and government) have *rational expectations* abc.. macroeconomic variables.

5.2 KEYNES' THEORY AND EXPECTATIONS

Expectations played a major role in Keynes' theory of the determination of aggregate output and employment in market economies in the short run. Expectations about future yields on investment projects underlie 'the marginal efficiency of capital' schedule. However, the volatile nature of these expectations plays a major role in explaining why investment expenditure and therefore output and employment in market economies are subject to fluctuations.

5.2.1 Non-existence of Objective Probability Distributions

Let us see why expectations are volatile in nature? According to Keynes (1936, pp.149): "Our knowledge of the factors which will govern the yield of an investment some years hence is usually very slight and often negligible." We can consider several examples: i) possible advances in production technology might make the currently installed machinery obsolete, ii) appearance of new substitutes might affect demand for output, iii) changes in industrial, labour, trade and tax policies might affect revenues and costs, iv) wars, trade embargoes and changing international relations might affect possibilities of production and sale. One can, with a fair degree of accuracy, predict the possibility of such events in the short term. However, such prediction becomes progressively more difficult, the farther ahead in the future is the time that such predictions relate to.

Such problems will, of course arise in making any decision about the future which involves long-term expectations. One possible way of dealing with such problems is to use a probability distribution over possible future outcomes. Keynes argued that in the case of variables like the future yields of an investment project there can be no objective basis for the formation of a probability distribution.

Let us explain the problem of forming a probability distribution through an example. Suppose we have to find out the outcome ('head' or 'tail') of a single toss of a coin in the future. We can repeatedly toss the same coin and observe outcomes. Alternatively we can consider past experience of coin tosses for coins with almost identical physical properties. In this way, we can obtain relative frequencies of the outcomes ('head' and 'tail') in the case of these tosses.

What are the factors presumably affecting the outcome of a single toss? Broadly, these are the nature of the coin, the method of the toss and the physical environment in which the toss is carried out. Certain factors can be broadly compared across different tosses and kept constant (so that only tosses *under essentially similar conditions* are studied), viz., the nature of the coin and the method of the toss. Other factors which might presumably affect the outcome are the exact initial position of the coin and the hand tossing the coin, the exact initial impetus given to the coin, the exact velocity of the wind blowing at the time the coin is tossed, and certain other factors in the physical environment. All these minute details may matter, but there is no way in which we can measure all these factors or keep them constant. For a particular coin the outcome (that is, obtaining 'head' or 'tail') depends upon the configuration of these factors.

However, suppose we compare sufficiently long sequences of coin tosses carried out *under essentially similar conditions*. Depending upon the configuration of these factors we can represent a sequence of coin tosses in the form of relative frequencies for the

outcomes. It implies that given a combination of factors the proportion of 'head' and 'tail' in a long sequence should remain the same.

In fact, it has often been empirically verified that for a sufficiently large number of tosses of a coin under essentially similar conditions, the relative frequencies of different outcomes tend to stabilise around fixed values. For example, for coins whose physical properties do not in any way appear to favour one outcome over the other, the relative frequency of the outcomes 'head' and 'tail' would both tend towards the value ½. These long-run relative frequencies then represent the objective basis for the probabilities assigned to different outcomes for a single toss of the coin in future.

Now, let us consider the case of an investment project. Certain pieces of information relating to past and present time periods are currently available which are relevant for forecasting possible future trends – for example, current yields on similar projects, past and current trends in these yields, current trends in science and technology (research and development) in related areas, current political developments and past political history. These, together with the nature of the investment project, can be considered as the observable conditions under which the experiment of investing in a project rather than tossing a coin is being made.

Unlike the case of coin tossing, we cannot undertake an investment project repeatedly and study the distribution of relative frequencies by outcomes. Therefore, one can only obtain this distribution by studying instances in the past where *essentially similar conditions* had prevailed. However, according to Keynes, there would be a very large number of pieces of information available at present, which could be considered relevant for predicting the long-run yields on any investment project. However, not all of these pieces of information are adequately quantifiable or comparable over time. Therefore, it is difficult to obtain sufficiently large numbers of instances in the past where investments have been made under *essentially similar conditions*.

Alternatively, suppose we wanted to use a limited number of quantifiable factors in defining the conditions under which investment is being carried out. In this case there is no reason why, if we consider sufficiently long sequences of these instances, it should necessarily be true that the distribution of relative frequencies of different configurations of the factors left out should be the same for all sequences. Science and technology or politics (human or social phenomena) are hardly of the same nature as physical (natural) phenomena. Consequently relative frequencies in the past might not be a good guide to relative frequencies in the future.

5.2.2 Conventions as a Basis for Forming Expectations

Since there is little objective basis for probability distributions about future yields, decision-makers have to act on the basis of subjective judgments. It means there must be some element of arbitrariness involved in the formation of expectations and therefore, in the decisions taken on the basis of those expectations. In such situations individual decision-makers, in forming their expectations, usually tend to fall back on practical norms or conventions generally prevailing in society.

For example, one convention for estimating the expected rate of return on an investment project may be as follows: *Assume* that an objective probability distribution for future returns on an investment project can be determined from quantitative historical data. Hence, estimate regression equations which have the rate of return on such projects as the dependent variable and particular subsets of a set of variables as independent

variables. Then, on the basis of some given statistical criterion (convention) choose the 'best' estimated regression equation. Use this, given values of the independent variables, to obtain an estimated probability distribution for the rate of return on the investment project.

The tendency to rely on conventional wisdom might be due to a variety of reasons. Individuals might feel that conventions reflect the collective wisdom of others who have been in similar positions and therefore would be less arbitrary as a guide to decision-making. Besides, individual decision-makers can justify their decisions as being of the same variety as that taken by many others placed in similar position. In this case it appears less the outcome of individual whim or sentiment or prejudice.

Moreover, in following conventions, particularly in relation to the valuation of investments or assets, the individual entrepreneur might be minimising risks. If a majority of investors follow the same conventions in calculating values then the individual entrepreneur would have a good idea about the market value of his investment over the short term. Once the investment has been made on the basis of such valuation, the entrepreneur will be exposed to the risk of a significant loss. Since individuals have relatively greater certainty about the near future, the chance of increasing losses over a short time period is small.

5.2.3 The State of Confidence in Conventional Judgements

While individuals fall back on conventions to guide their behaviour in the face of uncertainty, they are also aware that these conventions might prove to be misleading guides to the future, because the future might well be very different from the past. Consequently, individual decision-makers depending on their level of confidence decide whether or not to act on the basis of these conventions in the face of such uncertainty.

Thus, while a particular convention or norm for estimating the future returns on an investment project might suggest that investment projects should be carried out in two different instances, the actual investment may be carried out in only one, if the state of confidence is high in one and low in the other. In the latter case, the same predictions about future yields using prevailing conventions would as it were be discounted by a factor reflecting the decision-maker's confidence about whether the prediction would actually be correct.

Thus, it is not only various 'objective' factors in the economy, which through prevailing norms for forming long-term expectations, determine the volume of investment in the economy. The same set of values for the 'fundamental factors' (according to prevailing conventions) can influence investment decisions in either direction, the relation of these 'fundamentals' to expectations about the future being governed by the prevailing psychological state of businessmen and entrepreneurs. Thus, according to Keynes (1936, p.161), a certain degree of optimism, "of animal spirits – of a spontaneous urge to action rather than inaction," is necessary for enterprise and investment.

The preceding discussion assumes that the 'marginal efficiency of capital', which is relevant to the decision to invest, is derived from the expectations of the professional entrepreneur or businessman who actually undertakes the investment. However, Keynes believed that the rate of investment was significantly influenced by movements in the share market values of existing enterprises. According to him (Keynes, 1936, p.151): "... there is no sense in building up a new enterprise at a cost greater than that at which a similar existing enterprise can be purchased; while there is an inducement to spend on a new project what may seem an extravagant sum, if it can be floated on the Stock

Exchange at an immediate profit." Thus, it is the marginal efficiency of capital corresponding to the "average expectation of those who deal on the Stock Exchange as revealed in the price of shares" which is actually relevant in many cases.

In this case, the role played by psychological factors represented in the state of confidence, increases with the share of total equity capital held by market investors who (compared with professional entrepreneurs or businessmen) are relatively uninformed. Since the factual basis underlying the expectations of the relatively uninformed investor is smaller, the level of confidence in these expectations is also subject to greater instability.

The volatility of expectations (and of investment) arises because the state of confidence of investors is subject to waves of optimism and pessimism, sensitive to the extent to which even single small events seem to confirm or refute currently held expectations based on existing conventions. According to Keynes (1936, pp.153-4): "Day-to-day fluctuations in the profits of existing investments, which are obviously of an ephemeral and non-significant character, tend to have an altogether excessive, and even an absurd, influence on the market."

Also, major events, which take place in the present and whose impact on future events cannot be gauged to any adequate degree, increase the extent of uncertainty and make the state of confidence even more sensitive to the single small events. "In abnormal times in particular, when the hypothesis of an indefinite continuance of the existing state of affairs is less plausible than usual even though there are no express grounds to anticipate a definite change, the market will be subject to waves of optimistic and pessimistic sentiment, which are unreasoning and yet in a sense legitimate where no solid basis exists for a reasonable calculation." (Keynes, 1936, p.154)

Nowadays, there is often reference in the media to the 'feel good' factor, whereby a set of unrelated but favourable events taking place elsewhere in society might induce a high degree of confidence in positive judgments. Similarly, a sequence of unrelated but unfavourable events might induce pessimism about positive judgments. In the words of Keynes (1936, p.162): "... economic prosperity is excessively dependent on a political and social atmosphere which is congenial to the average businessman. If the fear of a Labour Government [a government favouring greater state intervention in the economy and greater support for organised labour] or a New Deal [a policy programme involving increased public intervention and expenditure] depresses enterprise, this need not be the result either of a reasonable calculation or of a plot with a political intent – it is the mere consequence of upsetting the delicate balance of spontaneous optimism."

5.2.4 Nature of Expectations in Keynes' Theory

The above discussion on the nature of expectations in Keynes' theory may be summarised as follows:

1) In forming long-term expectations, there exists no basis for inferring an *objective* probability distribution over future outcomes on the basis of past experience.

2) In forming long-term expectations, decision makers fall back on prevailing conventions. This could, for example, include the convention of using an estimated probability distribution from historical data for forming expectations about the future.

3) Decision makers are however aware that these methods for forming expectations have evolved as conventions (maybe, because they have been more successful on an average in the past compared to other methods). There is no objective rationale for thinking that they would always form a more accurate basis for judgments about the future.

4) The decision on whether or not to go by these conventional judgments depends on the confidence that decision makers have in these conventions as an adequate basis for forming expectations about the future. The state of confidence is a volatile factor. Therefore expectations also become volatile as economic actors go by conventional judgments or discount them.

5.2.5 Implications for the Role of Economic Theory

Like the schedule for the marginal efficiency of capital, expectations about the future market rate of interest underlie the liquidity preference schedule. In Keynes' analysis, there are three factors which influence influence the level of output and employment in the economy in the short-run significantly. These are i) the quantity of money in circulation, ii) the money wage rate, and iii) certain fundamental psychological factors, namely, the psychological propensity to consume, the psychological attitude to liquidity and the psychological expectation of future yield from capital assets.

In analysing the determination of aggregate output, Keynes therefore takes the above factors including 'the psychology of the public' as given. For example, he takes marginal efficiency of capital and liquidity preference schedules as given. Changes in these factors are then studied separately in terms of their effect on output and employment.

Psychological factors do not necessarily denote random factors. These might depend (though not necessarily *reasonably*) on specific social and political circumstances. Two major implications follow from the fact that psychological factors are important in the determination of output. First, the level of output and employment and other relevant variables in the economy will not, in general, be predictable (in the form of an *objective* probability distribution) on the basis of historical data on a limited number of measurable factors alone. Second, changes in independent variables brought about as a measure of policy may also lead to changes in other determining factors, but not necessarily in a predictable manner. For example, Keynes recognises that monetary policy can have different effects on output depending on its impact on expectations about future monetary policy and therefore on the liquidity preference schedule. Similarly, there is recognition (Keynes, 1936, p.120) that a government programme of public works *may* "through its effect on 'confidence', increase liquidity-preference or diminish the marginal efficiency of capital, which, again, may retard other investment unless measures are taken to offset it."

5.2.6 The Nature of Policy-Making

It follows that recommending policy must itself be a subjective exercise. The effects of particular policies at a particular historical juncture will depend not only on the values of current measurable variables, but also on knowledge of the current psychology of economic agents. Moreover, it will depend on how we organise and interpret the historical evidence of different instances in the past in terms of the light they throw on present circumstances.

According to Keynes, the role of economic theory was not to provide quantitative

predictions about the future. Rather, it provided a framework for thinking logically and in an organized manner about the problem under consideration. Past data on relevant variables could then be studied to obtain an idea about the nature of quantitative relationships that had prevailed in the past. However, in using such data for predictions about the future, it was necessary to make subjective judgments about the extent of similarity or dissimilarity between the present time period and different time periods in the past, not captured by objective measurable variables.

The above approach has two implications. First, choice between alternative models of the economy for present purposes cannot be made on the basis of historical data on measurable variables alone. That is, such choice cannot be made on *purely quantitative* grounds. Second, if there are few close parallels in history to present circumstances, then there exists little basis for *objective* predictions about the future.

Check Your Progress 1

1) Explain how expectations can be expressed in the form of a probability distribution.

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2) How does expectations influence policy-making?

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3) Write short notes on

i) conventional wisdom as a basis for expectation formation.
ii) Nature of expectations in Keynes' theory.

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5.3 RATIONAL EXPECTATIONS AND ECONOMIC THEORY

We assumed above that the role of economic theory is not to provide quantitative predictions about the future. Suppose we assume instead that the primary role of economic theory is the prediction of future values of variables of interest. Also, given this role of economic theory, suppose we stipulate that under any particular set of circumstances, the choice amongst alternative theoretical models should be possible on the basis of quantitative historical data alone. It implies that models should provide predictions in the form of relations between objectively measurable variables, predictions which can be checked using past data on these variables.

Note also that the above assumption implies any one of two things: i) the same relation between variables have prevailed for the times and places that the past data relates to and will prevail under the present circumstances, or ii) differences in time and space can be accounted for as different values of quantifiable variables within the model.

Therefore, once a model is chosen on this basis it can be assumed to provide, together with historical data on the variables in the model, *objective* quantitative predictions. Traditionally, this has meant that models have been used to yield predictions in the form of an *objective* probability distribution for the future values of dependent variables, given (conditioned on) current and past values of a set of variables.

This *objective* conditional probability distribution has been derived by econometric methods on the basis of past data on the variables appearing in relationships derived from theory. The basic assumption underlying such an approach is that either there is an *objective* conditional probability distribution relating these variables which does not change with time and space or that time and space can themselves be specified in terms of quantifiable variables in the model.

5.3.1 The Hypothesis of Rational Expectations

In the General Theory (Keynes, 1936) we noted that the state of expectations was taken as given. There was, in addition, explicit recognition that changes in other independent variables including policy variables could lead to changes in expectations. However, nothing could be said in general about the nature and extent of such shifts without specific knowledge of the prevailing psychology of the economic agents, which would be influenced by prevailing social and political circumstances.

In a model that aims to provide a probability distribution for dependent variables using data on *objective measurable* variables, however, changes in expectations cannot be assumed to be dependent on non-quantifiable factors outside the model. Expectations themselves must therefore be explainable in terms of *objective measurable* variables.

Suppose economic agents are assumed to be rational in the sense that they seek to best achieve their objectives, subject to external constraints on their choice of actions. Suppose also that the degree of 'correctness' of the expectations on the basis of which economic agents act is a sufficiently important factor determining their welfare. Then individual decision makers too, like the economists who make predictions on the basis of *objective* conditional probability distributions, will try to learn about and make decisions on the basis of these *objective* conditional probability distributions.

The above is the hypothesis of *rational expectations*. It implies that the subjective (individual) probability distributions that individual economic agents are assumed to use in making their decisions in an economic model are consistent with the objective conditional probability distribution implied by the model.

In most economic models, it is assumed that the decisions of economic agents are dependent only on one or two parameters of the subjective probability distribution they have for future values of relevant variables and not on the entire distribution. Often under the assumptions of a model, only the mathematical expectation or expected value of this probability distribution is relevant for decision-making. In this case, instead of assuming that the subjective probability distributions that economic agents have coincide with the objective probability distribution implied by the model, it is sufficient to assume that the expected values or expectations of these distributions are equal.

The latter case may therefore be called the *weak version* of the rational expectations hypothesis in contrast to the *strong version*, which assumes that the entire objective probability distribution is known.

If a model assumes a world of perfect certainty then it provides deterministic predictions about dependent variables on the basis of values of independent variables. In the context of such a world, the hypothesis of rational expectations implies that the expectations held by economic agents in the model must be the same as the predictions of the model. Since the expectations held by different economic agents are the same, it follows that in a model with perfect certainty, the assumption of rational expectations is equivalent to the assumption of *perfect foresight* for economic agents.

5.3.2 Phillips Curve and Inflation-Unemployment Trade-off in Policy-making

The hypothesis of rational expectations is better understood if we consider the debate on the implication of the Phillips curve for macroeconomic policy making. Keynes, in the General Theory, had explicitly recognised that increases in effective demand would not only lead to increases in output but also lead to increases in the money wage rate and the price level. It followed, therefore, that policies aimed at reducing unemployment would also lead to some amount of inflation in the economy. Policy-making would be simpler if one knew that a given change in the unemployment rate would be accompanied by a given change in the rate of wage inflation. In that case, one could decide whether it was worthwhile to pursue a policy of reducing unemployment given its costs in terms of an increased rate of inflation.

In 1958, A.W. Phillips published the results of his empirical work on the relationship between the average rate of unemployment and the average rate of change of nominal wages in a business cycle. His work was based on data for the United Kingdom over the period 1861–1957. Phillips was interested in testing the hypothesis that the lower the rate of unemployment, the more rapidly would firms have to increase wages in

order to attract new workers and retain existing ones. He also hypothesised that the lower the initial rate of unemployment, the greater would be the rise in the rate of wage inflation corresponding to a given rise in the rate of unemployment.

Phillips fitted a hyperbola relating the rate of nominal wage inflation to the rate of unemployment for the UK economy for a long period of almost a hundred years (1861-1957). The remarkably good fit of the data provided support for the hypothesis. However, it is to be noted that Phillips excluded periods of high inflation from his estimates and analysis, since he felt that wage inflation during such periods would be explained more by the rise in the cost of living than the unemployment rate.

However, beginning with a famous paper by Samuelson and Solow (1960), the Phillips curve was subsequently interpreted as representing a stable relationship between the rate of wage inflation and the rate of unemployment *over any particular business cycle*. Moreover, based on the assumption that the ratio between prices and nominal wage nate is constant in the short run, the curve was also seen as providing the relation between the rate of price inflation and the unemployment rate. Once this interpretation of the curve became standard, Phillips curves were estimated for almost all countries for which data were available and yielded similar inverse relationships between inflation and unemployment.

The Phillips curve was thus represented as a stable relation between inflation and unemployment over time, which provided a menu of policy choices. An economy could choose whether to have a combination of relatively low unemployment and relatively high inflation or a combination of relatively high unemployment and relatively low inflation.

5.3.3 Inflation-Unemployment Trade-off under Adaptive Expectations

By the late 1960s, the inverse relation between inflation and unemployment as suggested by the Phillips curve was increasingly questioned, especially in the United States. It was because prevailing rates of unemployment seemed to be associated with rates of inflation much higher than would be expected on the basis of Phillips curves estimated from the past. There was economic stagnation depicted through negligible GDP growth on the one hand and high rate of inflation on the other, a situation termed in economic jargon as "stagflation". In his presidential address to the American Economic Association in 1968, Milton Friedman advanced an argument as to why the Phillips curve might not represent a stable exploitable trade-off for policy making. Subsequently, this argument gained wide acceptance.

Friedman argued that workers, in making their labour supply decisions, were concerned not with their money wage rates but with their real wage rates. Moreover, given the structural characteristics of an economy, there was a unique equilibrium rate of unemployment in the economy called the *natural rate of unemployment*. At this rate of unemployment, firms and employed workers would be satisfied with the real wage rate paid for work done and it would not be desirable, given the constraints they faced, for both firms and unemployed workers to establish an employment relationship at a lower real wage rate[1].

[1] Note that, unlike in Keynesian theory, the presumption is that at higher rates of unemployment there would be a *natural* tendency for not only the nominal wage rate but also for the *real* wage rate to decline in the economy.

It might be due, for example, to the fact that because of the heterogeneous nature of jobs and the work force, some time is required by firms and workers to respectively find information about and search for appropriate workers and jobs. Or, it might be due to the fact that some unemployed workers due to costs of mobility (between geographical places or occupations) or due to other labour market imperfections (such as the actions of organised labour – trade unions) are not in a position to seek employment by lowering wages. Other possible causes will be discussed later when we consider theories of unemployment.

At rates of unemployment lower than the natural rate, firms, employing more labour, would want to pay a real wage rate lower than what they pay at the higher natural rate of unemployment, while a higher real wage rate must prevail in order for workers to supply more labour. If workers and firms entered into an employment relationship in terms of a stipulated real wage rate, then a rate of unemployment lower than the natural rate would never prevail.

However, workers and firms actually enter into an employment relationship on the basis of a stipulated nominal or money wage rate. Now, suppose that at a particular time, workers when they make their decisions on whether to accept job offers at a particular money wage rate, expect a lower future price level than firms expect when they decide to make these offers. That is, workers expect a lower rate of price inflation in the economy than do firms. Then a rate of unemployment lower than the natural rate might prevail because the expected real wage rate for workers would be greater than the expected real wage rate for firms.

Suppose that firms correctly perceive the state of demand in the economy and the rate of price inflation. Then, the actual real wage rate in the economy would always be equal to the real wage rate on the basis of which firms decide how much labour to demand. Then, if the economy is to remain at a fixed rate of unemployment, the real wage rate must be constant so that the rate of growth of the money wage rate must equal the rate of price inflation. That is, if $w(t)$ denotes the money wage rate and $p(t)$ the price level in the economy in period t:

$$w(t)/p(t) = w(t+1)/p(t+1) = \omega \text{ (a positive constant), so that}$$

$$[w(t+1) - w(t)]/w(t) = [p(t+1) - p(t)]/p(t) \qquad \ldots(5.1)$$

Remember that $\dfrac{w(t+1) - w(t)}{w(t)}$ gives the growth rate in nominal or money wage in period t.

However, suppose that the fixed rate of unemployment is lower than the natural rate. Then, for the amount of labour corresponding to this rate of unemployment to be supplied, suppose that a higher real wage rate ω' must be expected by workers. Workers therefore will supply the amount of labour corresponding to this rate of unemployment, if and only if

$$w(t+1)/p^e(t+1) = \omega', \qquad \ldots(5.2)$$

where $p^e(t+1)$ denotes the price level expected by workers in period $t+1$.

By re-arranging terms in (5.2) we find that

$$p^e(t+1)] = (1/\omega')w(t+1) \qquad \ldots(5.3)$$

That is, $[p^e(t+1) - p(t)]/p(t) = (1/\omega')[w(t+1)/p(t)] - 1$

That is, $[p^e(t+1) - p(t)]/p(t) = (\omega'/\omega)[p(t+1)/p(t)] - 1$

That is, $(\omega'/\omega)[p^e(t+1) - p(t)]/p(t) + [(\omega'/\omega) - 1] = [p(t+1) - p(t)]/p(t)$ ...(5.4)

Since $\omega'/\omega > 1$ it follows that the rate of growth of nominal demand in the economy must be such that the actual rates of nominal wage and price inflation, given by $[p(t+1) - p(t)]/p(t)$, must always be greater than the expected rate of price inflation $[p^e(t+1) - p(t)]/p(t)$.

If despite the actual rate of price inflation being greater than the expected rate of price inflation, the workers expected that the rate of price inflation remained the same over time, then the actual rate of price inflation required to maintain the given level of unemployment would be constant over time. There would be a stable relation between the rate of unemployment and the rate of inflation as given by the Phillips curve.

However, if the actual rate of price inflation in any period is greater than the expected value there would be a natural tendency for the expected rate of inflation to rise. For example, if $\phi(t)$ and $\phi^e(t)$ respectively denote the actual rate of inflation and the expected rate of inflation in any period t, then a possible assumption about formation of expectations about the rate of inflation in period $t + 1$, is given by

$$\phi^e(t+1) - \phi^e(t) = \lambda[\phi(t) - \phi^e(t)], \text{ where } 0 < \lambda \leq 1. \quad \ldots(5.5)$$

The above equation shows that expectations about the rate of inflation *adapt* (completely when $\lambda = 1$, or partially, when $\lambda < 1$) to deviations of the actual value from the expected value for the rate of inflation in the current period. In other words, expectations for the next period adjust for the prediction error in the current period.

This hypothesis about formation of expectations is therefore known as the hypothesis of *adaptive expectations*. The hypothesis implies that if the actual rate of inflation is always greater than the expected rate, then the expected rate would be rising over time. Therefore, in order to maintain a constant rate of unemployment lower than the natural rate, the actual rate of inflation must be rising over time. Otherwise, the difference between the expected real wage rate of workers and the actual real wage rate (expected by firms) would be falling in the economy.

In fact, substituting from (5.4) for the actual rate of inflation $\phi(t)$ in (5.5), we can show that

$$\phi^e(t+1) = [\lambda(\omega'/\omega) + (1 - \lambda)]\phi^e(t) + \lambda[(\omega'/\omega) - 1] \quad \ldots(5.6)$$

Since $\omega'/\omega > 1$, the coefficient of $\phi^e(t)$ in the above first-order difference equation is greater than one and the constant term on the right hand side is positive. It can therefore be easily shown that $\phi^e(t) \to \infty$ as $t \to \infty$. Hence, if the economy is to maintain a constant rate of unemployment lower than the natural rate, the actual rate of inflation in the economy will not only be increasing but will be increasing without any upper bound.

The stable relation between inflation and unemployment suggested by the Phillips curve is therefore illusory. The same rate of unemployment, if lower than the natural rate, would be associated with increasing rates of inflation over time. Similarly, it can be shown that a rate of unemployment greater than the natural rate, must, in the above case be associated with an increasing rate of deflation over time. The only rate of unemployment which can be maintained in the long run with a constant rate of inflation is the natural rate, where the actual rate of inflation is equal to the rate historically expected by workers. Thus, it follows that there exists no policy trade-off between inflation and unemployment in the sense that a permanently lower rate of unemployment

can be established through policy at the expense of a permanent but fixed increase in the rate of inflation in the economy.

5.3.4 Inflation-Unemployment Trade-off under Rational Expectations

Robert Lucas (1972) pointed out another implication of the above hypothesis of adaptive expectations. Suppose in a particular period (say period *0*) the unemployment rate is lower than the natural rate. Then $\phi(0)$, the actual rate of inflation in period *0* must have been greater than $\phi^e(0)$, the rate of inflation expected by workers. Now suppose that the rate of growth of nominal demand is such that over time there is a constant rate of inflation $\phi(0)$. Then, from (5.5) it follows that for all $t \geq 0$,

$$\phi^e(t+1) - \phi^e(t) = \lambda[\phi(0) - \phi^e(t)]$$

That is, $\phi^e(t+1) - \phi(0) = (1 - \lambda)[\phi^e(t) - \phi(0)]$ ...(5.7)

By solving equation (5.7), we get, $\phi^e(t) - \phi(0) = (1 - \lambda)^t[\phi^e(0) - \phi(0)]$ ...(5.8)

Let us interpret the equation (5.8). If $\lambda < 1$, it follows that, if $\phi^e(0) < \phi(0)$ then $\phi^e(t) < \phi(0) = \phi(t)$ for all $t > 0$. That is, if the expected rate of inflation is less than the actual rate of inflation in period *0* it will continue to be so in all future time periods even though the difference between the two rates converges to *0* as $t \to \infty$.

The implication is that together with a constant rate of inflation, the economy can have a rising rate of unemployment (because the difference between the actual rate of inflation and the rate of inflation expected by workers diminishes over time) but the rate of unemployment can still be lower than the natural rate in every time period (because the actual rate of inflation is always greater than the rate expected by workers). That is, over the long run, together with a constant rate of inflation, the economy could still have an average rate of unemployment lower than the natural rate.

Moreover, the above solution also implies that *ceteris paribus* the greater the value of $\phi(0)$, the greater would be the deviation of the actual from the expected rate of inflation in any time period. Therefore, the greater would be the deviation of the actual rate of unemployment from the natural rate in any time period. Hence, the higher the constant rate of inflation in the economy, the lower would be the long-run average rate of unemployment.

This implies that while macroeconomic policy cannot achieve a constant and permanently lower rate of unemployment in an economy by choosing a constant but permanently higher rate of inflation, an inflation-unemployment trade-off still exists. By choosing a constant but permanently higher rate of inflation policy makers can still achieve a permanently lower rate of unemployment in each period resulting in a lower long-run average rate of unemployment.

Now, consider what happens if we suppose that workers have *rational* expectations about the rate of inflation. First, this implies that, depending on information available to workers in any period t denoted by $I(t)$, it is possible to define an objective probability distribution for the rate of inflation in the economy in period $t + 1$. Thus, there exists a conditional probability density function $f(\phi(t+1)|I(t))$. Let $E[\phi(t+1)|I(t)]$ be the expectation of this conditional probability distribution.

The rational expectations hypothesis then implies that

$$\phi^e(t+1) = E[\phi(t+1)|I(t)] \quad \ldots(5.9)$$

Suppose $\varepsilon(t+1)$ represents the deviation of the actual rate of inflation in period $t+1$ from the rate of inflation expected by workers in period t. That is, $\varepsilon(t+1)$ represents the prediction error of workers about the rate of inflation in period $t+1$.

That is, $\varepsilon(t+1) = \phi(t+1) - \phi^e(t+1)$.

It follows that $E[\phi(t+1)|I(t)] = E[\phi^e(t+1)|I(t)] + E[\varepsilon(t+1)|I(t)]$ ...(5.10)

In (5.10) the first term on the right hand side gives the expectation, given the information set $I(t)$, of the inflation rate in period $t+1$ which would be expected by workers on the basis of the same information set. Workers have a single-valued expectation equal to $\phi^e(t+1)$, which, given information set $I(t)$, is always equal to $E[\phi(t+1)|I(t)]$.

Therefore, $E[\phi^e(t+1)|I(t)] = E[\phi(t+1)|I(t)]$.

Hence, $E[\varepsilon(t+1)|I(t)] = 0$. ...(5.11)

Suppose we consider the conditional probability distribution of the prediction error for the rate of inflation in period $t+1$, $\varepsilon(t+1)$, given that the set of information $I(t)$ is available in period t. If, workers do not make systematic errors in prediction, like consistently predicting a value higher than the actual or a value lower than the actual, then for a sufficiently large number of predictions based on the same information set, the average error in prediction must be zero. This is what is implied by the condition $E[\varepsilon(t+1)|I(t)] = 0$, which, in turn is an implication of our assumption that workers have rational expectations about the rate of inflation.

Thus, if workers have rational expectations about the rate of inflation, then the expected rate of inflation of workers can never consistently underestimate the actual rate of inflation. In fact, over the long run, the sum of positive prediction errors for workers must be equal to the sum of negative prediction errors.

The deviation of the actual rate of unemployment from the natural rate, according to Friedman, is in the opposite direction to the prediction error for the inflation rate. However, the absolute size of this deviation is positively related to the absolute size of the prediction error. Therefore, over the long run, the sum of positive deviations of the actual from the natural rate of unemployment must equal the sum of negative deviations. Hence, the long-run average rate of unemployment must equal the natural rate of unemployment.[2] This is, in contrast to the case of adaptive expectations, where the average rate of unemployment in the economy, over the long run, could be below the natural rate of unemployment.

The hypothesis of rational expectations, together with Friedman's argument about the determination of the rate of unemployment, therefore implies that the long-run average rate of unemployment cannot be anything other than the natural rate, whatever be the nature of the government policy for controlling nominal demand. Thus, even if we interpret the existence of a policy trade-off to mean that the economy can enjoy a smaller long-run average rate of unemployment with a higher but constant rate of inflation in the economy, this trade-off no longer exists once rational expectations are introduced into the Friedman model.

[2] This will be exactly true if the deviation of the actual rate of unemployment from the natural rate is linearly related to the deviation of the actual rate of inflation from the expected rate. Otherwise, one has to consider this to be approximately true. However, there is no reason to argue that, in general, the average rate would be either greater or smaller than the natural rate.

More generally, our analysis suggests that any economic policy, which seeks to achieve its objectives over the long run on the assumption that private economic actors can make systematic errors in prediction, will fail to do so if economic actors satisfy the hypothesis of rational expectations.

There is, however, a different role that the government can play in the economy. Note that the dispersion around the mean of the conditional probability distribution of $\varepsilon(t+1)$, given $I(t)$, gives an indication of the average magnitude or scale of prediction errors (whether positive or negative). *Ceteris paribus*, one expects the measure of this dispersion to be smaller the greater is the extent of information available to workers in period t. Since, the size of deviations of the actual rate of unemployment from the natural rate are related to the size of prediction errors by workers, it follows that the average magnitude of fluctuations in the actual rate of unemployment around the natural rate is smaller, the greater is the extent of information contained in $I(t)$.

Suppose, given a natural (long-run average) rate of unemployment, social welfare is greater for a smaller average fluctuation in the rate of unemployment around this natural rate. Then, the above discussion suggests that the only possible role for government policy, given rational expectations, is to ensure that workers in the economy have as much relevant information as possible while forming their expectations.

Check Your Progress 2

1) Explain the rational expectations hypothesis.

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2) Distinguish between adaptive expectations and rational expecations.

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3) How do you explain the unemployment inflation trade-off on the basis of rational expectations.

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5.4 LET US SUM UP

Expectations about future values of macroeconomic variables play an important role in determination of output and employment. Economic agents such as households, business firms and government take decisions on the basis of current as well as expected future values of relevant variables. Prediction of future values becomes increasingly difficult as we attempt to predict farther into the future. To deal with such a problem we can make use of an objective probability distribution based on past data, which of course is quite difficult.

In this unit we discussed about the basis on which expectations formation takes place. The basis could be simple conventions or certain hypothesis such as adaptive expectations and rational expectations. In adaptive expectations we assume that economic agents use current and recent past information to predict future values. On the other hand, in rational expectations we assume that economic agents use all possible information including prospective policy changes to predict the future. We applied both the types of expectations formation to a particular situation, that is, the trade-off between unemployment and inflation.

Historical data from market economies shows that the average rate of unemployment in a business cycle is negatively related to the average rate of nominal wage inflation. The graphical representation of this inverse relationship is called a Phillips curve. The Phillips curve was initially interpreted as representing the possible combinations of inflation and unemployment rate achievable through policy. The idea was that this relationship between inflation and unemployment would remain stable even when the government sought to use this relationship as a basis for policy-making.

Milton Friedman argued that there was only one real wage rate and one rate of unemployment (*the natural rate of unemployment*) at which firms and workers would be in equilibrium in the economy. In order to maintain a rate of unemployment lower than this rate, there had to be a constant positive differential between the rate of inflation expected by workers and the actual rate of inflation.

Under the hypothesis that workers' expected rate of inflation followed the rule of adaptive expectations, Friedman showed that maintaining a rate of unemployment lower (higher) than the natural rate would imply an unbounded increase in the rate of inflation (deflation) in the economy. Macroeconomic policy could not secure a constant and

permanently lower rate of unemployment in the economy at the expense of a fixed increase in the rate of inflation.

However, Robert Lucas showed that the hypothesis of adaptive expectations also implied that macroeconomic policy could attain a permanently lower (though rising) rate of unemployment in the economy at the expense of a fixed increase in the rate of inflation in the economy. If the hypothesis of adaptive expectations is replaced with that of rational expectations this policy trade-off no longer exists because the long-run average rate of unemployment must always be equal to the natural rate of unemployment.

5.5 KEY WORDS

Adaptive Expectations — Expectations are said to be adaptive when people form their expectations on the basis of past behaviour.

Business Cycle — Fluctuations in output, employment and income which is widespread across all sectors of the economy.

Deflation — A situation when general price level is falling.

Expectations — It means views or beliefs about future macro variables such as prices, interest rates, tax rates, etc.

Natural Rate of Unemployment — The rate of unemployment which prevails in the long run. It varies across countries and over time. However, empirical studies estimate it to be around 6 per cent for some developed economies.

Price inflation — Inflation is a situation when overall prices are rising. We have used the term price inflation to distinguish it from wage inflation. When nominal wage rate is increasing on a sustained basis we call it wage inflation.

Rational Expectations — Expectations are said to be rational when they are formed on the basis of all available information. Under this assumption, expectations are never biased.

Wage inflation — A situation when nominal wage rate, on an average, is increasing.

5.6 SOME USEFUL BOOKS

For section 5.2, the basic readings are:

John Maynard Keynes (1936), *The General Theory of Employment, Interest and Money*, London : Macmillan, Chapter 12.

John Maynard Keynes (1937), "The General Theory of Employment," *Quarterly Journal of Economics*, 51, pp. 209–23.

For further references as well as an idea about the current state of the discussion on Keynes' treatment of expectations:

Jochen Runde and Sohei Mizuhara (eds.) *The Philosophy of Keynes's Economics*, London: Routledge, 2003.

For section 5.3, the readings are:

Steven M. Sheffrin (1983), *Rational Expectations*, Cambridge: Cambridge University Press, Chapter 1.

Paul A. Samuelson and Robert M. Solow (1960), "Analytical Aspects of Anti-inflation Policy," *American Economic Review*, 50(2), pp.177–194.

Milton Friedman (1968), "The Role of Monetary Policy," *American Economic Review*, 58(1), pp.1–17.

Robert E. Lucas, Jr. (1972), "Econometric Testing of the Natural Rate Hypothesis," reprinted in Robert E. Lucas, Jr. (1981) *Studies in Business Cycle Theory*, Oxford: Basil Blackwell.

5.7 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Explain the formation of probability distribution through an example. In sub-section 5.2.1 we have given an example of tossing of a coin.

2) Go through sub-sections 5.2.5 and 5.2.6 and explain.

3) i) See sub-section 5.2.2.
ii) See sub-section 5.2.4.

Check Your Progress 2

1) Go through sub-section 5.3.1 and answer. Link your answer to the formation of objective probability distribution of expectations.

2) Bring out the point that in adaptive expectations we take into account past data white in national expectations we consider all available information.

3) Lender rational expectations economic policy is ineffective in bring out a trade-off between unemployment and inflation and the prevailing rate of unemployment in the long run hover around natural rate of unemployment.

UNIT 6 POLICY-MAKING UNDER UNCERTAINTY

Structure

6.0 OBJECTIVES

After going through this Unit you should be in a position to:

- explain the rationale behind Lucas' critique;
- bring out the implications of Lucas' critique;
- explain the significance of Lucas' critique; and
- explain the need for microeconomic foundations of macroeconomic models.

6.1 INTRODUCTION

In most undergraduate courses in economics, the effect of government policy is studied primarily as once-for-all changes in policy parameters embedded in traditional Keynesian macroeconomic models, like the IS-LM model. Since the 1970s, related to the introduction and gradual acceptance of rational expectations as a hypothesis for the formation of expectations, there has been increasing discussion about how the nature of macroeconomic theory and macroeconomic models might facilitate or hinder proper evaluation of alternative macroeconomic policies. A landmark in this discussion has been Robert Lucas' criticism of traditional macroeconomic models as inadequate bases for policy evaluation. Our discussion in this block therefore begins with the Lucas critique in Section 6.2. Since the critique was addressed to the nature of traditional macroeconomic theory, it had important implications for macroeconomic methodology – the way macroeconomic models *should* be constructed. The methodological significance of the Lucas critique, its influence on the nature of macroeconomic models that were subsequently constructed, is considered in Section 6.3.

An important implication of the critique was that policy should be evaluated not as one-time changes in the value of policy variables but as part of policy rules which also outline how future policy would be determined. There are obvious costs associated

with considering only rules-based-policy in terms of the failure to react to unforeseen eventualities or to correct for miscalculations already embodied in the rule. Despite this additional arguments have been advanced in favour of adherence to policy rules and restriction of discretionary policy-making. We consider these arguments in section 4.

6.2 THE LUCAS' CRITIQUE OF ECONOMETRIC POLICY EVALUATION

Keynes' *General Theory* was the origin for the development of macroeconomics as a branch of economics. However, the teaching of macroeconomics as a subject, especially in the United States, was based on a number of mathematical formalizations, which, correctly or incorrectly, were widely perceived as containing the essence of Keynes' economic doctrine. The simple Keynesian model, and the IS-LM and AS-AD models (see Block-1), provided the backbone of undergraduate macroeconomic textbooks for a very long period of time. These models also served as the basis for macroeconometric models, which were used in various countries to predict the impact of alternative policies on targeted macroeconomic variables.[1] Though Keynes himself largely disapproved of the use of such models for policy evaluation, by the mid-1960s macroeconomic policies in most industrialized economies utilized, in varying degrees, such models for policy making.

In any macroeconomic model there are certain features of the economy which are assumed to remain constant. The whole complex of features that do not change is called the *economic structure* or simply, the *structure* of the model. Numerical constants characterizing the structure are called *structural parameters*. Characteristics of the economy which are subject to change are the variables in the model and they can be divided into two categories: endogeous and exogenous. *Endogenous* variables are variables whose values are sought to be explained within the model while *exogenous* variables are those which can be assumed to be known in advance, being determined outside the model.

Let us consider the following simple model of income determination for illustration:

$$c + i = y \qquad \ldots (6.1)$$

$$c = a(1 - t)y + b \qquad \ldots (6.2)$$

where c : aggregate real consumption expenditure, i : aggregate real investment expenditure, y : real national income, and t : (real) revenue from direct taxes (less government transfer payments) as a proportion of national income. Here a and b are positive constants ($0 < a, b < 1$) which represent structural parameters, c and y are endogenous variables and i and t are exogenous variables. In (6.2) we can say that $(1-t)y$ is the personal disposable income.

The above is a *deterministic* model where the endogenous variables c and y are entirely determined, given the values of the exogenous variables. Since there are two equations with two endogenous variables we can find out the equilibrium value of c and y. Thus, from (6.1) and (6.2) we get,

$$y = (i + b)/\{1 - a(1 - t)\} \qquad \ldots (6.3)$$

$$c = \{a(1 - t)i + b\}/\{1 - a(1 - t)\} \qquad \ldots (6.4)$$

[1] Probably the two most important figures in the history of macroeconometric model-building were the Dutch economist Jan Tinbergen and later, the American economist Lawrence Klein.

However, a deterministic model is usually used to isolate the most important determining factors for the variables of interest, in this case y, and to represent the relationships between the variables in the model in a simple and clear manner. These models therefore are necessarily simplified representations of reality which do not take into account *every* factor which can affect the variables of interest. Therefore, economists accept that deterministic equations (such as (6.2)) will not exactly describe the relationship between endogenous variables (such as c and y) and exogenous variables (such as i and t) which is revealed by actual data.

The usual strategy, which is followed in order to relate deterministic economic models to actual data, is to separately introduce new variables in various deterministic equations of a model. The new variable(s) corresponding to each equation is supposed to encapsulate the effects of all other factors which can affect the exact relationship between variables given by that equation. The variables which are introduced are taken to be random variables representing random disturbances to the deterministic relationship between endogenous and exogenous variables in the model. Thus, the income-determination model in (6.1)–(6.2) may be modified to

$$c + i = y \qquad \ldots (6.1)$$

$$c = a(1 - t)y + b + u \qquad \ldots (6.2')$$

where u represents an additive disturbance term introduced into the exact relationship given by (6.2). In contrast to the equation (6.2), which is deterministic, we call (6.2) a *stochastic* equation as the stochastic or error term 'u' is added here. No disturbance term is introduced in (6.1) because it is a definitional identity.

Equations (6.1) and (6.2′) represent a very simple macroeconometric model, once the variables are all dated (that is, it is specified whether these variables all correspond to the same time period or whether lagged values of some variables should be taken) and assumptions about the probability distribution of u are specified. Actual macroeconometric models which are used for policy analysis in real economies are, of course, much larger, including many more variables and equations. For example, even the classic macroeconometric model for the United States developed by L. R. Klein and A. S. Goldberger in 1955, had twenty stochastic equations, twenty endogenous variables and eighteen exogenous variables.

In the simple income-determination model we considered above, t is a policy variable. If we assume that the random variable u is distributed with expected value 0, then from (6.1) and (6.2′) it follows that the expected value of y (given the values of i and t) is given by

$$E(y) = (i + b)/\{1 - a(1 - t)\}$$

In order to evaluate (assuming that i is known in advance) the impact of alternative choices of t on the expected value of national income y in an economy, one needs to obtain estimates for the structural parameters a and b for the economy. This can be done through statistically estimating the parameters in the model (6.1)–(6.2′) using past data on the variables in the model.

Broadly speaking, the statistical estimate of a gives us an estimate of the average change in aggregate consumption expenditure, which, in the past, has been associated with a unit change in disposable income in the economy. Note that theories of consumption like the life-cycle or the permanent-income theories (to be discussed in Unit 7) imply that consumption expenditure in the economy depends not only on current

disposable income but also on expected future levels of disposable income. Expected levels of disposable income depend in turn on expected future values of the variable *t*. The way consumption expenditure reacts to changes in current tax rates and disposable income in a particular instance therefore depends crucially on how expected values of tax rates and disposable income change in response to changes in current values.

Therefore, the statistical estimate of *a* derived from data for a particular time period tells us how consumption expenditure could be expected to change following a change in tax rates and disposable income, but only in a context where current changes in tax rates would have the same kind of impact on future expectations of tax rates as in the period from which the data is taken.

Now, suppose that in the past the policy environment has been such that most tax rate changes have been temporary in nature. Households, in this policy environment, will have adjusted their expectations keeping in mind the nature of policy changes. Thus, in the past, changes in current tax rates would have been interpreted by households as implying little change in expected future tax rates and therefore little change in future levels of disposable income. Hence, in such a policy environment, permanent incomes of households and consumption expenditure in the economy would be weakly related to changes in current tax rates and disposable income. The estimated value of *a* would therefore be relatively small.

Suppose, however, the government now contemplates a more stable tax policy in which changes in tax rates are to be of a more permanent nature. If households in the economy understand this change in the policy environment, they will interpret any change in current tax rates as having a significant implication for expected values of future tax rates and disposable incomes. Any change in current tax rates will therefore have a strong impact on the permanent incomes of households and on the level of consumption expenditure in the economy. Hence, if policy makers use the statistical estimate of *a* derived from past data they will underestimate the impact of tax policy changes on consumption expenditure and income in the economy.

The problem with econometric policy evaluation of the above kind can be traced to certain distinctive features which are also present in the above exercise. First, the macroeconometric model used to evaluate policy [(6.1) and (6.2′) in our example] includes equations relating the behaviour of various aggregate variables. For example, (6.2′) relates aggregate consumption expenditure in the economy to aggregate disposable income in the economy. Second, the actual behavioural relations between various *aggregate* variables are the resultant of the multitude of decisions made by different *individual* agents (households, firms, etc.) in this economy. Thus, the actual relation between aggregate consumption expenditure and disposable income in the economy is the result of the consumption decisions made separately by different households. Third, decisions made by individual economic agents are of an intertemporal nature. That is, current decisions are made taking into account objectives and constraints relating to future points in time. For example, in deciding on current consumption, households might wish to consider trade-offs between current and future utility derived from consumption and evaluate total consumption possibilities by taking account of both current and future disposable income.

The relation between different aggregate variables will therefore depend on how expected future values of variables change with current values. In particular, these relations will depend on how expectations about future values of policy variables are

affected by changes in current values of policy variables. Suppose the same change in the current value of a policy variable can induce, at two different points in time, different effects on expectations of private economic actors about future values of the policy variable. Then, the behavioural relations including the policy variable and other aggregate variables could be different at different points in time.

The implication is that the parameters of the behavioural equations which are assumed to be unchanging over time in a macroeconometric model, forming a part of the structure of the model, actually cannot be considered to be so. This, in essence, is Lucas' critique of the use of macroeconometric models for policy evaluation.

Let us illustrate the Lucas' critique through our discussion of the inflation-unemployment trade-off in the previous unit. So long as the government does not attempt to manage the level of nominal demand in the economy, workers accept that fluctuations in growth rates of nominal expenditure in the economy due to government policy are random in nature (not implying any systematic effort on the part of the government to control the level of demand) and continue to expect the same average growth rate of nominal expenditures as in the past. Therefore, they have fixed expected rates of inflation and the historical data relating fluctuations in unemployment to actual fluctuations in the rate of inflation traces out a Phillips curve.

If workers now believe that there is a change in the policy regime and that the government seeks to systematically exploit this trade-off by targeting a level of unemployment lower than the natural rate, workers would expect a higher growth rate of nominal expenditure and a higher rate of inflation in the future. Consequently, if the government now tries to evaluate the effects of a higher rate of inflation on unemployment on the basis of the Phillips curve estimated from past data, the government would overestimate the effect of this policy on unemployment. This is because the rate of inflation expected by workers would be higher than that in the previous policy regime.

Check Your Progress 1

1) Give an example of a simple stochastic macro econometric model.

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2) What is the main criticism of macroeconometric models by Lucas?

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6.3 SIGNIFICANCE OF THE LUCAS' CRITIQUE

The development of macroeconomic theory since the 1970s was significantly influenced by the Lucas critique. This critique implies that we cannot apply econometrics using macroeconomic models, which directly assumed certain behavioural relations between macroeconomic variables, in order to check the effects of alternative policies. The basic problem lies in the fact that the parameters in these behavioural equations cannot be assumed to be invariant with respect to policy if there are changes in the policy environment as a whole. This is, in turn, because the reaction of individual economic agents to policy changes usually differs under different policy environments or *policy regimes*.

6.3.1 Micro Foundations

The Lucas critique implies that in order to correctly evaluate policies it is necessary in macroeconomic models to take into account how differences in the policy regime influence individual reactions to a particular policy. This can only be done if macroeconomic models make explicit assumptions about how individual economic agents make their decisions (including how current and future government policies enter into their decision-making processes), how their expectations about the future (including future government policies) are formed and how individual agents interact in the economy to determine the values of macroeconomic variables. Any relation between aggregate variables in the model must be derived from these microeconomic assumptions. In other words, the Lucas critique implies that every macroeconomic model must be endowed with *microfoundations*. Many of the macroeconomic models that we will consider in the remainder of this course have explicit microfoundations.

There is another rationale for including micro foundations. Traditional macroeconomic models such as the IS-LM model contain various behavioural relations such as the aggregate consumption function, the investment function and the demand-for-money function. However, economists who used these models have tried to justify the assumed behavioural relations between macroeconomic variables in terms of microeconomic behaviour. For example, in the 1950s, William Baumol and James Tobin tried to explain the form of the Keynesian demand-for-money function by building models explaining the demand for transactions balances in an economy and James Tobin tried to do the same by modeling the demand for speculative balances in an economy.[2]

Thus, any traditional macroeconomic model can also be thought of as implicitly making a set of microeconomic assumptions. However, various behavioural equations in a model (each probably justified independently by various economists at various points in time) are not derived explicitly from exactly the same set of assumptions about the microeconomic structure of the economy. The consistency of these implicit microeconomic assumptions and of the behavioural relations in the model, can therefore only be considered at a fairly superficial level. If one desires a stricter check on the consistency of the assumptions in a macroeconomic

[2] William J. Baumol (1952)"The Transaction Demand for Cash: An Inventory Theoretic Approach," *Quarterly Journal of Economics*, v.66, pp.545–66; James Tobin (1956)"The Interest-Elasticity of the Transactions Demand for Cash," *Review of Economics and Statistics*, v.38, pp.241–47; James Tobin (1958)"Liquidity Preference as Behavior Towards Risk," *Review of Economic Studies*, v.25, pp.65–86.

model it becomes necessary to explicitly derive the behavioural equations in the model from the same set of assumptions about the microeconomic structure of the economy. This would involve endowing all macroeconomic models with explicit microfoundations.

6.3.2 Rational Expectations and Policy Rules

Suppose we have a macroeconomic model endowed with microfoundations. We know that any plausible set of microfoundations must incorporate the fact that individual economic agents make decisions based not only on the current values of policy variables but also on expected future values of these variables. In order to predict the effect of choosing a particular current value of a policy variable it is necessary to specify how such a choice would affect expected future values of the variable.

We have already discussed how, in order to reduce the dependence of economic predictions on the subjective judgment of the policy maker, macroeconomic models usually assume that economic agents have rational expectations. Rational expectations, however, imply that there is an *objective* probability distribution associated with future values of the policy variable, with at least the expected values of such distributions being known.

Therefore, in order to evaluate policy using such a macromodel, the policy maker himself must know the objectively expected value for the future value of the policy variable. This implies that the policy maker himself must know the specific values of the policy variable which will be targeted by policy under various circumstances in the future. Therefore, in order to evaluate the effects of choosing a particular policy in the current period, the policy maker must already have a *policy rule* in mind. Thus, in models endowed with microfoundations and assuming rational expectations, it is not possible to evaluate the effects of a particular current policy but it is only possible to evaluate the effects of a particular current policy as part of a particular policy rule.

For example, in such a model it will not be possible to evaluate the effect of a particular rate of growth of money supply in the current period. It will only be possible to evaluate the effect of choosing, for example, a rule that stipulates a particular constant rate of growth of money supply in the current and in all relevant future periods, or a rule that stipulates a particular time path for money supply over a time horizon encompassing the present and all relevant future time periods, or a rule which makes the rate of growth of money supply a function of the rate of inflation and the rate of unemployment in the previous period.

6.3.3 Some Qualifications

The requirement of microfoundations clearly imposes additional restrictions on macroeconomic models. Only those sets of behavioural equations between aggregate variables can be postulated for which every member of the set is derivable from the same assumptions about the microeconomic structure of the economy. This suggests that the set of models which can be constructed with microfoundations at any given point in time is dependent to a greater degree on the boundaries of mathematical knowledge possessed by economists at that point in time. Since the tractability of macroeconomic models – the ease with which assumptions in a model can be manipulated to logically yield interesting implications – is also a desirable feature, it follows that there will be significant restrictions on the nature of microfoundations with which macroeconomic models can be endowed at any given point in time.

A possible consequence of the above limitation is that economists might be confined in their analysis to models with microeconomic structures far removed from reality. Note that the possible policy alternatives which can be suggested by a model and an evaluation of the effects of these policies will be entirely determined by the model's microeconomic structure. Therefore, even if such models successfully mimic the working of the real economy over a period of time in the past, the policy conclusions of the model might be seriously misleading for the real economy in the future. This implies that, while macroeconomic modeling with microfoundations may be a worthwhile endeavour, one must always be alert to the possibility that in simplifying reality, microfoundations may also distort reality to an unacceptable degree.

Moreover, while macroeconomic models equipped with microfoundations might perform better in time periods involving a change in policy regime, within a particular policy regime there is no reason why they should perform better. Also, if individual economic agents find it costly to gather and process information about changes in policy regime or to make changes in decision making procedures, then they might resort to using 'rules of thumb' or procedures which are approximately satisfactory for a large range of policy regimes instead of procedures which are designed optimally for single policy regimes. In this case, unless changes in policy regimes are distirict in nature, economic agents might ignore the impact of such changes on the relation between current policy and expected future policy. The Lucas critique would in such circumstances lose much of its significance.

6.4 RULES VERSUS DISCRETION

We saw earlier that in models endowed with microfoundations and assuming rational expectations on the part of economic agents, choice amongst alternative policies took the form of choice amongst alternative policy *rules*. However, such rules could also take the form of choosing, at any given instant of time, a policy which is best according to some well-defined criterion at that instant of time. What is required is that future policy intentions be sufficiently unambiguous so that policy makers themselves can correctly gauge the (rational) expectations of private economic actors (households, business firms) about future policy.

For example, suppose that a government in its choice of current and future policy is entirely governed by what would be the effect of such policies on its electoral prospects at the next general elections, subject to the constraint that as a result of these policies it should not be forced out of office in the intervening years. Moreover, suppose it is clear to the public which sequences of policies the government feels would best serve this purpose under alternative sequences of relevant events in the intervening years. In that case, private economic actors would rationally expect the government, depending on the unfolding sequence of events, to follow the corresponding sequence of policies. If there is an objective probability distribution associated with the possible sequences of relevant events, private economic agents would have an objective probability distribution associated with the future sequence of policies.

First note that every sequence of events relevant for government action cannot be anticipated in advance. Therefore, in defining a policy rule one necessarily rules out the possibility of discretionary government action in the case of events, which are completely unanticipated. Revision of policy rules within the time period for which they are announced is a difficult matter because policy rules must be credible. The expectations of private economic agents about future policy will be in accordance with the policy rule announced by policy makers only if they believe that in the future the government

will stick to this rule. Therefore, the greater the deviation from rules that a government displays in undertaking discretionary action even in circumstances where intervention is unanimously demanded, the less will be the credibility of policy rules announced by the government in the future. Thus, even when faced with unanticipated eventualities requiring policy intervention or even after realizing that announced policy rules were framed under certain mistaken assumptions, governments might be reluctant to revise announced policy rules.

Note also that in order for an objective probability distribution to be associated by the public with the possible sequence of relevant events and to know the desired policy sequences corresponding to alternative sequences of relevant events, these alternative sequences must be definable simply (not using too many characteristics) and precisely. The possibility of government policies being designed very specifically according to circumstances or according to qualitative judgments about the economy is therefore also eliminated if policy rules have to be followed.

While the inflexibility imposed by the use of policy rules has obvious costs, some economists have argued that this inflexibility might have advantages as well. Milton Friedman has been the most noted proponent of this view. In Friedman's opinion, allowing governments flexibility in reacting to current circumstances is counterproductive because governments often abuse this discretion by framing policy for narrow short-term political gains. Moreover, policy makers are tempted to fine tune the economy, reacting to every short-term or small disturbance. This may be costly when there are substantial time lags between the recognition of the need for intervention and its ultimate impact on the economy and when there is substantial uncertainty as regards the magnitude and timing of the impacts of various alternative policies. Time lags may arise, for example, from the time required to draw up an appropriate policy, the time required to obtain executive and legislative approval for the policy or the time required to adjust the administrative mechanism for implementation of the new policy. Given the uncertainty surrounding the effects of policies, Friedman suggests that discretionary policy actions might themselves become the source of random disturbances in the economy.

The credibility of an announced policy rule depends not only on past experience regarding a government's ability to adhere to commitments but also on a rational evaluation about the future possibility of a government adhering to a policy rule. From this perspective, governments like private agents in the economy have objectives, which they aim to achieve through policy actions. Suppose we define a policy rule to be *time-consistent* or *dynamically consistent* if at every instant over a given time-horizon the policy chosen under the rule is optimal for the remaining part of the time-horizon, taking as given the policies that have been chosen before that instant and assuming that at every future instant, policy will be similarly optimally chosen. If governments have the discretion to change policy at future points in time then an announced policy rule will not be credible unless it is time-consistent. If a policy rule is not time-consistent, at some point in time it will not be optimal for the government to follow the policy dictated by the rule. The government will then benefit by deviating from the rule at that point in time.

A problem might arise because the policy rule which is optimal over the entire time horizon may not be time-consistent. This possibility was initially raised by Finn Kydland and Edward Prescott in a research paper published in 1977. In a celebrated example, Kydland and Prescott illustrate their argument by considering the case of policy designed to safeguard against flood hazards. Suppose the socially desirable outcome is not to have houses built in a flood-prone area but, if there already exist settlements there, to

undertake certain costly flood-control measures involving the building of dams and embankments. If the government announced that it would never undertake flood control measures in a currently uninhabited flood-prone area and if private agents believed that the government would adhere to this policy rule then nobody would erect buildings in that area. However, the rational agent will not find this policy rule credible because he knows that once he and others construct buildings in that area, the government will find it optimal to take flood-control measures. Therefore, society will be forced to accept a sub-optimal outcome under which private agents erect buildings in the flood-prone area and the government then steps in to build dams and embankments.

If we rule out the possibility of enacting a law to prevent the construction of buildings in the flood-prone area, then the only way that the government can make the policy rule (that it is not going to ever undertake any flood-control measures in a currently uninhabited flood-prone area) credible is to somehow bind itself to the implementation of such a policy rule over time. The government must be able to convince that it is not going to be able to pursue policies in the future which will be optimal for it to pursue at future points in time. Thus, according to this view, not only might policy rules allow for more optimal outcomes than discretionary policy choices over time, the possibility of using discretion in policy making must itself be restricted if optimal policy rules are to be made credible.

An obvious way by which the government can commit to a particular policy rule is to enact legislation making it costly to deviate from the rule in the future. However, it might be difficult and time-consuming to amend this legislation if there arises unanticipated eventualities which urgently require deviation from the rule or if it is found that important assumptions made in framing the rule are erroneous. An alternative way by which an optimal policy rule may be made credible without losing the flexibility for using discretion in emergencies is for the government to delegate responsibility for this policy to some autonomous agency which the public perceives as having a different objective function. Thus, often governments make monetary policy a responsibility of an independent central bank, the idea being that a monetary policy rule aimed at lower inflation would be more credible if it is executed by financiers known to be averse to inflation rather than by politicians.

Of course, some politicians or political parties might have longer time horizons over which they wish to attain their objectives compared to others. In this case, they might build up a reputation while in government for following policy rules. While initially these politicians or parties might have to incur certain costs (people who build houses expecting the government to take flood-control measures might find their houses washed away by floods), in the long run they might be able to benefit from being able to enforce the socially desirable outcome (the public might begin to find the government's claim of never taking flood-control measures in currently uninhabited flood-control areas credible and stop such building).

Check Your Progress 2

1) How does discretion results in sub-optimal outcomes of a policy even if a time-consistent policy is followed?

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2) What is the rationale of including microfoundations in policy making?

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6.5 LET US SUM UP

In this Unit we discussed the issue of policy formulation given the uncertain nature of future economic environment. In most cases we resort to macroeconomic model building on the basis of past data. Such models, however, implicitly assume that the past trend is likely to continue in future also. When the economy is in transition or past policies were ad hoc in nature then the estimates of macro econometric models may not give reliable outcomes. Robert Lucas pointed out the limitations of macro econometric model building which is known as Lucas' critique.

Another issue that we discussed in this unit is the relevance of microeconomic foundations for macroeconomic models. We explained the concept of microeconomic foundation through Keynesian consumption function. Moreover, the role of rational expectations should be taken into account while interpreting macroeconomic models.

In practice policy formulation needs to be based on certain rules or procedures. However, there is a need for revision of policy rules against unanticipated developments which may be time-taking and costly. In order to tackle such eventualities the government can delegate the responsibility to some autonomous body. The possibility of following a sub-optimal policy over time cannot be ruled out.

6.6 KEY WORDS

Endogenous Variable	The variables determined within the system of equations.
Exogenous Variable	The variables given from outside the model.
Microfoundations	The procedure where macro-behaviour of a model is based on micro-behaviour.
Permanent Income	That part of the current income that is expected to remain stable over the long run.
Rational Expectations	The hypothesis that expectations of people on the whole is unbiased.

6.7 SOME USEFUL BOOKS

The classic reference for Section 6.2 is the original paper by Lucas:

Robert E. Lucas, Jr. (1976) "Econometric Policy Evaluation: A Critique," in Karl Brunner and Allan H. Meltzer (eds) *The Phillips Curve and Labor Markets*, Carnegie-Rochester Conference Series on Public Policy, Vol.1. Amsterdam: North-Holland. Reprinted in Robert E. Lucas, Jr. (1981) *Studies in Business Cycle Theory*, Oxford: Basil Blackwell, pp.104–130.

See also Thomas J. Sargent (1980) "Rational Expectations and the Reconstruction of Macroeconomics," *Federal Reserve Bank of Minneapolis Quarterly Review*, 4(Summer). Reprinted in Preston J. Miller (ed.) *The Rational Expectations Revolution: Readings from the Front Line*, Cambridge, Mass.: The MIT Press, pp.31–39.

An important reference for Section 6.3 is:

Robert E. Lucas, Jr. (1980) "Methods and Problems in Business Cycle Theory," *Journal of Money, Credit and Banking*, 12(4, part 2). Reprinted in Robert E. Lucas, Jr. (1981) *Studies in Business Cycle Theory*, Oxford: Basil Blackwell, pp.271–296.

See also the discussion of Lucas' paper by Edwin Burmeister and James Tobin in the same issue of *Journal of Money, Credit and Banking* and Sargent's paper cited above.

A critical overview of the endeavour to introduce microfoundations is provided by:

Kevin D. Hoover (2001) *The Methodology of Empirical Macroeconomics*, Cambridge: Cambridge University Press, Chapter 3.

For Section 6.4, refer to:

Milton Friedman (1948) "A Monetary and Fiscal Framework for Economic Stabilization," *American Economic Review*, **38**, pp.245–64.

F. E. Kydland and E. C. Prescott (1977) "Rules Rather than Discretion: The Inconsistency of Optimal Plans," *Journal of Political Economy*, **85**(3), pp.473–92.

David Romer (1996) *Advanced Macroeconomics*, Singapore: McGraw-Hill, Chapter 9.

6.8 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) We have presented the simple model of income determination in section 6.2. Think of another example.

2) Go through section 6.2, particularly pages 26 and 27.

Check Your Progress 2

1) Go through section 6.4 and answer.

2) See sub-section 6.3.1 and answer.