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Wage Inflation in the U.K.: 1951 - 1975, A Switching Regimes Model

by

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Declaration

The work on the U-V curve in chapter 3 was largely based on a joint working paper with Dr. Van Doorn, "The Relationship Between Unemployment and Vacancies in Great Britain", Discussion Paper No 77-16, Department of Economics, University of British Columbia. (Parts of chapter 2, also drew on this work).

The work on expectations in chapter 5 was largely based on a paper published in 1978, "Expectations of Wage Inflation and their Formation", Applied Economics.

Summary

This thesis has been primarily concerned with explaining why excess demand based theories appear to provide a satisfactory explanation of inflation prior to 1969, but appear to break down after that date. This explanation took the form of a synthesis between such theories and wage bargaining ones.

Each of these theories emphasise aspects of the inflationary process which the other ignores. Excess demand based theories emphasise the role of the employer, but ignore that of the trade union, whilst wage bargaining theories do the opposite.

Thus the employer will seek to pay a wage, which we call the competitive wage, based on the ease with which labour can be attracted and retained. The more difficulties he is experiencing, the higher the competitive wage will be. The wage the trade union leader seeks to negotiate will be that which satisfies some mimimum proportion of his membership. It is this which we call the union leader's target wage.

If, in the wage negotiations, the competitive wage exceeds the target wage, then this is the wage that will be"negotiated". This is, we argue, in fact the situation which existed prior to 1969, and this is why excess demand based theories appeared to be satisfactory in this period. If, however, this is not the case, then we are in a more genuine bargaining situation, which is what we argue has happenned several times since 1969.

In developing this theory several subsidiary themes emerge, e.g., the importance of profits within an excess demand framework, the problem of perception with respect to expectations, the specification of the error term in the wage equation and the link between the worker's aspiration wage and permanent income. We also examine the search process, the degree of certainty with which expectations are held and the relationship between union leaders and their membership.

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Chapter 1

Introduction to the Thesis

1.1 Introduction

The purpose of this chapter is not to provide a comprehensive survey of the work on wage inflation. This has been done elsewhere, to varying degree's of thoroughness (Mulvey and Trevithick (1975), Laidler and Parkin (1975), Gordon (1977), Fleming (1976)). Instead we will be laying the foundations upon which the thesis can be built, by examining certain contributions and trends within the literature. Because of this there will be a bias to considering the theoretical side of the literature and ignoring somewhat empirical contributions. Within this framework we shall also occasionally be calling attention to what seem to us to be certain deficencies in the theories and reconciling the different trends.

There appear to be two main trends or approaches to the problem of wage inflation. First there are those studies which see it essentially as, for want of a better phrase, an excess demand type phenomenon. The alternative is to see it in terms of a bargaining situation between bilateral monopolists. In this latter case,although the forces of supply and demand may influence the outcome, they may not be the most important factor. The degree of trade union militancy, which may not be governed by economic factors alone, may also affect the rate of wage inflation. We will begin by analysing work in the excess demand tradition and then turn to the trade union bargaining approach.

1.2 Excess Demand Theories of Inflation

One of the earliest works which explicitly and in detail postulated a relationship between unemployment and inflation was Fisher's 1926 paper. Fisher took the rate of change of prices as the independent variable, i.e.

the causation runs from price changes to unemployment in his words

> "When the dollar is losing value, or in other words when the price level is rising, a businessman may find his receipts rising as fast, on the average, as this general rise, but not his expenses, because his expenses consist, to a large extent, of things which are contractually fixed ... Employment is then stimulated - for a short time at least."

In more recent times interest in such a relationship stems, not from Fisher, but from Phillip's classic paper (1958), where to quote Friedman (1975) he "rediscovered" this relationship. This rediscovery consisted of fitting a curve through observations in the unemployment-wage inflation plane for the period 1861 to 1913, when he came to compare post-war observations with this curve he found a "stunning correspondence". Phillips also found that actual observations tended to loop around this curve in, generally, an anticlockwise direction. Thus if unemployment was falling the rate of wage inflation would be higher than that indicated by the curve and vice versa if unemployment was rising. Phillips' rationale for these loops was not made entirely clear. Although Lipsey (1960) thought that he might have had some expectational mechanism in mind, whereby employer's might vary the strength of their bidding not merely in response to present need, but because of what they expect to need in the future. However as Lipsey also noted there are certain difficulties with this,and other possible explanations, and finding a rationale for these loops bacame a favoured occupation for economists for several years.

Finally Phillips postulated a restricted role for price increases which operates with a threshold effect. It is only when the cost of living rises more rapidly then money wages that these become operative. He claims that when money wages are rising more rapidly than the cost of living then

> "... employers will merely be giving under the name of cost of living adjustments part of the increases which they would in any case have given as a result of their competitive bidding for labour."

This hypothesis has not received much attention, nor been further developed. Trevithick and Mulvey, for example, find it "not particularly convincing". However it seems to us a hypothesis worth pursuing and we will be returning to this when we come to examine inflation in the 1970's.

One important implication of Phillips' work is that it indicated the existence of a trade off between unemployment and inflation, e.g. the curve showed that at a rate of unemployment of about 2½% wages would rise at about 2% p.a., which is consistent with price stability if productivity is also rising at 2%. The existence of this trade off generated a great deal of literature on the optimal combination of unemployment and inflation.

Although it is clear that Phillips had in mind the hypothesis that wage inflation was a function of excess demand in the labour market there was little in the way of theoretical justification for this. This had to wait until Lipsey's paper which basically, for the case of a single micro-labour market, postulated a wage reaction function dependent upon the ratio of excess demand for labour to total supply

$$\dot{W}_i = f\left(\frac{D_i - N_{si}}{N_{si}}\right) \qquad (1.1)$$

He then linked the rate of unemployment with the excess demand for labour

$$U_i = g\left(\frac{D_i - N_{si}}{N_{si}}\right) \qquad (1.2)$$

and upon combining these two relationships we get a further one between wage inflation and unemployment

$$\dot{W}_i = f(g^{-1}(U)) \qquad (1.3)$$

Lipsey's explanation of the loops is simply that in the upswing some some labour markets might lag behind others, pushing the Phillips curve to the right, whilst in the downswing the lag disappears hence the macro curve coincides with the micro curves. Ingenious as it is this explanation suffers from a number of flaws. Firstly relatively little in the way of justification is given for the operation of the lags in this manner. Secondly it assumes identical micro-reaction curves, an assumption which has been called into question by, for example, Bowers et al (1970) and Sargan (1971).

An alternative explanation for these loops,which can be made compatible with the rest of Lipsey's theory, was put forward by Hines (1971). He proposes that vacancies and unemployment are not related in a linear manner. But when excess demand is rising vacancies will rise more rapidly than unemployment falls and vice versa when excess demand is falling (the reasons for this will be examined in detail when we come to consider specifically the relationship between unemployment and vacancies). Thus unemployment will understate the true level of excess demand when it is rising and overstate it when it is falling. Hines claims that a valid proxy for excess demand is provided by the level of unemployment together with the rate of change of unemployment. This then would seem to offer an explanation for the loops which suffers from none of the drawbacks of either Phillips' or Lipsey's.

1.3 The Breakdown of the Phillips Curve

This concept of a relationship between the level of unemployment and the rate of change of wages quickly became accepted by economists. As an empirical concept it seemed beyond dispute, in addition Lipsey's analysis seemed to have provided the basis for a satisfactory explanation. Thus Corry and Laidler in 1967 were able to write

> "It is apparent that the Phillips curve has been absorbed rather rapidly by the profession, a tribute to the great insight furnished in Professor Phillips' orignal article and also to the high quality of subsequent literature."

In the opinion of most of the "profession" the only remaining questions were mainly peripheral ones, such as those surrounding the trade off.

Unfortunately, as so often happens, this feeling of satisfaction was rudely shattered by actual events. The U.K. Phillips curve appeared to shift substantially and unpredictably to the right in 1966/7 and again in 1969/70, this latter shift being replicated in most other developed countries. In the face of this many economists attempted to reconstruct the Phillips curve in a manner which could account for these shifts. This reconstruction took place on two planes, the first revolved around attempts to improve upon registered unemployment as a measure of excess demand. The second was more fundamental and involved a reconstruction of the theoretical framework proposed by Lipsey, which led to what has become known as the expectations augmented Phillips curve.

Those economists who argued that unemployment was a less than adequate measure of excess demand noted that there was also an apparent shift in the relationship between unemployment and vacancies (Bowers et al (1970)). Possible reasons for this shift, which also implied a shift between unemployment and excess demand, included the introduction of earnings related benefits in October 1966, which had the effect of almost doubling unemployment benefit payable to a man who had previously been recieving average earnings, the introduction of statutory redundancy payments in December 1965 and various labour shake-out hypotheses.

Because of this it has been argued that vacancies give a more accurate measure of excess demand than unemployment and Trevithick and Mulvey report that the vacancy rate performs considerably more satisfactorily than the unemployment rate as an explanatory variable in the wage equation for the years 1966-69, but that in 1970 and 1971 this too seems to break down.

In a similar vein Simler and Tella (1968) used a "labour reserves" variable based on variations in participation rates. Taylor, in a series of papers (1970, 1972 and Godfrey and Taylor (1973)), has used a measure of unemployment which includes estimates of hoarded labour. The results of such exercises are somewhat contradictory, Perry (1971) and Taylor (1970) found that including hidden unemployment in the regressions for the U.S. did not improve the results wheras Simler and Tella found that they did. For the U.K. Taylor (1972) and Godfrey and Taylor found hoarded labour to be a significant factor, though this only seems to apply to the rate of change of earnings corrected for overtime and not to the wage rate change equation.

Thus this line of approach seems less than satisfactory. Economists, faced with the apparent breakdown of the Phillips curve seemed to be replacing registered unemployment with anything which appeared to work. They then, sometimes, attempted to find a theoretic justification for their superiority over unemployment as a measure of excess demand in the labour market. Consider, for example, Taylor's justification for the importance of labour hoarding. He argues that the correct measure of excess demand would take account of hidden unemployment and hoarded labour. The argument for hidden unemployment is the stronger of the two, although even here there are difficulties. It can be divided into several components, firstly those workers who are actively involved in search for employment but have not registered as unemployed, probably because they do not qualify for unemployment benefit.Secondly there are those, not actively engaged in search, but who would take a job "if one came along". The first of these components will probably have a stronger influence on wage inflation than the second.

The justification for hoarded labour is, however, more tenuous. Whether they are actively engaged in productive work or not, the fact remains that they are employed. They do not represent an excess supply of labour because they are not actively engaged in looking for employment or,in offering their services in the job market, for their services have already been bid for, and in excess demand terms it matters little as to the possible motives of the employer in bidding for them. To stress the point again, they do not represent an excess supply of labour because they are already employed.

Although, in another context,it could be argued that as these workers are not currently engaged in productive work the employer will not be so keen to bid for more workers as he might otherwise be. This might be quite valid but in this case it would appear that hoarded labour is acting as a proxy for "employer's keeness" to bid for labour, and it does not seem valid to place it in the equation on the same grounds as registered unemployment, which is there to represent the excess of supply over demand. If hoarded labour is to be included in the equation as a proxy for employer keeness then it should properly be entered as affecting the speed with which the market responds to excess supply, not as a component of excess supply itself.

Similar comments can also be made about the work of Bowers et al. If, for example, the relationship between unemployment and vacancies has shifted this might imply not only a shift between unemployment and excess demand, but also one in the opposite direction, between vacancies and excess demand.

1.4 The Expectations Augmented Phillips Curve

The second line of approach,aimed at rehabilitating the Phillips curve, involved a much more fundamental reappraisal of the theoretical framework proposed by Lipsey. Once again within this general reappraisal there appear to be two fairly distinct approaches. The first was developed by Friedman (1968), and involved a more rigorous application of the commodity market approach. The second approach was developed basically by Phelps (1968), Mortenson (1970) and Holt (1970), but has been expanded upon by other economists. In some respects it is more revolutionary than Friedman's approach as it abandoned the perfectly competitive labour market assumption made, implicitly or otherwise, by Lipsey and Friedman. In addition it is, as developed by Mortenson for example, a dynamic theory, in the sense that the decision makers are not restricted to considerations of the present alone. However a more detailed consideration of this approach will have to be postponed until we have examined the contributions made by Friedman and others who have been influenced by him.

Friedman argues that the relevant wage rate in (1.1) is the real wage and not the money wage. In addition, as both potentialemployers and potential employees envisage the employment contract covering a fairly long period, it will be the anticipated real wage not the current real wage which is relevant. The "Phillips curve" can then be written as

$$\dot{W}_t - \dot{P}^e_t = f(U_t) \tag{1.4}$$

or

$$\dot{W}_t = f(U_t) + \dot{P}^e_t \tag{1.5}$$

where $\dot{P}^e_t$ is the expected rate of price inflation over some future period. This equation is known as the "price expectations augmented Phillips curve". Friedman also argued that for short periods price inflation expectations might lag behind actual inflation, but given a constant inflation rate expectations would eventually equal inflation. If we also make the assumption that in the long run the rate of price inflation equals the rate of wage inflation plus a constant, k, which may be negative and represents the rate of productivity and any other long term effects on the inflation rate, then we can rewrite (1.5) as

$$\dot{P}_t = f(U_t) + \dot{P}^e_t + k \tag{1.6}$$

It then follows that, if the coefficent on expectations is equal to unity (which is implicit in the way the equations have been presented), any trade-off between unemployment and inflation will disapear. Thus in the long run there is only one possible sustainable level of unemployment, which is known as the "natural rate of unemployment" and is given by the following formula

$$U_t = f^{-1}(-k) \tag{1.7}$$

If the unemployment rate is below this level then it will lead to a rate of wage inflation higher than the growth in productivity and hence to price inflation, this in turn will generate price inflation expectations which will further increase the rate of wage inflation and so on. This hypothesis has come to be called the accelerationist or the natural rate hypothesis, as a policy of trying to hold unemployment below the natural rate must lead to an ever accelerating inflation. Similarly a rate of unemployment above the natural rate would lead to ever accelerating deflation. It is therefore of little surpriseto learn that the coefficent on expectations in the augmented Phillips curve has become a subject of considerable interest to economists.

A great deal of empirical work has been done which has tried to estimate this coefficent, the chief problem in this work is finding a suitable measure for expectations of inflation. An early attempt to surmount this was made by Solow (1969). He assumed expectations to be formed by an adaptive expectations mechanism and experimented with different parameters for this, choosing that which was most satisfactory in terms of statistical significance. From this he concluded that the coefficent on price expectations was about 0.4, and significantly less than one. Solow therefore concluded that there was a trade-off between unemployment and inflation. Other studies followed by, for example, Turnovsky (1972), Lucas and Rapping (1969), Saunders and Nobay (1972), Parkin, Sumner and Ward (1974) and Mcguire (1976). The results varied, most found expectations to be significant, some e.g. Parkin, Sumner and Ward found the coefficent to be insignificantly different from one, but this was by no means a universal conclusion.

These studies tackled the problem of proxying expectations in different ways, some generated an expectations series in a similar manner to Solow.

Others used an expectations series derived from sample surveys, whilst Mcguire estimated expectations by treating them as coefficents on a dummy variable in a set of equations which besides the Phillips curve equation also included Fisher's nominal interest rate equation, a price change equation and a price expectation formation equation. On the other hand Sumner proxies expectations by using the difference between the real and the monetary rate of interest, and others have used still other methods. In short considerable ingenuity has been expended in attempting to overcome the problem of proxying expectations of inflation. However it is far from clear that any of these has been wholly successfull as we shall see when we come to discuss expectations in greater detail. This, coupled with the lack of agreement in the empirical work means that the question as to whether the coefficent on expectations is unity is far from settled.

One important strand of the literature, developed by Lucas (1972) and Sargent and Wallace (1975), builds upon an initial concept first put forward by Muth (1961). Muth proposed that certain expectations were rational in the sense that they were essentially the same as the predictions of the relevant economic theory. This implies that expectations of inflation and actual inflation differ only by a random forecast error. In this case, because there is no lag between inflation and expectations,there is no longer any possibility for even a short run trade-off between unemployment and inflation. A more detailed examination of this concept, together with the more general problem of expectation will wait until later in the thesis. For the moment we will restrict ourselves to the comment that in view of all the evidence that there is a short run trade-off, it seems surprising that anybody can seriously put forward a proposition which denies it. As Gordon (1977) observes Hall (1975) has shown that only 1.7% of the quarterly variation in United States unemployment during 1954-74 remains unexplained in a simple two quarter autoregression. Hall therefore concludes that 98.3% of the variance must have been due to shifts in the natural rate of unemployment, a proposition Gordon finds difficult to accept.

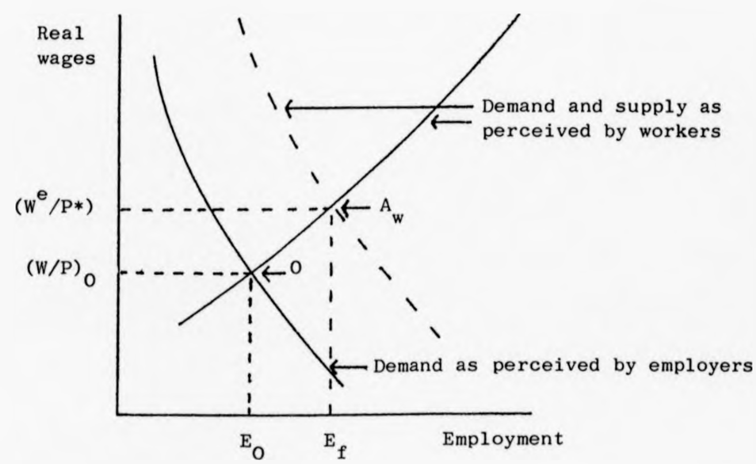
One possible reason why the coefficent on price expectations might not be unity is that price inflation below a certain level may be too small to be perceived, or that though perceived it is too small to make adjustments for in the labour market. This argument can be found in Eckstein and Brinner (1972), on the grounds that in "normal times", defined as any period when consumer prices have risen on average by no more than 2.5% p.a. over the previous two years, workers percieve and experience relatively little wage reduction. Consequently they have small incentive, when bargaining with employers to insist on obtaining money wage settlements proportionate to their expectations of price increase. Askin and Kraft (1974) when testing this hypothesis do find a non-linear effect, such that in normal times the coefficent on expectations is much less than in inflationary times, indeed in normal times it is insignificantly different from zero.

Johnston and Timbrell (1974) have also argued for a non-linear price expectations effect within a bargaining model. They argue that since price expectations are a crucial determinant of the size of the real claim and the vigour with which it is pursued it is not clear that it must enter the wage equation in a simple linear fashion, and that a plot of nominal wage claims against price changes over recent years would give a highly non-linear relationship. In the empirical results they also find some support for this relationship.

A rather different line of development,found for example in both Gordon (1971) and Parkin, Sumner and Ward (1974), is to try and include not only the general price inflation expectations, which are relevant to the average worker, but also product price expectations, or actual product prices, which are the main concern of employers. Parkin, Sumner and Ward include three measures of price inflation expectations, one set relating to consumer prices and two others with specific reference to employers, one for domestic and a second for export prices. It is worth noting that employers' expectations seem to be most important in that the sum of the two expectational terms relating to them is around 0.7, and that relating to consumers around 0.3.

Apart from the matter of expectations Friedman also differs from Lipsey and Phillips in another way. According to them the direction of causation runs from unemployment to inflation. In Fisher's ealier paper it is the other way round. Friedman has commented upon this difference and concluded that the fallacy lies with Phillips. The essence of his argument is as follows. In figure 1.1 E_0 is the equilibrium employment level and $(W/P)_0$ the equilibrium real wage. Initially he assumes a constant price level, now let something produce a widespead increase in nominal demand

Figure 1.1 Demand and Supply in the Labour Market



which leads employers to seek to hire more workers. As the workers have no reason to suppose a change in the price level their supply schedule will not shift. It will remain the solid supply curve in Figure 1.1. If we interpret P^* as the price level perceived or anticipated by workers. To them it will appear as if the demand for labour has shifted to the right, to the dashed demand curve. At each nominal wage rate (also each real wage rate as perceived by them) employers are seeking to hire more labour. The new equilibrium will be A_w, involving a higher nominal and perceived wage rate and a higher level of employment. This situation is only temporary as employers come to recognise that prices in general have risen which leads them to slide back down their supply curve from A_w to O.

Hence the direction of causality runs from an increase in prices and then wages to an increase in employment and a reduction in unemployment. This hypothesis has become widely accepted amongst monetarists in particular, Gordon writes that, with respect to a rational expectations model, the monetary authority cannot cause even temporary changes in unemployment unless it does the unexpected, any feedback type monetary type policy rule which systematically incorporates past information becomes part of the information set upon which expectations are formed, and hence cannot cause the deviation of $\dot{P}_t$ from $\dot{P}^e_t$, which is necessary for unemployment to diverge from the natural rate. Thus here too the direction of causality is from inflation to unemployment.

Friedman himself holds that the line of causality runs from something increasing demand in the product market, leading to increased demand in the labour market to increased wages, to increased employment, to reduced unemployment. Hence he appears to be criticising the Phillips-Lipsey framework in as much as unemployment is not a valid proxy for excess demand in the labour market. He appears to accept the fact that excess demand determines wage inflation, i.e. comes before a rise in wages in the logical chain of events. This then leaves us with several possibilities. If we are trying to establish a link between unemployment and wage inflation then the correct formulation within a Friedman framework would be

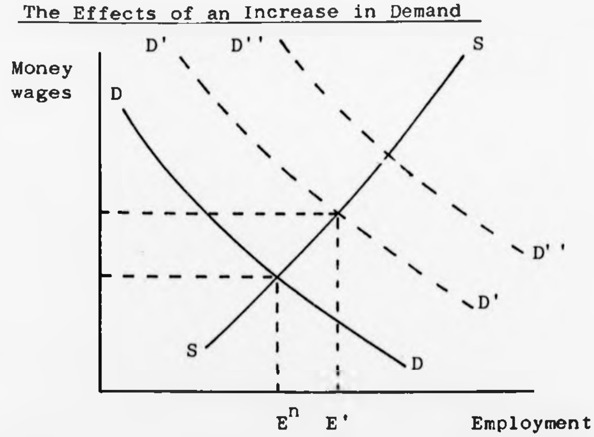
$$U_t = U^n + f(W^e_t - W^n_t) \tag{1.8}$$

where W^e_t is the worker's real wage as he perceives it, and W^n_t is the real wage consistent with the natural rate of unemployment. Alternatively if we are attempting to explain wages then this should be linked to excess demand for labour. It is not valid within a general monetarist framework, based upon Friedman's work, to use unemployment as the independent variable and inflation as the dependent one, although this is what may economists, including monetarists, have done. However it may be valid to use some other measure of excess demand as the independent variable.

There are, however,serious difficulties with Friedman's theory, which is essentially a static one, despite his claims to the contrary. It is developed in terms of wage levels and not rates of change, the latter being a dynamic concept. Moreover the theory is developed within a market clearing framework, yet, and this applies equally as well to Lipsey, the market does not clear, at the end of the period there are always some unemployed workers and unfilled vacancies.

In order to cope with inflation the theory must be made dynamic. One simple way of doing this is to take the simple static analysisof Friedman in successive periods. We will begin with the same assumptions as Friedman. Figure 1.1 represented the labour market as seen by the workerand is reproduced below, but this time with money wages on the vertical axis.

Figure 1.2 The Effects of an Increase in Demand



Initially we suppose the economy to be in equilibrium, at the natural rate of unemployment, with no inflation. Let us then suppose that something then happens to cause an increase in demand in the goods market, leading to an increase in prices, which leads to entrepeneurs attempting to increase their labour force, in the process of which they offer higher money wages to the employee. He, in turn, has not yet percieved the rise in prices and believes the demand curve has shifted to D'D', employment then increases to E'. Let us further assume that in the next period product market conditions are such that prices again rise, leading the demand curve to shift to D''D'', what happens to the supply curve? This depends upon what happens to expectations. If employees are forming expectations in an adaptive manner about the price level, then the curve SS will shift up by an amount determined by how quickly expectations adapt. But Friedman's argument is not couched in terms of price level expectations, but price change expectations, which seems to imply that people fully percieve the price level in any one period and base their expectations of future price levels by adding to the present price level the expected rate of change. Yet if people fully perceive the price level the curve SS begins shifting up as soon as prices change. Thus, if one insists on introducing expectations of inflation into the picture, there is no relationship between unemployment and inflation.

A further criticism of both Friedman and Lipsey is that their theories are developed within market clearing frameworks. Figure 1.1 tells us nothing about unemployment, indeed it is based upon the assumption that there is no unemployment, i.e. the market always clears. The reasons why the market does not clear are simple, a worker is not in general looking for employment for one period only, but perhaps for an indefinite number of periods into the future. In a sense a worker who accepts a job in one period is not only committing himself to such a sale for that one period, but also probably for many periods after that. Perhaps this in itself, although making the commodity labour somewhat unique, would not prevent market clearing if it were not combined with certain other properties of the labour market, in particular the fact that it is not perfectly competitive. Workers do not have perfect information about what jobs are available, the characteristics of those jobs, nor, most importantly perhaps, the wage they are being offered at. Similarly employers do not have full information about unemployed workers searching for jobs, their characteristics, nor the wage they will accept the job at. Because full information is not available workers and employers may feel that there are gains to be made from search.

But if one is going to analyse unemployment within a search theoretic context then the whole of the analysis must be conducted within this context. It is not valid to add it on to a static market clearing theory, almost as an after thought, as Lipsey and Friedman have done in a few "intuitive" paragraphs. Admitting that the market does not clear is also an admission that the market clearing hypothesis is not relevant. If one is going to justify the existence of both unemployment and vacancies on search theoretic grounds, then any relationship between unemployment and inflation will probably also have to be examined within a search theoretic context, it certainly cannot be examined within a market clearing one.

1.5 Search Theories

Interest in search theories began with a study by Stigler (1962) which emphasised the fact that labour markets were not characterised by perfect information and that individuals in order to gain information about the market needed to undertake search activities. Using this as a base Phelps, Mortenson, Holt and others (1970) produced a remarkable group of essays, which gave rise to what has become known as the "new micro-economic" approach to macro-economics. Much of this work is aimed at providing a theory consistent with the joint occurrence of unemployed workers and unfilled vacancies, and a negative relationship between wage changes and unemployment.

The gist of Phelps' theory is that, given a constant differential between the firms wage rate and wages paid by other firms, a fall in the unemployment rate will tend to increase quits. At a sufficiently high quit rate, corresponding to a low level of unemployment, the firm will want to increase the differential between the wage it pays and the average wage paid elsewhere. Thus one role of unemployment in this theory, stems from its effect on quit rates, rather than any supposed underbidding for jobs by unemployed workers. The number of vacancies will also be relevant,as the more vacancies it has the more anxious it will be to fill them, in addition vacancies may affect quits. Hence the desired differential will be a function of the level of unemployment and the number of vacancies. The actual rate of wage change is then a constant proportion of the average desired differential. If we also take into account that wage contracts may last for some time into the future, then,in setting this differential, the employer will take into account expected future labour market conditions as well as present ones. Therefore, as with Friedman's model, expectations play a major role. However the relevant expectations are not about prices, as in Friedman's model, for Phelps believes that inflationary price expectations affect money wages only through their effect on expected vacancy and unemployment rates. Given the latter, a rise in the expected rate of inflation will have little or no effect upon the wage increases which a firm grants, provided that it expects other firms to hold the line over the money wage rates they pay. In Phelps' world it is therefore expectations of wage inflation, with a unit coefficent, which enter the wage equation, in order to maintain the desired differential over the wages others are expected to pay. The other variables in this equation being unemployment and vacancies.

Holt is also concerned with providing a theoretical basis for the Phillips curve. In doing this he pays slightly more attention to the specific problems of search than Phelps. Important, in this context, is the concept of an aspiration, or acceptance, wage, which declines with the length of search. If the wage at which a job is offered to a specific worker is above his acceptance wage then he will accept the job, if not he will refuse it. Holt assumes that the wage from the last job is the initial reference for setting the acceptance wage, but that this is adjusted to take account of the worker's initial perception of his job opportunities. For example, when the labour market is tight, workers may reasonably raise their initial aspirations. Information on the state of the labour market being conveyed by factors such as the number of vacancies, the duration of unemployment that other workers have experienced, and the wages that are being offered. Thus for an individual worker the longer he is unemployed the lower his acceptance wage will be. Holt then assumes that the wage the worker is hired at will vary directly with his acceptance wage, and hence the hiring wage will also vary inversely with the time he has been unemployed.

It follows from this that, upon aggregation, the average rate of change of wages between jobs, for all workers passing through the market, varies inversely with the average duration of unemployment. To obtain a Phillips curve relation from this, Holt links the average duration of unemployment to the number of unemployed workers, proposing that the two vary directly. Hence we get a relationship between the average rate of change of wages between jobs and the level of unemployment. To obtain the average rate of change for all workers, he also examines those workers who search and obtain other jobs whilst still employed, and those who obtain wage changes whilst remaining in the same job, because of a potential quit threat. Both of these problems are handled in similar vein to that of unemployed job searchers, and a Phillips curve emerges at the end of the analysis. It is perhaps worth noting that neither expectations of wage, or price, inflation enter Holt's analysis, although these could easilly be incorporated. If they were our initial impression is that it would be wage inflation expectations which would be most relevant.

Like Phelps and Holt, Mortenson was concerned with providing a search theoretic rationale for the Phillips curve. Although, compared with these, he prefers to emphasise the optimisation problem facing the firm. In doing this, he makes the assumption that the job searcher acts as if he knows with certainty what his next offer will be. His optimisation problem then consists of comparing this with his current wage offer. Using this theory he then analyses the various flows in the labour market, and concludes that the rate of change in the firm's labour force depends upon the firm's own relative wage, and upon the unemployment rate in the market.

Mortenson then states the ith firms problem as one of maximising nett present worth

$$V = \int_0^\infty R_i(t)e^{-rt}\, dt \tag{1.9}$$

where

$$R_i(t) = P_i(t)\,F_i(N_i(t)) - W_i(t)\,N_i(t) \tag{1.10}$$

and $F_i(N_i)$ is the rate of production, P_i the price, W_i the wage and N_i the labour force. The firm's optimal wage employment policy is one for which the time path of W_i and N_i maximise V, subject to the rate of change of the labour force equation and the initial employment level. As a result of this optimisation problems solution, by the various firms in the market, the rate of wage inflation is related to the unemployment rate, the ratio of the average product price to the average market wage, the rate of product price inflation expected by the firms in the market, the expected unemployment rate and the real interest rate.

There are several things to note here. Firstly, the ratio of the average product price to the average market wage is relevant, as this represents an improvement in the value of labour productivity relative to cost, and therefore increases the target level of employment. The real interest rate enters because there are implicit costs in adjusting the level of unemployment. An increase in the real interest rate reduces the incentive to incur such costs, and therefore reduces both the target employment level and the rate of adjustment to it. Thus there are two concepts here, the target level of employment and the desired speed of adjustment. Given a constant adjustment rate, an increase in the target level of employment increases the desired rate of change of the labour force and hence the rate of inflation. Similar comments apply to an increase in the desired rate of adjustment given a constant target employment level.

Secondly it is the expected rate of product price inflation that Mortenson thinks is relevant. However he makes the assumption that firms expect their own product price and the average market wage rate to inflate at the same rate, hence one could reinterpret this conclusion as implying that both sets of expectations are in fact relevant. As to the direction of causality in Mortenson's paper, both unemployment and wage inflation are endogenous variables within a simultaneous system. Thus whilst the unemployment rate partially determines the desired differential of each firm and hence the rate of wage inflation, changes in the unemployment rate itself are partially determined by the difference between the actual rate of inflation and the rate of inflation expected by job searchers. Whilst in Phelps and Holt the direction of causality is from the levels of employment and vacancies to the desired differential and the rate of inflation (although there seem to be hints of a simultaneous relatiionship, but this is not really emphasised). Thus it is not true, or at least not the whole story, to say, as Gordon has, that in the Holt, Phelps and Mortenson papers the explicit line of causality is from prior wage changes to subsequent quit decision and resulting increase in unemployment.

These papers by Phelps, Holt and Mortenson appear to us to represent the most detailed theoretical analysis which has been done on wage inflation, in fact almost the only analysis which stands up to rigorous probing.

Having said that, there are of course weakness's in these papers, both individually and collectively. The Phelps and Holt papers, for example, do not analyse the employer's decision problem in as great detail as Mortenson. Mortenson on the other hand does not give as much emphasis to the unemployed searcher's problem as Holt does, neither does he analyse the search process in as great detail as Holt. Rather he makes use of the fact that unemployed workers do not accept every job offer without really explaining why not. Finally none of these authors, or any since, has really succeeded in integrating into one theory the interaction of employer and employee search and the way this interaction affects the flows in the market and the rate of inflation. In addition there is also some truth in the comment that the models strain reality by forcing all entry to unemployment through the mold of voluntary quit decisions, with no explanation for firing or lay-offs.

1.6 Wage Bargaining Theories

A completely different approach, which to some extent predates the excess demand type of analysis, is to view wage determination as the outcome of a bargaining process, between employers on the one hand and trade unions on the other. A relatively early formulation of such a theory can, for example, be found in Shackle (1949). The survey presented here is not meant to be comprehensive of all the work done in this tradition. Rather it aims at being representative or illustrative of such work in order to highlight the differences between this approach and the excess demand one.

Within this approach there are several different strands of development, not all of which we shall be concerned with here. For example, we shall not be examining the key sector hypothesis. Nor shall we be concerned with models which postulate that the principal thrust of union policy is to establish and maintain a certain differential over non-union wages, or to be involved in a fight over income shares. It may well be that, as a result of unions' actions, a union/non-union differential is established. It may also be that, again as a result of unions' actions, the share of labour's income in the national cake increases over time. But it does not seem to me that these are a result of intentional planning, but rather a consequence of unions' actions in maintaining their workers standards of living. Thus explanations of inflation couched in terms of unions attempting to increase, either the union/non-union differential, or the share of labour in national income, seem to me to be ill concieved. These may well be the consequences of their actions, but they are not the cause. In partial support of this view is the considerable volume of evidence which shows that the union/non-union differential varies over time with the business-cycle (Lewis (1963)). Although, of course, this evidence is consistent with alternative theories.

However, we shall be looking at the literature which concentrates more directly on the baragining process itself and the economic variables which influence the outcome. One such variable, which has figured prominently in nearly all the literature, is profits. Kaldor (1959), for example, put forward the view that the rise in money wages depends upon the bargaining strength of labour which is closely related to the prosperity of industry. This determines both the eagerness of unions to demand higher wages, and the ability of employers to grant them.

A slightly more sophisticated analysis can be found in Eckstein and Wilson (1962). They analyse the variables, both labour and product market ones, which influence the cost of settlements and strikes to the bargaining participants. Thus on the trade union side members expect large settlements in good times, and make it difficult for union leaders to settle for less. Similarly, for employers, the disutility of large settlements varies with economic conditions. When demand is high and the market is considered tight firms have little concern that they will lose sales to their rivals, on the other hand when demand is low prices cannot be easilly raised, and wage increases are more likely to come out of profits. Secondly when profits are low high wage settlements increase the risk of managements having to disappoint stockholders, and generally complicates managements' financial problems.

In addition they also feel that the costs of strike action and the probability of winning vary with economic conditions. Thus in good times, when operating rates are high, the loss of profits during a strike are great. However alternatively, in many situations the hazard of losing customers to competitors is greater when the product market is not prosperous and competition is keener. On the union side the loss of payrolls is greater in good times, but the employees may be better able to stand the loss.

More recent work in this tradition has grown slightly more sophisticated. Thus Johnson (1972) and Johnson and Timbrell (1973) propose a model whereby the union makes a claim for a wage increase of amount ΔW^e. The employer's response is assumed to be determined by the principle of minimising his expected costs. Important here is the employer's assessment of the real claim, ΔW^{re}, which is defined as the size of the offer that has to be made in order to reduce the probability of a strike to zero. The main conclusions of the theory are that the size of the wage settlement will be positively related to the employer's estimate of the real claim, the rate of time discounting used by the employer, the current rate of profit per unit of output or per man, the employer's estimate of δ, the union's propensity to endure a strike and the subjective costs imposed by a strike on the employer. It will also be negatively related to the time-span over which the employer discounts.

The role of most of these variables is fairly obvious, and we shall not discuss them in great detail. Of special interest however, is the employer's estimate of the real claim, which is largely unique to this model. There are several determinants of this, and in their analysis Johnson and Timbrell lay special emphasis upon price expectations. They argue that if unions are concerned with the real wage, then the higher they expect the rate of inflation to be the greater will be their wage claims and the vigour with which they are pursued. Thus leading a rational employer to increase his estimate of both ΔW^{re} and δ.

They also lay special emphasis upon the effects of tax changes on real income. During the post-war years the retention ration, the ratio of nett to gross income, has been steadily falling for all workers. They put forward the hypothesis that unions attempt to allow for unfavourable movements in the retention ratio. Alternatively they suggest that unions have a target level of real wage growth and if actual growth falls short of this target, whether due to changes in the tax structure, unforseen price movements or whatever, then in succeeding years they will attempt to compensate for this shortfall. This latter argument is an extremely important one and the fore-runner of more recent work in this direction.

As has been emphasised before this chapter is not designed to be a survey of all the literature, and the work we have examined so far only represents a small sample from a large population. Yet they are fairly representative of that population in several respects. Firstly the arguments are often phrased in rather loose verbal terms with a distinct absence of rigour. The main reason for this is probably the difficulty of assigning a specific role to trade unions within a general economic model - a problem we shall return to later. Secondly, in as much as they do examine the effects of trade unions upon wage inflation, they concentrate upon the variables which influence trade unions'demands, for example the level of profits and the rate of unemployment. An alternative strand of the literat-is more concerned with what might be called "militancy variables".

An obvious example of this kind of variable, which has been widely used, is some measure of strike activity (Ashenfelter and Johnson (1969), Ashenfelter et al (1970), Taylor (1970) and Godfrey (1971)). There are obvious empirical problems in the use of such a variable, for example what is the appropriate measure, the number of strikes, days lost or workers involved, should the measure be restricted to strikes over pay or should it include all strikes. But apart from these problems a major problem with the variable is that it lacks any firm foundation in economic theory. It has been used because it seems "intuitively plausible" that increased trade union militancy will be associated with an increase in strike activity. Yet is it not just as plausible to assert that increasing "employer militancy" might also be coupled with an increase in strike activity? A strike over money wages occurs because the employer makes an offer, which may merely be the continuation of the old offer, which the union finds unacceptable and no suitable compromise can be reached. It is by no means obvious that this will always be because the trade union is being more militant in its demands, rather than the employer becoming more militant in his offer. In the former case we would, of course, expect increased strike activity to be associated with larger than usual wage inflation, but in the latter case the reverse would be true.

An alternative measure,which does not suffer from this objection, has been proposed by Hines (1964). The gist of Hines' argument is that trade union militancy is manifested in areas other than the actual wage bargaining process. Specifically he argues that unions would regard a successful membership drive as a prerequisite for success in the wage bargain. Therefore when a union puts in a wage claim, it would seek immediately before and during the period of negotiation to increase it's bargaining power, by increasing the proportion of the labour force over which it has direct control. A measure of trade union militancy is therefore provided by the rate of change of the labour force which is unionised.

When tested empirically, by Hines and others, there does appear to be a significant relationship between wage inflation and this measure of militancy, both in the U.K. and the United States. However this has not resulted in any general acceptance of the hypothesis by economists, and ever sinceit was first proposed there has been a constant battle between Hines and his many protagonists. In particular his results have been criticised on statistical grounds. But it remains true, that even when all the statistical irregularities have been removed from the regressions, the change in union density remains a significant variable within wage inflation equations (Purdy and Zis (1973)). Consequently much of the debate has centred around the economic interpretation that should be attached to this significance.

Purdy and Zis argue that workers will tend to join unions as a defensive measure to secure strike benefit when a strike seems likely. If the strike leads to an increase in wages this would then explain the statistical findings. It has also been suggested that,when trade unions secure wage increases, for whatever reason, the union may attract an increase in it's membership. However it seems to us that neither of these alternative explanations are any more convincing than Hines' orignal one, especially when it comes to explaining the very large increases in union membership which occurred simultaneously with the wage explosion at the beginning of the 1970's.

A further criticism of this whole approach to the wage bargaining process is that the term militancy seems to be a catch-all phrase for almost anything which tends to increase wages or wage demands. One distinction that has been made, again by Purdy and Zis (1974), is between power and militancy. Power reflects the capacity to influence the bargaining process via, for example, strike action, whilst militancy reflects the will to exercise such power. However a second distinction may also be made, as we have already observed to some extent the militancy proxy variables have been used as substitutes for other variables, such as profits and unemployment, which influence the size of the union's claim and eventual settlement wage. But this concept of militancy is not in accord with the ordinary usage of the term. Perhaps a better practice would be to try and differentiate between unions' actions when faced with essentially the same set of economic conditions. If, in such a situation, one union pursues a wage claim in excess of that pursued by another union, then we can say that the first union is in some sense more militant than the second. If, however, the same union in one year is faced with a situation where profits are higher and unemployment lower than in a previous year, and it attempts to secure a higher wage increase than previously, is the union more militant than before, in the sense that it is somehow more aggressive? There are also questions of exactly who is being militant, the leaders of the union or the membership, and what exactly is the relationship between these two groups? These are questions which we shall consider later, but they bring us to a much more general point, which has been mentioned before. Trade unions have not been satisfactorily integrated, in any of these models, into economic theory (see, e.g., Rees (1962)).

Within an economic model trade unions are generally regarded as suppliers of labour, but what policy do they attempt to follow in selling that labour? Marshall (1920) suggested that in negotiating the wage bargain they would have regard to the necessity of retaining a sufficient supply of "capital and business-power" in the industry. Others speak of unions' aims as establishing a fair, just or standard rate for the job (the Webbs (1897)). However all these concepts are rather inexact, especially when compared with other actors on the economic stage, whose behaviour can be proxied by maximising models. Consequently economists have searched for some maximand which can be attributed to be at the base of union behaviour. Hicks (1932) suggested the wage rate. But perhaps the only example of a union following this policy irrespective of what is happenning to employment in the industry is the United Mine Workers in the United States.

Alternatively it has been suggested that unions take into account both the wage rate and possible effects on employment. Some economists have argued that these two aspects can be combined into one maximand - the wage-bill. But there seems no compelling logic as to why this should be so, in the same way as there is with utility maximising individuals, or even profit maximising firms. It must be recognised that the union is not one individual, but a collection of individuals each with their own interests, some of which may conflict with, or at least not coincide with, those of other members. In addition the union is an organisation with a hierarchy of "elected leaders", whose interests are not entirely those of their membership.

It is the recognition of this fact, in an extrordinarily perceptive paper by Ashenfelter and Johnson (1969), that has led to perhaps the best attempt at incorporating trade unions within an economic model. Although their paper is not basically concerned with wage inflation, but the related problem of strikes, it nonetheless contains a fairly concise staement of a bargaining theory of wage determination. Their starting point is that there are three parties involved in labour-management negotiations, the management, the union leadership, and the union rank and file. The objectives of the leadership are firstly, the growth and survival of the leadership as an institution, and secondly, the personal political survival of the leaders themselves. These two objectives are accomplished by satisfying the expectations of the rank and file as well as possible. From an employer's point of view they argue that a strike could perform the function of reducing the minimal wage increase which is acceptable to the rank and file.

They then go on to argue that, initially, this wage will depend negatively on the unemployment rate as, when this is low the typical worker has the chance of moving to a higher paid job, but he will first try and secure a wage increase from his present job. In addition the leadership will be less likely to reduce this minimal wage aspiration when unemployment is low, because the employment effects of a large wage increase will have little effect upon their political stature, and a sizable strike fund may replace part of the workers' lost income. Finally there will be decreased opposition, among the rank and file, to a militant course of action, since there will be part-time opportunities for potential strikers.

They then argue that a second determinant of this wage should be a moving average of previous changes in real wages. Profits are also likely to be relevant on the grounds that, if the firms profits have been high in recent periods, the typical union member may feel that he deserves a larger wage increase. Also the motivation of the leadership to attempt the task of persuading the membership to be content with a lower settlement will be diminished.

Other studies which can be placed within a bargaining classification concentrate upon the different aspects of the bargaining problem, rather than view the problem as a whole,as Ashenfelter and Johnson have done. Nonetheless several useful concepts have emerged from these studies. Runciman (1966), for example, introduced the notion of relative deprivation, by which when the growth of real income is low relative to expectations people come to feel "relatively deprived". These expectations are determined by people's own earlier experience, and on observations of other people's real incomes. Individuals then attempt to obtain wage increases which will bring their real wages in line with their desired real wage. Laidler and Parkin (1975) dismiss this hypothesis on the grounds that it either requires that people suffer from money illusion, or is in all essentials equivalent to Friedman's expectations hypothesis. Unfortunately they do not expand on this criticism, which to us is far from obvious. Indeed this concept of relative deprivation links up with important work by Henry, Sawyer and Smith (1976), to which we turn later.

1.7 The Effects of Incomes Policies

In addition to these two basic approaches to the problem of wage inflation,there are several questions which arise independently of them. One of the most important of these being the impact of incomes policies, whether within a bargaining or excess demand framework. There has been considerable discussion, within the literature, as to whether there are any effects and if so whether they are only temporary in the sense that when the controls are removed there will be an effort, by workers and their representatives,to make good lost ground. Within a theoretical context incomes policies may affect inflation in different ways depending upon which model of inflation is being used.

In a Friedman-type excess demand framework incomes policies may work by changing the coefficients on the independent variables, unemployment and price expectations, by changing price expectations themselves, or by replacing this relationship with an altogether new one. Similarly,within a search theoretic framework, incomes policies may affect the coefficents on the independent variables, those independent variables directly or simply replace the search theoretic relationship with another. Similar comments apply to bargaining models. However such a description of the way incomes policies work is not adequate, it is not sufficient to say that with a specific model the coefficients may be changed by incomes policies, we want to know what theoretical reasons there are for supposing such a change.

Within the literature discussion of the theoretical rationale for such policies has been limited when compared with the empirical work on their effects. One place where there is some discussion of these theoretical aspects is in a paper by Lipsey and Parkin (1970). This is to some extent surprising, as the paper as a whole has come in for a good deal of criticism. However much of this criticism has been directed at the empirical content of the paper and it remains true that the theoretical analysis does make a valid contribution.

They adopt what is basically an excess demand framework, although they confuse matters by introducing a proxy for trade union pushfulness. Their justification being,that in such non-competitive situations as bilateral monopoly, there is a substantial range over which wages can be determined independently of economic variables and such considerations as bargaining strength, strategies adopted and possibly union aggressiveness become important. They also include the present period rate of change of prices as a proxy for expectations.

Within this general framework they then delineate a similar classification of the ways incomes policies can affect inflation as we have already done. They feel that the most likely result is that the "norm" established by the incomes policy, although intended as a maximum only, triggers off two other reactions. First some sectors of the economy regard the norm as a minimum as well as a maximum and other sectors may be forced to give higher wage increases than they would otherwise have done in order not to fall too far behind in relative wages. Secondly,the norm is not fully effective as a ceiling, but it does exert some downward pressure when wages would otherwise have exceeded the norm. The nett effect of this will be to make the Phillips curve flatter.

For the purposes of the empirical work they denoted the following periods as being ones when incomes policies wer in operation: 1948(3) - 1950(3), 1956(1) - 1956(4), 1961(3) - 1964(3) and 1964(4) - 1967(2), this last date being the end of the sample period. Of these, they concluded that only the first, the policy operated by Cripps, exerted a significant downward effect on wages. In addition they found that the Phillips curve was swivelled in an anti-clockwise direction,during periods when incomes policies were operative, so that it became nearly horizontal and thus confirming their a priori expectations.

The Lipsey-Parkin paper aroused a great deal of criticism, much of it on statistical grounds. One of the most serious was that they included the current rate of change of prices in the wage equation, whilst ignoring the simultaneity problems that this gives rise to. There were also problems of serial correlation with the disturbance term, partially induced by their use of a four quarter moving average of wagc inflation as the independent variable.

Godfrey (1971) in a follow-up paper allowed for both of these problems and concluded that it was not the case that incomes policies had been successful in breaking down the relationship between wage inflation and unemployment, but that no such relationship had existed since 1948. Against this, Parkin (1970), in a further paper, overcame both the statistical problems, though by using a different method to Godfrey, and found that the original conclusions remained substantially unaltered.

These contradictory results are reflected in the more general empirical work on incomes policies. For the U.K., Parkin, Sumner and Ward (1976) identify two periods of incomes policy, 1961(3) - 1962(2) and 1966(3) - 1967(2). They found no significant effect for either. Similarly Tarling and Wilkinson (1977) claim that "incomes policies have repeatedly failed to achieve any of their stated objectives". Other authors, however, do find a significant role for incomes policies, for example Burrows and Hitiris (1972) and Sargan (1977). Finally Henry and Ormerod (1978), using a version of Henry, Sawyer and Smith's model (1976), which we shall discuss later, find that whilst some incomes policies have reduced the rate of inflation during the period in which they operated, this reduction has only been temporary.

Similar confusion is present with respect to the United States experience. Sheahan (1967) reported that a majority of the studies that attempted to measure the impact of the Kennedy-Johnson guideposts, 1962 - 1967, supported the conclusion that the guideposts restrained the rates of wage and price inflation by between o.8% and 1.6% a year. However Gordon (1972) using different explanatory variables found no significant effect. Mcguire (1976) when investigating the effects of the Nixon wage controls, August 1971 - June 1973, found that they increased the rate of wage inflation. On the other hand he also found some evidence for an announcement effect on price expectations, which would tend to reduce the rate of inflation.

From this it can be seen that there is no clear agreement as to either the short or the long term effects of incomes policies upon wage inflation. Indeed there is even disagreement over the correct way in which to measure these effects within an econometric exercise. Most researchers have tended to use shift dummy variables. But Oi (1976), for example, thinks this is invalid, as it requires that the slope coefficents on the independent variables be equal during policy-off and policy-on periods. An assumption he thinks unlikely in view of his own empirical analysis and the theoretical arguments advanced by Lipsey and Parkin. Indeed, the whole practice of using dummy variables to proxy the effects of incomes policies is open to question and this is one of the points we shall be concerned with at a later stage.

1.8 Recent Developments

The recent trend has been away from excess demand based models of inflation, not only towards bargaining models, but to other ones as well, not all of which are economic in origin. Thus Williamson and Wood (1976), for example, question whether the expectations augmented Phillips curve is capable of explaining inflation in the U.K. between 1966 and 1975. They conclude that it is not and moreover that none of the accepted theories of inflation, as expounded by Laidler and Parkin (1975), seem capable of explaining the wage explosion which occurred in late 1969. They also conclude that sociological factors, such as the frustration of wage earners at having their expectations of real income growth disappointed, or the increasing militancy of trade unions in pursuing a set of mutually inconsistent claims, seem to offer a more plausible explanation of the wage explosion than alternative theories.

Such a conclusion is similar to the wage bargaining theories which we examined previously, particularly Runciman's theory of relative income deprivation. One of the first tests of this type of hypothesis was by

Johnston and Timbrell (1973). They found that the extent to which annual percentage changes in real wages, nett of taxes, fell short of some postulated constant had a significant effect on wage inflation. Though this result is somewhat qualified, as a simple tax retention ratio gives better results in terms of statistical significance. A more recent paper which develops a similar theme is that of Henry, Sawyer and Smith (1976), herafter referred to as HSS. They take a hypothesis originally developed by Sargan (1964), that trade unions bargain for real wages, but that the means to achieve a given real wage is to strive for a particular money wage increase in the light of expected price developments. This target money wage is then tempered by the prevailing level of unemployment, either reflecting the effects of excess demand or the bargaining strength of unions. Like Johnston and Timbrell they use real wages, or earnings nett of taxes. In the empirical work they further postulate that the desired real wage grows at a constant rate, which they find to lie between 2% to 2½% per annum, it tending to be higher when more recent periods are used.

HSS test this model and find that it outperforms several alternative ones. They conclude that the expectations augmented Phillips curve does not provide an adequate explanation of money wage changes in the U.K., nor does this approach indicate the presence of a negative relationship between unemployment and wage inflation. Neither do they find any support for the trade union pushfulness measure used by Hines. They do find "impressive support" for the modified Sargan model, and believe that their results lend support to a trade union bargaining approach.

On the policy side they find that the pay standstill of 1966(3) - 1967(2) had an important effect on money wage movements. Thus providing evidence for the effectiveness of incomes policies. They also suggest that income tax concessions raising real take-home pay would slow down money wage increases, a point previously emphasised by Jackson, Turner and Wilkinson (1975). Finally they conclude that aggregate demand policies aimed at reducing wage inflation via an increase in unemployment will produce little or no effect upon the rate of wage change.

1.9 <u>Conclusion</u>

The most obvious point to emerge from this chapter is that, within the economic literature on inflation, there have been two distinct strands, the excess demand approach and the wage bargaining one. Until 1970 most economists accepted the excess demand approach as providing a fairly satisfactory explanation of inflation. But since then wage bargaining theories have become more accepted, as the view has grown up that the Phillips curve "no longer works". Although in the rush to find an explanation for inflation in the seventies it is often forgotten that it did work for nearly a hundred years. It should also be mentioned that in recent years, even amongst economists, a multi-disciplinary approach, incorporating aspects of political science, sociology and psychology, has come into vogue (see, for example, Hirsch and Goldthorpe (1978)). However, fundamental to much that follows is the assumption that inflation is essentially an economic phenomenon. This is not to deny a role to other disciplines, but their's is essentially a supporting role and not a central one. For this reason these alternative approaches will not be developed here.

Also central to the thesis is an attempt to combine the two economic strands of inflation into a coherent whole. The basis for this idea is the belief that both strands seem to contain certain elements of truth and that more is to be gained from seeing how they can be regarded as complementary rather than, as they are generally presented, alternatives. If we may briefly expand on this, we will argue that in many cases the wage rate is the outcome of a bargaining process between employers and trade union leaders. The objective of the trade union leaders in this is to secure a wage which will satisfy some minimum proportion of their membership, this we shall call the union leader's target wage. The employers on the other hand, will be willing to give a wage very similar to that which they would have given in a perfectly competitive labour market, taking into account the relative ease of attracting and retaining labour, this we will call the competitive wage. If this is sufficient to satisfy the trade union side then this is the wage that will get established. If, however, it is not, if the union leader's target wage exceeds the competitive wage, then we will argue that we are in a more genuine bargaining situation. Hence we are here faced with a rather unique example of a switching regimes model.

We then go on to argue that in the post-war period, until 1969, the competitive wage did in fact exceed the target wage. But that after that date there were several periods when this was not so. This we shall argue is the reason why excess demand type models work well until 1969. It is also the reason why after that date wage bargaining models seem to provide us with a better explanation. We can therefore claim to have reconciled two apparently conflicting models in a synthesis which is consistent with the evidence both prior to and after 1969. It is therefore this synthesis which is the central linking theme of the thesis.

To develop this synthesis we must look at the determinants of both the competitive and target wages. The next five chapters are devoted to the first of these concepts. In the second chapter the basic model is set out, this is, basically, a neo-classical search theoretic model whereby the existence of trade unions acts more as a catalyst rather than changing anything substantial. The neo-classical approach assumes that individuals are essentially rational in their decision making. Many economists believe that such a degree of rationality as is often assumed is unlikely and are critical of the whole approach. None the less it has been, and continues to be, widely used in economics and this is both our justification and defence in using it. The search theory itself is similar to others, but the interaction between employer and employee is developed more extensively than hitherto, particularly with respect to the hiring decision. One of the implications of the theory is that the higher the profit contribution of the average worker, the keener an employer will be to fill any vacancy, as the greater is the opportunity cost of not having it filled in terms of foregone profits. But in order to fill the vacancy more rapidly the employer must make it more attractive, possibly by increasing the wage rate at which it is offered. Hence we would expect high profits to be associated with rapid wage inflation. An alternative way of putting this, more in keeping with Lipsey's terminology, is that the speed of reaction of wages to excess demand varies directly with the net revenue contribution of the average worker. Moreover because productivity growth will tend to increase this over time we can expect, ceteris paribus, a gradual shifting outwards in the short run relationship between, for example, wage inflation and unemployment.

In the following chapter we present an initial test of this search theory in an area seperate to that of wage inflation. The reason for this is that most, if not all, of the variables which the search theory indicates as being important, are also consistent with other, for example, bargaining theories of inflation. Therefore any significance of these variables within a wage equation cannot be regarded as proof of the validity of the search theoretic interpretation, as opposed to a wage bargaining interpretation. Indeed these cautionary remarks are valid for almost all of the empirical work that has been done on wage inflation. The significance of certain variables within the inflationary process can be established, but once this is done there is considerable licence as to what theoretical framework one chooses to interpret that significance. It is for this reason that we have devised an alternative test of the theory.

This initial test is based upon the fact that the theory is about the labour market as a whole, and as such it has implications for areas other than inflation. In particular we test its implications for the relationship between unemployment and vacancies. Thus if the theory can be accepted in this alternative context it would enable us to proceed to test its implications for inflation. It would also provide important confirmation for our interpretation of any significance of the resulting explanatory variables, as furnishing proof for the validity of our search theory, as opposed to, for example, a bargaining theory. If, however, the theory cannot be accepted in this alternative context, there would be little point in pursuing it further.

An important role in the search theory is played by expectations of inflation, and it is with these that the fourth chapter is concerned. Basically it is a critical review of the theoretical and empirical literature on expectations. There is, as far as we know, no such summary article which has been published, and certainly nothing which attempts to combine these two strands of the literature.

The fifth chapter is concerned with empirical work on expectation formation, using data derived from the Financial Times Survey of Business Opinion.It is from this empirical work that we are able to derive a series on expectations which can be used in the main empirical work in chapters seven and eight. In chapter 6 we are concerned with the degree of certainty with which expectations are held. There has been very little work in this area, and as such there were relatively few precedents upon which we could build. For this reason alone the arguments in this chapter are put forward very tentatively, with many reservations. But we feel that the area is potentially a very important one whose neglect is a matter of concern. A concern which is apparently shared by others, for example Laidler and Parkin (1975):

> "Thus we have an important unsolved problem. The analysis of anticipated inflation needs to be so conducted that it covers all the varying extents to which inflation may be anticipated, including unequal expectations, and lack of certainty about them. We do not pretend to know how such integration is to be achieved, but a much clearer idea than we have at present of the way in which economic agents form expectations and the way in which they change their behaviour in the light of changed expectations will

> be required before we can expect to get very far with this problem."

This section of the thesis is then a first attempt to tackle certain aspects of the problem.

The next chapter represents the main empirical work aimed at testing the search theoretic model of inflation developed in chapter 2, particular emphasis being placed on the correct specification of the error term, an area which has also been relatively neglected. Initially this empirical work will be based on a sample base extending from 1951(1) - 1969(2), the latter date being chosen as it was about this time that excess demand based theories are supposed to have broken down. After having ascertained whether the theory is consistent with this earlier period, we will then turn to examine whether it is also consistent with events after 1969, or whether it too "breaks down".

In the event the theory also breaks down and in chapter 7 we face the task of explaining why this is so. As we have already said, this explanation takes the form of a synthesis between wage bargaining and excess demand models of inflation. Thus we argue that both these approaches contain certain elements of truth, which the other misses. For example, excess demand based theories fail to take account of trade unions in an adequate manner. Wage bargaining theories, on the other hand, give scant attention to the role of the employer and his reaction to excess demand conditions in the market.

In developing this synthesis we shall pay special attention to the relationship between trade union leaders and their membership. Important here will be the concept of the worker's aspiration wage, which is the minimum wage the worker will be satisfied with. Recent theories have suggested that this is growing at a constant rate over time, we shall suggest the alternative hypothesis that it will be such as to maintain his standard of living, i.e. his planned consumption pattern will be attainable.

We then link consumption with permanent income and reach the conclusion that the aspiration wage will be just sufficient to maintain his permanent income.We are then left with the task of examining Friedman's original concept of permanent income. The empirical work, besides testing this hypothesis, also looks at the critical assumption that prior to 1969 the competitive wage exceeded the union leader's target wage. Finally in chapter 9 we present a summary and conclude the thesis.

Chapter 2

A Search Theoretic Model of Inflation and the Labour Market

2.1 Introduction

We saw in the previous chapter that there are several competing theories of wage inflation. We shall begin this analysis by assuming that one in the excess demand tradition is capable of explaining wage inflation between 1950 and the end of 1969, an assumption we shall later attempt to justify. In particular we will develop a search theory along the lines of Phelps (1968), Mortenson (1970) and Holt (1970). The reasons for choosing this approach, in preference to others within an excess demand tradition, were expounded in the prvious chapter. In short we do not feel that these alternative theories are mutually consistent within themselves, without considering the further question of whether they are consistent with events.

In order to understand how the labour market generates inflation, we must first ask the broader question of how the labour market allocates workers to jobs. There are three basic flow concepts through which this allocative procedure takes place, these are hires and quits, which have been the subject of some examination by Phelps and others, and fires, which have not been the subject of such examination. In our approach the analysis of all three variables revolves narrowly around the concept of a wage aspiration level as a main determinant of individual decision making under conditions of imperfect knowledge. Holt introduces it in the following way:

> "In predicting the decision behaviour of workers in changing from one state to another: one job to another, unemployed to working, working to unemployed, or familly to labour force, we assume the following decision process. If the alternative is enough "better" to outweigh the costs of transition, the change is made, otherwise not. The acceptance of an alternative state depends upon an aspiration

> level. Alternatives below this will tend to be rejected and those above accepted. For example, the present state might be "unemployed and searching" and the alternative state might be "accept the offer that has just been received."

The wage aspiration level is essentially a subjective notion, reflecting the workers' perception of labour market conditions. The way these perceptions are formed,Holt describes as follows:

> "We postulate that the aspiration level of the i^{th} unemployed worker is given by the relation
>
> $$w_{t+T}(i) = w_t(i)\,A_i\,\frac{W_{t+T}}{W_t}\,e^{-D_i T}\,r_{t+T}$$
>
> where w_{t+T} is his aspiration wage level at the time t+T; t the time when the worker entered the labour market; T the length of time he has been unemployed; $w_t(i)$ his wage at the end of the previous job; A_i a constant, usually greater than one, that sets the initial aspiration level; W_{t+T}/W_t the ratio by which general wages have changed during his unemployment, D_i.a constant which is the rate at which expectations decline exponentially in response to unemployment; and r_{t+T} a random variable whose geometric mean is unity to reflect sporadic and non wage factors that influence the wage aspiration level."

Thus Holt's initial wage aspiration level is determined by his previous wage, the duration of unemployment, and A_i (later he goes on to say that A_i may be expected to vary with the level of unemployment and/or vacancies).

It would seem, however, that this formulation ignores the central theme of search theory: that an individual can expect to find a better alternative state if he plans to search for a longer period. But information is not a free good and whilst search is being undergone income is not earned and thus there is a trade-off choice involved. In determining his expected period of search the individual must balance these losses and gains so that he could not make himself any better off by changing his expected period of search. Thus the individual's problem can be looked at as having to determine his optimal expected period of search, however as we shall see this also amounts to determining a wage offer which the unemployed worker

> level. Alternatives below this will tend to be rejected and those above accepted. For example, the present state might be "unemployed and searching" and the alternative state might be "accept the offer that has just been received."

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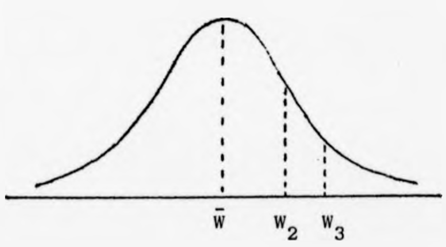
Of course others have seen this problem and in the years since Holt's original paper appeared in the Phelps volume a large body of literature on search theory has appeared (for a summary of this see Lippman and McCall (1976)). Our approach has largely been developed independently of that literature, and therefore differs in certain crucial aspects from much of it. For example much of the literature seems based upon the limiting assumption that the individual is restricted to one interview per period. This assumption does not appear here and partly because of this our analysis of hires, where employer and employee interact in their decision making process, is rather different from what has appeared elsewhere. We assume instead that the individual can expect to get a number of interviews per period,(1) which we will denote λ_1. This is shown in figure 2.1 which represents the individual's expectations concerning the distribution of wages in his particular market, which we assume to be normal. If he receives one interview then the wage he expects to be offered will be equal to the mean of this

Figure 2.1 The Distribution of Wage Offers



distribution. But if he has two interviews, he will expect a higher offer in at least one of them, for example W_2, and for three interviews a higher

(1) The important point being that the expected number of interviews will vary with the economic conditions.

offer still. This mechanism was made explicit first by Stigler (1962), and then by Alchian (1970), thus for markets in general:

> "If potential prices are normally distributed with mean m and with variance σ, then the expected maximum observed bid W(n) at the nth observation is approximately
>
> $$W(n) = m + \sigma\sqrt{2 \log n}$$
>
> W(n) starts at m and increases at a decreasing rate with n."

Analogously if a worker expects to receive λ_1 interviews per period of time we can replace n by $\lambda_1 t$ and let W_0^{elt}, which is defined as the maximum wage offer which the worker expects to receive after planning to search for t periods, be determined as follows:

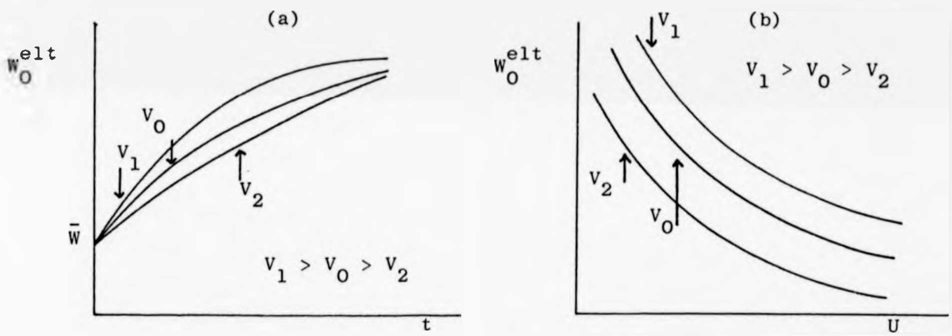
$$W_0^{elt} = \bar{W}_1 + \sigma_1\sqrt{2 \log \lambda_1 t} \qquad (2.1)$$

The maximum expected wage offer will be a function of $\bar{W}_1$, σ_1 and λ_1, that is, the mean of the distribution of the worker's expectations of wage offers, its variance and the expected number of interviews per period. We can assume $\bar{W}_1$ to bear some relation to actual wages currently being offered by employers, and σ_1 to be constant (although it is possible that it will vary with the cycle). It is, however unlikely that λ_1 will be constant. It seems more reasonable to assume that the expected number of interviews per period will be positively related to the number of potential interviews, i.e. vacancies, and inversely to the number of potential competitors for those interviews. These we assume to be those unemployed, although it should be noted that workers can search for better jobs whilst remaining employed. We make this assumption to facilitate the empirical work, there being no real quantative data on "employed searchers". Thus the greater the number of vacancies the greater will be the expected number of interviews, whilst an increase in the number unemployed will have the opposite effect:

$$\lambda_1 = f(U,V) \; ; \; f_U < 0, \; f_V > 0 \qquad (2.2)$$

An increase in vacancies is likely to lead to an increase in the expected number of interviews per period, ceteris paribus the number unemployed, and as is shown in figure 2.2(a) this in turn leads to an increase in the wage an individual can expect to be offered after t periods of search. On the

Figure 2.2 The Effects on Search Productivity of Unemployment and Vacancies



other hand the expected wage will be inversely related to the number unemployed, given the number of vacancies. This is shown in figure 2.2(b), where an increase in V relative to U will shift the curve up to V_1, and a decrease down to V_2.

Having discussed what factors influence the wage aspiration level in a particular period, we will now attempt to analyse its role in the three labour market variables, quits, fires, and hires. Beggining with quits.

2.2 Quits

We begin by assuming, although the importance of this assumption will not become fully apparent until we consider fires and hires, that workers are not homogenous and that there will be differences in their productivity. But that the individual employer has no means of knowing in advance the productivity of a worker, this only becoming apparent after he has become employed. This assumption could at a later stage be relaxed, and we could attempt to incorporate some of the literature on job signalling (see,for example, Spence (1973)). The reason for not doing so here is that we are not so much concerned with search theories in themselves, but only in as much as they can help our understanding of the inflationary process. The assumptions that we make are simplifications, but they do, in our view, facilitate the analysis without subtracting anything substantial from that understanding.

We shall also make the assumption that the individual behaves as if he maximises discounted expected lifetime income. Given this assumption an employed individual will then quit his job if he expects to be better off in the long run by doing so, that is if he expects that the discounted gain in income from accepting an alternative state will more than compensate him for the transition costs, i.e. the income foregone during the period of search. Using discrete time we can illustrate this with the following inequality(1)

$$\sum_{i=0}^{N} (W_0 - B_i)\frac{1}{(1 + r_1)^i} < \sum_{i=N+1}^{I} (W_0^{eIN} - W_0)\frac{1}{(1 + r_1)^i} \qquad (2.3)$$

where $i = 1,2,\ldots,N-1,N,N+1,\ldots,N+X_1-1,I$ and $X_1 = I - N$.

The left hand side of 2.3 measures total income foregone during the expected period of search. The right hand side measures total gains, discounted over the number of years that the worker expects to keep his new job, X_1. If the expected gains outweigh the expected losses then the individual will quit, otherwise he will not. His decision will therefore depend upon expected and present wage rates, W_0 and W_0^{eIN}, the rate of discount, r_1, social security benefits, B_i, and I, the date at which he expects to quit his new job. Of crucial importance is N, the expected number of periods he will have to search for. This will be decided in the following manner, take for

(1) A summary of all the variables and parameters used within this chapter can be found in an appendix at the end of the chapter.

example, the situation where the individual is considering whether to spend two or three weeks in expected search. The expected additional loss by extending the expected time of search by one period will be the best wage offer he could expect to get after searching for two periods, less any benefits he might qualify for. The expected additional gain will be the difference between the wage he expects to receive after searching for three periods, and that after searching for two, suitably discounted over the length of time he expects to hold the job. On this reasoning the individual will not search for more than t periods if:

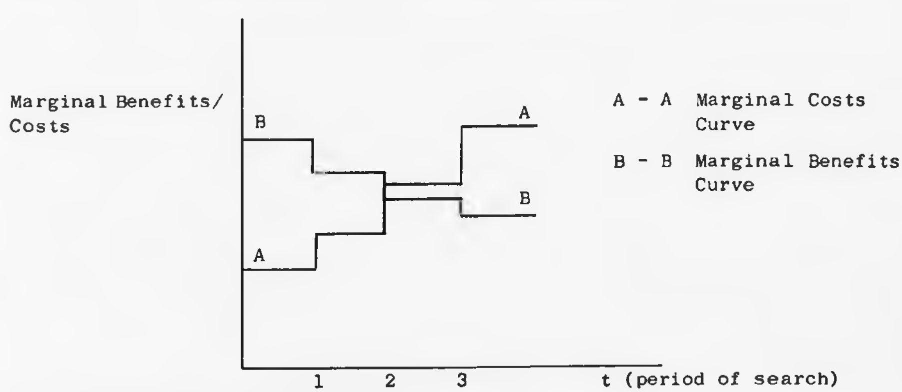
$$W_0^{elt} - B_t > \sum_{i=0}^{X_1} (W_0^{el(t+1)} - W_0^{elt}) \frac{1}{(1 + r_1)^{i+1}} \qquad (2.4)$$

and not search for less than t periods if:

$$W_0^{el(t-1)} - B_{t-1} < \sum_{i=0}^{X_1} (W_0^{elt} - W_0^{el(t-1)}) \frac{1}{(1 + r_1)^{i+1}} \qquad (2.5)$$

Together both inequalities determine the optimal length of search (N), as illustrated in figure 2.3 below

Figure 2.3 Determination of the Optimum Search Time

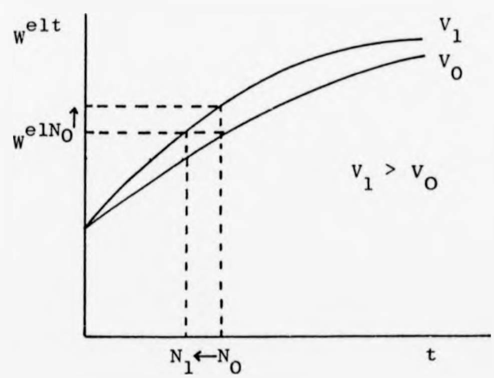


Note: individual will search for two periods, i.e. N=2.

Hence we can determine the optimal length of time for being "unemployed and searching" once we know the expected wage rate, and the values for the other - institutionally determined variables. On the other hand, we also know from equation (2.1), that t is a major determinant of the expected minimum wage rate. Both variables are thus interdependent, and combining (2.1) with (2.4) and (2.5) gives a system in which N and W_0^{elN} are simultaneously determined.

To acquire a better understanding of the system it may be useful to analyse the effects of a change in V or U, and B seperately. An increase in V, or a decrease in U, will lead to an upward shift in the expected maximum wage rate curve as in figure 2.4. This shift can be interpreted in two ways. For a previously determined optimal period of search an individual can now expect a higher number of interviews, which will raise his expectations. Or

Figure 2.4 The Effect on the Worker's Search Strategy of an Increase in Vacancies

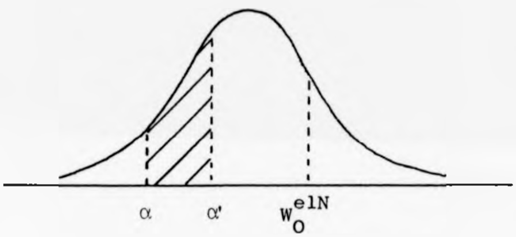


given an unchanged expected wage rate the individual might also wish to adjust the period of search. The most likely outcome seems to be a combination of both options. We can therefore expect to see an increase in the equilibrium number of quits, as well as a shortening in the expected time spent searching. The effects of an increase in unemployment benefit has, following the work of Gujarati (1972), attracted considerable attention and discussion. The way it should work out in our model is as follows. First it is clear that the expected wage rate curve will in this case shift neither up nor down. What is affected is the left hand side of equation (2.3), and this can be visualised by a downward shift of the cost curve in figure 2.3. Hence the increase in benefits will therefore bring about an increase in N, and indirectly - through a movement along the curve in figure 2.4 - also an increase in W_0^{elN}. This, in turn, will lead to an increase in the equilibrium number of quits, and an increase in the average duration of unemployment.

This conclusion is not much different from that reached by most other theorists, (see, for example, Lippman and McCall (1976)). In addition what empirical work has been done also suggests this conclusion. Most of this empirical work has been done for the United States. Thus Classen (1977), Holen (1977) and Ehrenberg and Oaxaca (1976) all provide strong evidence for a small but positive effect of the size of weekly benefits on unemployment duration. Whilst for the U.K. Cubbin and Foley (1977) and Nickell (1979) both find similar effects.

There is a danger that the effects of vacancies and unemployment may be exagerated. The reason for this is that as the economy moves out of a recession there will be a backlog of quits to be cleared before the equilibrium rate has been attained. This backlog will temporarily exagerate the number of quits. This mechanism can be analysed within the framework of our model. We first make the assumption that the relevant labour market for any individual is only part of the total labour market. For instance, office managers are usually only interested in vacancies for office managers and they will compare their wages with what is currently being offered for office managers. For illustrative purposes we again make the assumption that these wages are normally distributed as in figure 2.5. W_0^{elN} is defined as before, with N again being the expected period of search. The individual will not quit immediately, when his wage falls below W_0^{elN}, due to search costs in the form of foregone income. Instead he will quit when his present wage falls below α, where α is determined by equation

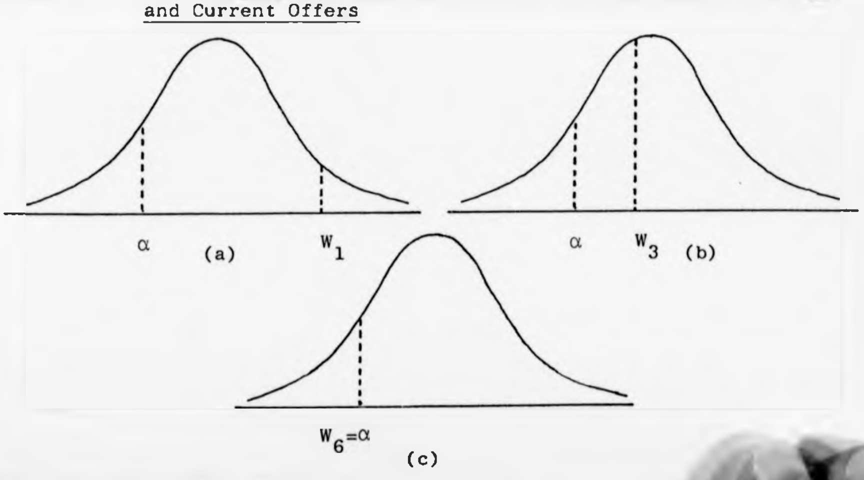
Figure 2.5 The Employed Workers Perceptions of Current Wage Offers



(2 3).

As an individual gains experience in a job so he will begin to compare himself with those on the next rung of the ladder. Thus after five years as an assistant office manager he will begin to compare his salary with those being offered to managers of small offices, who in turn will begin to compare themselves with managers of large offices, and so on and so forth. Therefore the mean wage of the group that an individual compares himself with is continually drifting towards the right. This is illustrated in figure 2.6. In figure 2.6(a) an individual gets more than those he compares himself with, two years later he gets the average, and five years

Figure 2.6 The Changing Relationship Between the Employee's Own Wage and Current Offers



later he is ready to quit as his wage coincides with α.

Consider now what happens as the economy moves out of recession, the number of vacancies increases, then either the expected duration of search, N, will fall, or the wage he expects to get after an optimal period of search, W_0^{elN}, will rise, or both. In other words either the costs of search will fall, in which case the gap between α and W_0^{elN} narrows, or the benefits will increase, in which case both α and W_0^{elN} shift to the right. In either case α will have moved to the right, from α to α' in figure 2.5. Thus all those individuals whose wages lie between these two points will now quit. This is in addition to the normal volume of quits generated by the continual movement of α to the right, along with the whole distribution. These additional quits represent the backlog we have been discussing.

Thus the initial effect of an increase in vacancies will be to increase quits above the new equilibrium level by an amount proportional to the shaded region of figure 2.5. Once this increase has been absorbed quits will have risen to a new equilibrium value at a higher level than the previous one. (It is at a higher level as people will now quit at more frequent intervals than before). But this increase in the equilibrium level of quits will be greatly exagerated in the initial stages of a boom. Similarly as the economy moves into a recession there will be an exagerated decline in quits.

Summarising. According to the theory so far developed quits will depend upon the level of unemployment and vacancies, cyclical changes in those variables, the rate at which future earnings are discounted, any benefit the individual might qualify for, and expectations of wages currently being offered for jobs they feel qualified for. We will now turn to an examination of fires.

2.3 Fires

When a worker quits his job he does so in order to find a better one. The analysis of fires is slightly more complicated because there are several reasons for firing workers. Workers are in general fired due to a lack of demand for the goods they produce. This situation can arise in several ways.

1. Due to a change in aggregate demand, i.e. cyclical factors. (F_c)
2. Due to seasonal factors. (F_s)
3. Due to a changing pattern of aggregate demand, which leaves some industries expanding and others declining.
4. Due to a changing pattern of production which leaves some firms expanding and others declining.
5. Due to a changing locational pattern of production, as firms move from one area to another.

It is a combination of these factors which form the category known as "layoffs", which has already been discussed by several writers, and to which we shall briefly return later. However there is another category of firing which can be thought of as the analytical counterpart to quits, replacement fires, which we will term F_r. An employer may fire a worker not because of changing demand conditions, but due to a desire to replace the worker with a better one. A decision closely related to that of an employee who quits his job to replace it with a better one. The analysis of replacement fires is therefore similar to that of quits.

An employer will fire a worker, even if he has not yet found a suitable replacement, if he believes that the discounted gains of doing so will outweigh the losses. The gains will be the expected increase in net revenue discounted over the expected duration of the contract. The losses equal the amount which the fired worker would have contributed to net revenue over the expected length of search, plus any redundancy payments the employer has to pay, which are related to the length of service. In algebraic form therefore the j'th worker will be fired if the following inequality holds.

$$\sum_{i=0}^{n} \Pi_j \frac{1}{(1+r_2)^{i+1}} + R_j < \sum_{i=n+1}^{I-n} (\Pi_0^{e2n} - \Pi_j) \frac{1}{(1+r_2)^i} \qquad (2.6)$$

where $i = 1,2,\ldots,n,n+1,\ldots,n+\chi_2-1,I$

and $\chi_2 = I-n$

Π_j represents the expected net revenue contribution of the j'th worker. Π_0^{e2n} represents the expected contribution to net revenue of a worker hired at a wage of W_0^{e2n}. (Again for an exact definition of all these symbols see the appendix at the end of this chapter).

Thus the introduction of redundancy payments will have made the employer less willing to fire unsatisfactory workers. This is not likely to be important as regards newly hired workers, but it could become very significant for workers who become less satisfactory because of age.

It is also important to note that the contribution to net revenue the employer can expect a worker to make if he searches for t periods will increase as t increases. This is because the wage he can expect to pay falls with length of time he may plan to search which can be formulated as:

$$W_0^{e2t} = \bar{W}_2 - \sigma_2\sqrt{2\log\lambda_2 t} \qquad (2.7)$$

The minimum pay offer after searching for t periods, is a function of the mean, $\bar{W}_2$, and variance, σ_2, of the distribution of wage offers, and the expected number of interviews, λ_2, per period. All variables differ from the corresponding variables in equation 2.1 as the expectations are held by the employer in this case and not the employee.

As before it seems reasonable to assume that the expected number of potential interviews per period will be related to the number of vacancies relative to the number of unemployed. An increase in the number of vacancies, ceteris paribus, will lead to a decrease in the expected number of interviews that the employer can expect for his own vacancy. Whilst an increase in the number unemployed will have the opposite effect. Hence

$$\lambda_2 = g(U,V) \; ; \; g_U > 0, \; g_V < 0 \tag{2.8}$$

Given the analysis set up so far we are now faced with a similar problem already tackled in the section on quits, namely how is the expected optimum period of search, in this case n, decided? As before an individual will determine his expected period of search so that he could not make himself better off by changing it. In the unemployed worker's case the expected optimum search period corresponded to that value of t which satisfied inequalities (2.4) and (2.5). In the employer's case it satisfies the following inequalities:

$$\Pi_0^{e2t} > \sum_{i=0}^{X_2} (W_0^{e2t} - W_0^{e2(t+1)}) \frac{1}{(1 + r_2)}^{i+1} \tag{2.9}$$

and

$$\Pi_0^{e2(t-1)} < \sum_{i=0}^{X_2} (W_0^{e2(t-1)} - W_0^{e2t}) \frac{1}{(1 + r_2)}^{i+1} \tag{2.10}$$

The left hand side represents the cost of searching for one more period, and the right hand side the gains.

Again we may wish to find the effects of a general increase in vacancies or a decrease in unemployment. Both will lead to a reduction in the productivity of search time. An employer who might be unwilling to change his habitual period of search can expect to have to pay higher wages in order to become a successful recruiter. He may on the other hand have to extend the expected period of search. A rational employer will probably do both. In any case, it is clear that the cost of search is bound to rise, which will decrease the left hand side of inequalities (2.8) and (2.9). The right hand side may also decrease, though not necessarily, but to a smaller extent. The net effect will be to cause an increase in the optimal search period, as well as a reduction in the replacement firing rate.

A rather different motive for firing workers is to be found in a downward adjustment in the desired labour force, because of cyclical variations. The extent to which an employer may decrease his labour force depends upon his expectations regarding the fall in demand, for both now and in the future, and on hiring conditions. Some employers may find it more profitable to hoard labour (Taylor (1972)). But for those employers who do decide to adjust their labour force this adjustment can be brought about in two ways. They can fail to make good losses through voluntary quits, retirements etc, or through firing existing staff. Which method is resorted to will depend upon how the employer balances the costs and gains of each course of action, an analysis we shall not undertake, apart from mentioning that the scales must have been tipped against firings by the introduction of redundancy payments in December 1965.

Another major category of firings will be those due to seasonal factors. In this case there is little scope for a trade-off relation between firing workers and not making good losses through natural wastage. There might be a relationship between the level of unemployment and seasonal firings as, given a constant workforce, if the economy is running at a high level there will presumably be more seasonally employed people of all kinds. But on the whole we might regard seasonal firings as being fairly constant.

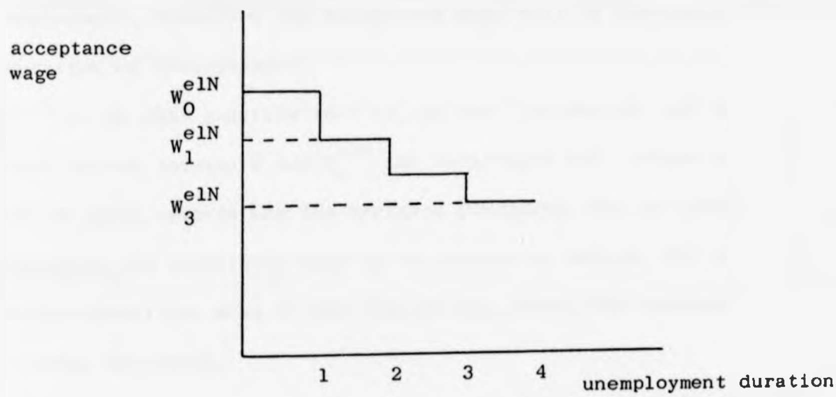
The final category of firings will be those associated with a dynamic economy. There are several sub-categories in this group, for example workers might be fired due to a changing pattern of aggregate demand, due to changing technology which does not affect all industries equally, or due to a changing geographical distribution of production. In the empirical analysis these will largely be ignored on the grounds that, apart from the effects of the business cycle which have already been dealt with, this category of firings may be supposed to be largely constant, except for sudden and large changes in demand and supply conditions which might have been brought about by the introduction of S.E.T., where an exploratory attempt will be made to discern any possible effect.

2.4 Hires

Of the three concepts, hires, fires and quits, this is the most difficult to analyse as it depends upon the interaction of the two sets of decision makers, employers and the unemployed. We shall begin the analysis by presenting Holt's (1970) concept of acceptance curves, but in discrete time.

The worker's acceptance curve is shown in figure 2.7 and it plots his acceptance wage over the length of time he has been unemployed. In the first

Figure 2.7 The Job Searcher's Acceptance Curve



period of being unemployed his acceptance wage will be W_0^{elN}. It equals the maximum wage offer he expects to receive after searching for N periods, where N is the optimal search time. But this acceptance wage will not be constant throughout the entire time he is unemployed for, rather it will be adjusted in a Bayesian manner. Thus if at the end of the first period of search he is still unemployed, even if he has had several interviews, then all the wage offers will have been less than his acceptance wage. Because of this, and because, if his expectations of the distribution of wage offers had been correct, he would have expected some of those offers to be in excess of his acceptance wage - the first of which he would have accepted - he will revise his expectations of the distribution, and probably adjust the mean downwards. This reflects the fact that search performs two functions, the prime one being to find an acceptable offer of employment, but there is a secondary one of providing the individual with up to date information about the market. Thus in equation 2.1, $\bar{W}_1$ will be lower in the second period of search than it was in the first. This will also cause his acceptance wage to fall, i.e.

$$W_1^{e1N} < W_0^{e1N} \tag{2.11}$$

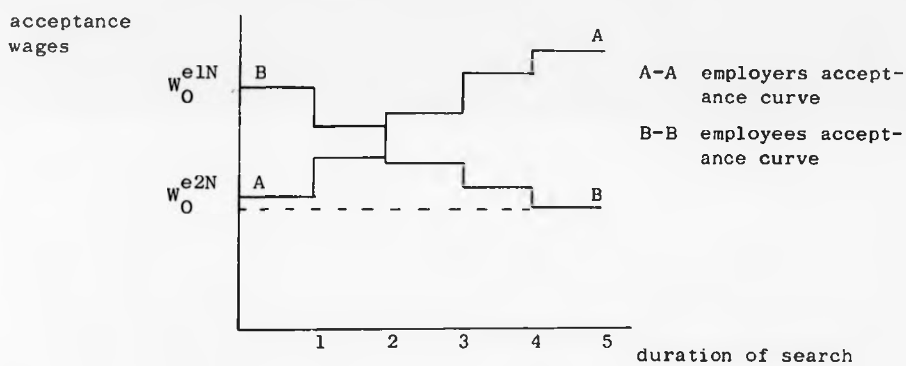
The same process will be repeated at the end of the second period of unemployment, and the third and the fourth and so on, until he finds employment. Therefore the acceptance wage will be inversely related to the duration of unemployment.

It is just possible that if, in the i'th period, all the wage offers have fallen between $\bar{W}$ and W_i^{e1N} the individual will revise his expectations of the mean upwards and the variance downwards, the net effect being to <u>increase</u> the acceptance wage in the following period. But on average we would expect the mean to fall and we have drawn the acceptance curve sloping downwards.

The assumption is also made that all the unemployed, voluntary or involuntary, whether they have quit or been fired, have the same acceptance curves. In our analysis no reason has been put forward to suppose otherwise. The acceptance curve is derived from an income maximising process the parameters of which are presumably the same for all unemployed workers.

We can also derive an acceptance curve for an employer. This plots his acceptance wage over the length of time his vacancy remains unfilled. In figure 2.8 we have drawn the employers and the employees acceptance curves

Figure 2.8 The Employer's and Employee's Acceptance Curves



on the same diagram. It can be seen that the employer's curve slopes upwards, the rationale for this is based upon the same Bayesian type adjustment process we have used to justify the downward slope of the worker's acceptance curve. If we assume that hiring takes place discretelly over each period[1], we can write the expected number of hires, H_O, that will take place from those vacancies which have been available for less than one full period, V_O, as:

$$H_O = \sum_{r=0}^{R} V_{Or} P_r \qquad (2.12)$$

The probability component of this equation, P_r, consists of two elements:

$$P_r = f_r(\lambda_2^a).S_r \qquad (2.13)$$

where λ_2^a is the actual number of interviews over a full period of search that the average employer will experience. $f_r(\lambda_2^a)$ can then be interpreted as a probabilistic concept relating the probability of an interview within each

(1) We can suppose that there are R subperiods during which interviews might occur.

r'th subperiod to λ_2^a, it approximately equals λ_2^a/R, being slightly less in the later stages of the period as some will have jobs and not be searching. Thus the greater the average number of interviews in a full period of search, the greater will be the probability of an interview in any sub-period. The second component of (2.13), S_r, reflects the probability of an interview proving successful, i.e. the offer, which we assume always follows the interview being accepted. This probability will depend upon the acceptance wage of the unemployed worker, W_t^{e1N}, and that of the employer W_O^{e2n}, where t, in W_t^{e1N}, varies from one unemployed searcher to another, reflecting the different lengths of time for which they have been unemployed. The relationship is straightforward: the probability of a successful interview equals the number of potential interviews which will result in acceptable offers, divided by the total number of potential interviews.

The interviews which will result in acceptable offers are those where the employee's acceptance wage is lower than that of an employer whose vacancy has been available for less than one full period of search. In figure 2.8 this means job searchers who have been unemployed for four or more periods, we denote the number of such searchers by U_O. The total number of potential interviews is simply equal to the total number of searchers, i.e. the total number unemployed, which we denote by U. Therefore the probability of a single interview resulting in an acceptable offer is

$$S_{Or} = U_{Or}/U_r$$

Thus equation (2.11) now becomes

$$H_O = \sum_{r=O}^{R} V_{Or} f_r(\lambda_2^a)(U_{Or}/U_r) \qquad (2.14)$$

In words then, this relates the number of hires from those vacancies which have been available for less than one full period to their number and the probability of any one of them being made an acceptable offer. This latter probability is equal to the joint probability of an offer being made and it proving acceptable.

In (2.14) V_0, the number of acceptable vacancies is not constant throughout the period, as after part of it has elapsed some of these vacancies will have been filled. V_0 therefore declines as the period progress's, as does V and U_0. This is the reason for including them as part of the summation, i.e. the reason for the subscript r.

An analysis can also be made to find the number of hires made from those vacancies which have been unfilled for between one and two periods. These will have a higher probability of generating an acceptable offer, as their acceptance wage will be higher than those vacancies which have been unfilled for less than one period.

$$H_1 = \sum_{r=0}^{R} V_{1r} f(\lambda_2^a)(U_{1r}/U_r) \tag{2.15}$$

Further analyses can also be made of vacancies unfilled for a longer time still. The total number of hires in any one full search period, can then be found by summing hires over all such categories of vacancies.

$$H = \sum_{i=0} H_i = \sum_{i=0} \sum_{r=0}^{R} V_{ir} f(\lambda_2^a)(U_{ir}/U_r) \tag{2.16}$$

Thus the total number of hires will be related to the number of vacancies, directly from (2.16), in a positive manner, and also inversely via its indirect effect on λ_2^a. However it seems likely that the direct effect will prove dominant, and that as vacancies rise so will the number of hires. It will also depend upon the level of unemployment, mainly through its effect on λ_2^a, the average number of interviews per period. In this case an increase in unemployment, at least up to a limit, will almost certainly cause an increase in hirings.

Besides depending upon the total numbers of unemployed and vacancies, hirings will also vary with their "age distribution". For instance, a sudden increase in vacancies will at first have a muted effect on the number of hirings as they will be characterised by an acceptance wage less than that of the average vacancy which has remained unfilled for some time. The same remark applies to sudden changes in the number unemployed. Thus sudden increases in unemployment will cause hirings to be below their equilibrium level, and vice versa

Hirings will also depend upon the two acceptance curves in figure 2.8. We have already seen that the employer's acceptance curve will depend upon average net revenue per worker, his discount rate, his expectations of the number of interviews per period, which in turn will depend upon the levels of unemployment and vacancies, and the mean and variance of current wages being accepted by unemployed workers (in effect their acceptance wages). The employee's acceptance curve will depend upon any benefits he might qualify for, his discount rate, his expectations of the probable number of interviews per period and his expectations concerning the mean and variance of current wage offers.

2.5 The Hiring Wage

We begin by denoting the hiring wage from each class of hires, H_i, as W_i^{e2n}, this is the wage paid to job searchers who accept a job which has been vacant for i periods. The average wage paid to newly hired workers, W^h, can be found as a weighted average of the W_i^{e2n}'s. Where the weights are simply the number of workers hired at that wage divided by the total number of hires, i.e. H_i/H. Hence:

$$W^h = \frac{1}{H} \sum_{i=0}^{\infty} \sum_{r=0}^{R} V_{ir} f_r(\lambda_2^a)(U_{ir}/U_r)\, W_i^{e2n} \tag{2.17}$$

The problem now is to explain each W_i^{e2n}, i.e. the acceptance wage of an employer who has been searching for i periods, and from (2.7) we can see that this is defined as

$$W_{it}^{e2n} = \bar{W}_{2it} - \sigma_{2i}\sqrt{2 \log \lambda_2 n} \tag{2.18}$$

where n is the number of periods he expects to continue searching, W_{2it} and σ_{2it} are the mean and variance of the distribution of unemployed workers acceptance wages and λ_{2t} is the expected number of interviews per period, as opposed to λ_2^a which is the actual number. We now make the assumption that $\bar{W}_{2it}$, the employer's a priori belief as to the average acceptance wage of unemployed job searchers is formed as in (2.19)

$$\bar{W}_{2it} = \bar{W}_{1(t-1)} + g_t(i) + \Delta W^e_{2t} \qquad (2.19)$$

where $\bar{W}_{1(t-1)}$ is the actual average acceptance wage of job searchers in the previous period. Hence we make the assumption that, basically employers make the right guess, on the information available, as to the job searcher's acceptance wage. This assumption is slightly qualified by the second term, $g_t(i)$, which raises this estimate at a decreasing rate, with the length of search the employer has already undertaken, due to the Bayesian type adjustment process already discussed. The final term in (2.19) updates the wage by the employer's expectations of the rate of increase of the job searcher's acceptance wage. Inserting this into (2.17) we get, (omitting the t subscript when its presence is clear implicitly):

$$W^h = \frac{1}{H} \sum_{i=0}^{\infty} \sum_{r=0}^{R} V_{ir} f_r(\lambda_2^a)(U_{ir}/U)(\bar{W}_{1(t-1)} + g_t(i) + \Delta W^e_{2t} - \sigma_{2i}\sqrt{2\log\lambda_2 n}) \qquad (2.20)$$

$\bar{W}_{1t-1}$ is the actual average acceptance wage of job searchers in the previous period and we can further decompose this in a similar way to $\bar{W}_{2i}$ in (2.19):

$$\bar{W}_{1(t-1)} = \bar{W}_{2(t-2)} - g_{(t-1)}(\bar{i}_1) + \Delta W^e_{1(t-1)} \qquad (2.21)$$

Inserting this into (2.20) we get:

$$W_t^h = \frac{1}{H} \sum_{i=0}^{\infty} \sum_{r=0}^{R} (V_{ir} f_r(\lambda_2^a)(U_{ir}/U_r)(\bar{W}_{2(t-2)} - g_{t-1}(\bar{i}_1) + \Delta W^e_{1(t-1)} + \sigma_1\sqrt{2\log\lambda_1 N} + g_t(i_2) + \Delta W^e_{2t} - \sigma_2\sqrt{2\log\lambda_2 n}) \tag{2.22}$$

if we make the simplifying assumption that σ_1 and σ_2 are independent of i then this simplifies to

$$W_t^h - \bar{W}_{2(t-2)} = \frac{1}{H} \sum_{i=0}^{\infty} \sum_{r=0}^{R} (V_{ir} f_r(\lambda_a^2)(U_{ir}/U_r)(\,{}_2g_t(i_2) - g_{t-1}(\bar{i}_1) + W^e_{1(t-1)} + W^e_{2t} + \sigma_1\sqrt{2\log\lambda_1 N} - \sigma_2\sqrt{2\log\lambda_2 n} \tag{2.23}$$

This then relates the hiring wage in period t to the average employers acceptance wage in period t-2, and various other variables. The labour market variables of unemployment, profits and unemployment benefits operate through the last two terms. Ceteris paribus, an increase in profits will reduce n, the optimal expected search time for the employer, and hence increase W^h. Similarly an increase in unemployment benefits will increase N, the optimal expected search period for the employee, and hence also increase W^h. An increase in vacancies and/or a fall in unemployment is more complex, as it will tend to increase λ_1 and reduce λ_2, the expected number of interviews for the employee and employer respectively, both of these effects tending to increase W^h. But the effects on N and n, the optimal search times for employee and employer will work in the opposite direction. However the overall effect will be to increase $\lambda_1 N$ and reduce $\lambda_2 n$, and therefore to increase W^h. (Vacancies will also have a direct effect, of course, via the first term in the summation. This will however tend to reinforce the indirect effects just discussed as we will see).

As with other theories of inflation expectations enter the picture, in this case of wage inflation. Ostensibly they enter with a unit coefficient. However this is misleading as expectations of wage inflation may also affect the two standard deviation terms in (2.23). This will not be the case if employers believe that each job searchers acceptance wage will increase by a given absolute amount. In this case the distribution of their beliefs as to this acceptance curve just shifts to the right with the variance staying the same. But if employers have in mind expectations concerning the same relative or proportionate increase then not only will the distribution shift to the right, but the variance will increase as well, similar comments apply to σ_1 as well. Hence in this case expectations will not have a simple unit coefficient, but one that varies with labour market conditions via ist association with the last two terms in (2.23). Thus, for example, if labour market conditions are "tight", the coefficient on expectations would exceed unity. This is rather a surprising conclusion, and one which we shall return to examine later.

Finally we come to the first term, the two terms in brackets reflect the effects of unsuccessful job search on the acceptance wages of the two groups.The first term has a positive effect, the longer the employer has been searching for then, ceteris paribus, the higher will be his acceptance wage, because his estimate of the job searchers acceptance wage will be revised upwards in a Bayesian manner. A similar argument explains the negativity of the second term, i.e. the longer the employee has been searching the lower will be his acceptance wage, and this will have a negative effect on the rate of inflation. Thus when labour market conditions are favourable to job searchers the term in brackets will be positive and thus the first term as a whole will tend to increase the rate of inflation. The opposite being the case when conditions are more favourable to the employer.

2.6 The Quit and Firing Wages

So far we have concentrated on the effects of labour market conditions upon hires and the hiring wage. However there are two other channels by which labour market conditions can affect the wage rate, one important one being through their effects upon quits. Indeed this is the transmission mechanism favoured by Phelps (1968) himself. He put forward the hypothesis that firms in setting the contract wage would take into account conditions in the labour market, as these would determine the number of quits over the period which the contract is operative. The firm then sets the contract wage taking into account the likely number of quits, and also presumably the likely costs of those quits in terms of lost production whilst not having the job filled, and balancing these costs against the cost of increasing the contract wage. This is an approach to which we shall return to later. But first we shall turn to an analysis which has more in common with that of hires which we have just completed.

The underlying idea of this analysis is that when an employee informs an employer that he wishes to quit, the employer may respond by making him an improved offer in the hope of making the job sufficiently attractive to retain his services. It is this wage, when accepted, which we call the quit wage. The employer would do this if, in discounted terms, the cost of this course of action was less than the expected cost of hiring a new worker. Turning to equation (2.3) we can see that the decision to quit depends upon the present wage which partially determines both the expected costs of search and the expected gains. Therefore if the present wage is increased this will increase the costs of search and reduce the gains, such action may well persuade the worker to remain in his present job.

So much is fairly obvious, what is not so obvious is how much the employer will be prepared to offer to tempt the worker to remain in his service. Using the notation and terminology previously defined, the employer will be prepared to increase the wage as long as, in discounted terms, the benefits of doing so outweigh the costs. This can be expressed in an algebraic formulation by slightly modifying inequality (2.6) to

$$\sum_{i=0}^{n} \Pi'_j \frac{1}{(1 + r_2)^{i+1}} > \sum_{i=n+1}^{I-n} (\Pi_0^{e2n} - \Pi'_j) \frac{1}{(1 + r_2)^i} \qquad (2.24)$$

where the j denotes the j'th worker who has just informed the employer of his intention to quit, Π'_j is the nett revenue contribution of the j'th worker at a wage of W'_j. The left hand side of the expression represents the discounted costs of foregone revenue during the expected period of search. The right hand side represents the expected gains, which may be negative, of not employing the j'th worker at the wage W'_j, but of searching for a replacement. As long as the costs outweigh the gains, the employer will offer the wage W'_j to the j'th worker. The upper limit to what the employer is prepared to offer is reached when the inequality no longer holds. (It should also be noted that in practice there may also be training costs involved in hiring a new worker, these will tend to increase the quit wage even further).

There are several implications arising out of this analysis some obvious and some not so. Firstly, the longer the expected period of search, the greater will be the costs of foregone revenue (provided Π'_j is positive), and hence, ceteris paribus, the higher will be the wage the employer will be prepared to offer. Similarly the more productive the worker, the greater will be Π'_j which will again tend to increase the wage the employer will be prepared to offer.

If now we assume that the j'th worker has an average productivity level it follows that when W'_j is equal to the employers acceptance wage, i.e. the wage he expects to have to pay to hire a replacement worker, the term in the brackets on the right hand side of (2.24) is equal to zero. Hence the whole of the right hand side is equal to zero. Therefore provided that at this wage Π'_j is positive, this inequality will be automatically satisfied. It is indeed likely that it will continue to be satisfied at certain wage levels above the acceptance wage. We thus get the interesting result that the limit to the wage an employer is prepared to offer to an employer who threatens to quit, and who has an average level of productivity is at least equal to, and probably greater, than the wage he expects to have to pay in the hiring market. This possible premium exists because the expected cost to the employer of replacing this worker is not just the wage he expects to have to pay in the hiring market, but also his foregone contribution during the expected period of search. The minimum wage that will be acceptable to the worker will, of course be equal to his acceptance wage during the first period of search, suitably adjusted to take account of the costs of foregone revenue whilst searching. The hiring wage will be in excess of the employers initial acceptance wage, but nonetheless the existence of this premium of the quit wage over this initial acceptance wage, points to the possibility that in some circumstances it might also exceed the hiring wage.

We therefore have an upper and lower limit to the quit wage, the exact point within this range might presumably depend upon bargaining factors, random or otherwise. But there is no reason to suppose that it will depend upon cyclical factors, hence we can assume it to be stochastically constant. The quit wage is therefore a function of the same variables as the hiring wage, in addition it may be greater than the hiring wage. This will depend upon whether the premium discussed earlier, over the employers' initial acceptance wage, outweighs the increase in this acceptance wage after several periods of unsuccessful search.

There is a third mechanism by which wages might change, which concerns the reaction of a worker who is being fired. The j'th worker faced with dismissal because his productivity and wage rate are such that the inequality (2.6) holds, could theoretically offer his labour at a lower rate so that this inequality no longer held. A lower limit will again be set by that worker's acceptance wage during his first period of search, suitably adjusted for foregone income during the expected period of search.

An upper limit to this wage will be set by the necessity that it must invalidate inequality (2.6).

It should be noted that there are two possible reasons why this inequality might hold in the first place. Firstly the j'th worker may have a low level of productivity, in which case it is possible that he has been dismissed several times in the past, with the possibility that he will be dismissed again when he is hired for a new job. With this in mind the worker might well accept a lower wage to that suggested above. The second possible reason is that this workers wage rate is higher than the average. Perhaps he was employed at a time when the employer had difficulty in filling the vacancy because the market was tight. Or alternatively it might be that all wages are falling in a depression.

According, therefore to the analysis so far developed, the aggregate average wage rate will change from period to period due to some workers changing jobs and other potentially mobile workers accepting alternative wages instead. More exactly we get the following approximation

$$W_t \simeq \frac{(L_t - H_t - \hat{F}_t - \hat{Q}_t)}{L_t} W_{t-1} + \frac{H_t}{L_t} W_t^h + \frac{\hat{Q}_t}{L_t} W_t^q + \frac{\hat{F}_t}{L_t} W_t^f \qquad (2.25)$$

where W_t is the average wage paid in period t, L_t the employed labour force, $\hat{Q}_t$ the number who receive higher wages after having threatened to quit, $\hat{F}_t$ the number who accept lower wages as an alternative to being fired, and W_t^q and W_t^f the quit and firing wages respectively. This expression is only an approximation as those who do not receive wage changes might not have been receiving the average wage in t-1.

The rate of inflation can then be found by dividing through by W_{t-1}, which gives us

$$W_t/W_{t-1} \simeq \frac{(L_t - H_t - \hat{F}_t - \hat{Q}_t)}{L_t} \frac{W_t}{W_{t-1}} + \frac{H_t}{L_t}\frac{W_t^h}{W_{t-1}} + \frac{\hat{Q}_t}{L_t}\frac{W_t^q}{W_{t-1}} + \frac{\hat{F}_t}{L_t}\frac{W_t^f}{W_{t-1}}$$

(2.26)

All of these terms depend upon the basic labour market variables which have predominated our analysis so far, the numbers of unemployed and vacancies, the average nett revenue product per man, unemployment benefits, expectations of wage inflation and changes in unemployment and vacancies. H/L is simply the number of hires expressed as a proportion of the employed labour force. $\hat{Q}/L$ has not been examined explicitly, but it represents the number of workers who are dissuaded from quitting by an increased wage offer, again as a proportion of the employed labour force. We may suppose that it is related to the actual number of quits, although the exact ratio of the two at any particular time will depend upon our basic labour market variables. Similar comments apply to $\hat{F}/L$.

2.7 Conclusions

Thus far we have established a theory which generates wage increases to the mobile part of the population, i.e. those who change jobs, and eventually to the remainder of the population who are potentially mobile. At this point it is perhaps worth illustrating what happens as the economy moves out of recession. The initial increase in vacancies will make hiring more difficult for any individual employer by reducing the value of λ_2, the number of interviews per period the employer can expect to receive. This, in turn, will increase the minimum expected pay offer the employer can expect to have,to make after having searched for t periods, which will result in a worker being hired (see equation (2.7)). This, in its turn will reduce the left hand side of inequalities (2.9) and (2.10), whilst increasing the right hand side. The nett effect of all this being to increase both the optimal length of search and the acceptance wage. Partly because of this the hiring wage will also rise. This increase in the hiring wage, together with the increase in the number of vacancies, will cause an increase in the number of quits and a reduction in the number of fires, which will be particularly marked if the recession has been prolonged, as there will then be a backlog of quits to clear up. Faced with these quits the employer will attempt to persuade the worker to remain in his employ by increasing his wage. If the boom continues then eventually every worker, even the least productive, will have received a wage increase, either from his present employer or by changing jobs. A reverse process would operate when the economy moves into a recession, with generally falling wages in the hiring market being disseminated throughout the entire labour force via the firing mechanism.

It is also of some importance to examine the profit variable, this is in fact the nett revenue contribution per worker. If profits in general are buoyant, then this too will be high, and employers will be anxious to retain and attract labour. Profits will vary in a cyclical fashion, there may even be longer run trends, for example in the U.K. there has, in the post-war years, been superimposed upon cyclical fluctuations a long run secular decline in profits. This would have tended to reduce the rate of inflation consistent with given values of other labour market variables. But there is likely to be a second secular effect connected with the growth in labour productivity. This will have the effect of increasing the nett revenue contribution per worker, and hence lead to an upward drift in the wage equation. Specifically the growth in labour productivity makes each worker more productive, this increases the opportunity cost to an employer of having an unfilled vacancy. In an attempt to fill the vacancy more rapidly he will increase his acceptance wage. Similarly when faced with a worker who wishes to quit he will be prepared to offer him a higher wage than in the absence of labour productivity growth in order to retain his services. This conclusion, that there will be an outward drift of the wage equation which is linked with productivity growth, is we believe a most important one.

Also of some importance is the conclusion that the coefficient on expectations will vary with the labour market conditions. This is at variance with the conclusions reached by nearly all other theorists. Thus Phelps, for example, talks of the necessity of a unit coefficient on expectations in order for an employer to maintain his desired differential over what he expects other employers to be paying. However on reflection it becomes apparent that this will only succeed in maintaining the absolute differential. An example may clarify this, if an employer desires to maintain a differential over other employers of 10% when they are paying £20, then he will have to pay £22. If however he expects them to increase their wages by 5% to £21, then in order to maintain a desired differential of 10% he will have to pay £23.1. If he were merely to increase his wages by the desired differential plus any general percentage increase in wages, he would pay £23, merely succeeding in maintaining an absolute differential of £2, but not a relative differential of 10%. It is therefore our belief that the ease with which labour can be "attracted and retained" is related to the relative and not the absolute differential. In addition we believe that our interpretation of the theory is more in keeping with the spirit of search theories than are alternative models such as Phelps'.

The theory has, of course, been very neo-classical in nature, with many strong assumptions being made. For example, that job searchers are restricted to the unemployed, that employers cannot differentiate between different workers prior to hiring them and the exclusion of trade unions from the analysis. Nonetheless several interesting, and in our view plausible conclusions have emerged from the analysis, which cannot be found elsewhere. The role of profits within an excess demand framework has not previously been stressed, neither have the concepts of a backlog of quits as the economy moves out of a recession, or the non-unit, variable coefficient on expectations been discussed alsewhere. In addition the analysis of hires has illuminated the interactive nature of this process, highlighting, for example, the effects of a sudden increase in the number unemployed or of vacancies.

However at least one of these restrictions on the analysis will need to be relaxed, and we shall at a later date consider the impact that trade unions have on the inflationary process. Meanwhile we are faced with the problem of testing the search theoretic model of inflation developed in this chapter. This is done in chapter 7. As we have seen expectations of inflation play a crucial role in this theory and in chapters 4 - 6 we will be examining these in some detail, with a view, in part at least, to deriving a workable data series on expectations that we can use in chapter 7.

However, as we argued earlier, even if we find the coefficients of our model to be significant, this does not allow us to conclude that the search theory is a valid representation of the inflationary process. For the variables of that model are all perfectly consistent with other, e.g. wage bargaining, theories of inflation. It is for this reason that we need to conduct a second test of the search theory, in an area where these alternative approcahes have no implications. If then we find that this test also supports the theory we may with some confidence attribute the significance of the coefficients in chapter 7 as confirming our interpretation of inflation. This then leaves us with the task of finding a suitable alternative test of the theory. A task we approach in the next chapter.

Chapter 3

An Initial Test of the Search Theory

3.1 Introduction

So far we have formulated a search theoretic approach to wage formation. The theory has linked the rate of inflation to such labour market variables as unemployment, vacancies, profits, unemployment benefits and expectations of wage inflation. However besides being consistent with the theoretical framework which we have developed, any empirical significance of such variables would also be fairly consistent with several alternative theories, particularly a bargaining based one. Thus on the empirical side it becomes very difficult to directly test a bargaining theory against an excess demand type theory.

But there is an indirect test, the bargaining theories of, for example, Eckstein and Wilson (1962), Johnston (1972) and Ashenfelter and Johnson (1969) have little or no relevance for the more general problems concerning the determinants of labour market flows. These are concerned solely with the generation of wages from a series of conflicts, actual or potential. The roots of our search theoretic approach however lie in these flow concepts. It was formed by analysing these flows, and as such it is as much a theory about them as it is about wage inflation. If therefore we were to test the implications of our theory as to these flows and the results were significant, this could be interpreted as proof of the general validity of the theory. In other words the search theoretic approach to wage inflation has implications for other areas of the labour market, about which bargaining theories have little or nothing to say. If the theory is vindicated in these other areas, this would be some indication that the theory is also relevant as regards the wage formation process. It is not a complete test, it could still be that our search theory is relevant for the analysis of labour flows, but is superseded in the wage formation process by a bargaining theory. On the other hand, if the search theory was not found to be vindicated in an analysis of labour market flows, then severe doubts would be cast on its relevance for wage inflation. In fact there would be little point in testing its implications, and consideration would need to be given to some other approach to inflation.

3.2 The Relationship Between Unemployment and Vacancies

Unfortunately direct data on labour market flows is difficult to obtain. However we can, to some extent, overcome this problem by making use of the following accounting identity

$$\Delta U = Q + F - H \qquad (3.1)$$

Thus changes in unemployment are a simple function of the three flow concepts discussed in the previous chapter. Implicit in this identity is the assumption that the flow of new entrants into the labour force exactly match the flow of withdrawals. This is a simplifying assumption which will not be valid in all periods. The effect of this will be threefold, firstly to make equation (3.1) stochastic, secondly to introduce seasonal factors and thirdly to introduce trend or cyclical factors if the size of the labour force varies, either with time or with the cycle. We make the assumption as it simplifies the theoretical exposition which follows, however we shall return to it when discussing the empirical work.

We have already examined hires, fires and quits and found them to be differing functions of the level of unemployment, the number of vacancies, underlying cyclical changes in these variables, average nett revenue per worker, unemployment benefits, employers and employees rates of discount, and seasonal and cyclical firings. It therefore follows that the change in unemployment will also be a function of these same variables

$$\Delta U_t = f(U_t, V_t, \dot{U}_t, \dot{V}_t, \Pi_t, B_t, r_{1t}, r_{2t}, F_{st}, F_{ct}) \qquad (3.2)$$

The main disequilibrium forces within this equation are[1] $\dot{U}_t$, $\dot{V}_t$ and F_{ct}. If these variables remain unchanged, i.e. $\dot{U}_t = \dot{V}_t = F_{ct} = 0$, and if we also ignore seasonal firings, F_{st}, then given constant values for Π_t, B_t, r_{1t} and r_{2t}, we can relate changes in unemployment solely to the level of unemployment and the number of vacancies

$$\Delta U_t = h(U_t, V_t) \qquad (3.3)$$

and setting $\Delta U_t = 0$

$$0 = h\,(U_t, V_t) \qquad (3.4)$$

We have now defined the locus of points in the unemployment, vacancies plane, which will result in no changes in unemployment, and by implication, no changes in vacancies either. This is what Phelps (1968) has defined as the U-V curve, i.e. a semi equilibrium relationship between unemployment and vacancies.

Several economists, including Phelps himself, have attempted to estimate this relationship, and also to test hypotheses about the labour market, by regressing, either unemployment on vacancies, or vice versa. The first work in this tradition was by Dow and Dicks-Mireaux (1958), who were also the first to put forward the hypothesis of an equilibrium relationship between unemployment and vacancies. Many studies followed, for example Bowers et al (1972), Gujarati (1972), Taylor (1972) and Knight and Wilson (1974). Many of these papers have centred on possible explanations for observed shifts in the U-V curve. These range from the introduction of earnings related benefits and redundancy payments, both in 1966, to changes in the age structure of the labour force.

However it has recently been realised that it is not valid to regress,

---

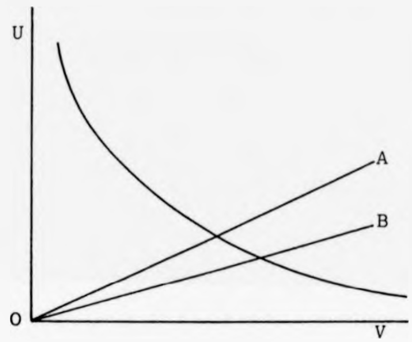
1. Where $\dot{U}_t$ and $\dot{V}_t$ represent the underlying cyclical changes in U_t and V_t.

either unemployment on vacancies or vice versa. This is because neither unemployment nor vacancies can be regarded as independent variables in such a system, and treating them as such leads to estimation bias (see Parikh (1977)). However we can still test the theories we have put forward about labour market flows by estimating equation (3.2) directly. Moreover, from this estimate we can also derive estimates of the U-V curve by setting ΔU_t to zero and solving for U in terms of V.

This approach is essentially similar to that of Warren (1977), who relates percentage changes in employment to both U and V. He finds "no significant equilibrium relationship between unemployment and unfilled vacancies". However there are a number of factors which might tend to invalidate his analysis. Firstly he regresses changes in employment upon a composite unemployment and vacancies term, thus forcing any potential relationship to take a specific functional form. Secondly he allows for no disequilibrium effects, such as a backlog of quits as the economy moves out of recession. Indeed he includes no other explanatory variables, other than a constant term, seasonal dummies and a relatively unexplained time trend. Finally when the dependent variable is a flow concept the time period over which it is defined is of importance. In particular, the longer the period, the more difficult it is to discern any underlying relationship. Now whilst his basic time period, a quarter, does not seem excessively long, it would have been preferable to adopt a still shorter unit still, e.g. one month, as we do here.

In deciding upon an appropriate functional form for this estimation it is important to realise that most observations will be found within a narrow range of values, for example between lines O A and O B in figure 3.1 and we can only speculate about the position of possible values outside this segment. However we can theorise about the possible shape outside this narrow range of values, even though they are extremely unlikely ever

Figure 3.1 The Observed Segment of the U-V Curve



to be observed. We know, for instance, that unemployment will never equal zero, for even in the absence of other kinds of unemployment, there will always be some frictional unemployment as people change jobs. Hence we would expect some minimal level of unemployment which forms a theoretical horizontal asymptote in figure 3.1. Indeed it may even be that above a certain minimum level of vacancies, unemployment actually increases, with workers quitting more often in a very tight market.

One can, however, envisage a situation where there are no vacancies, but this would correspond to an economy with no employment at all. For even if there were only a very small number of jobs, say equivalent to one percent of the workforce, some of these would become vacant from time to time as workers retired or died etc. Hence the relationship between unemployment and vacancies is such that there is some minimum level below which unemployment will not fall, and perhaps which it approaches asymptotically. In addition the number of vacancies will approach zero as unemployment increases to one hundred percent. But it should be re-emphasised that the segment of the relationship over which we have details is only relatively small, and the functional form which best fits this segment may have asymptotic properties which differ from those we have just described. We will therefore experiment with several functional forms in an attempt to discover which corresponds most closely to the observed data. However all of these functions will imply a convex negative relationship between unemployment and vacancies, and it is to the justification for this that we now turn.

3.3 Negativity and Convexity Conditions for the U-V Curve

The U-V curve is usually drawn downward sloping and convex with respect to the origin as in figure 3.1, and in this section we will discuss the conditions for this. The technical structure of our approach is similar to the one employed by Phelps. The economic interpretation differs however, and relies heavily on the discussion of quits, fires and hires made in the previous chapter.

We have already learned that each of the variables on the right hand side of equation (3.1) depends upon total unemployment and vacancies, among a range of other explanatory variables which we will ignore in this section. Hence

$$Z = Q(U,V) + F(U,V) - H(U,V) \qquad (3.5)$$

(where Z stands for changes in unemployment). Therefore along the steady state U-V curve

$$dZ = \frac{\delta Z}{\delta U} dU + \frac{\delta Z}{\delta V} dV = 0 \qquad (3.6)$$

so that

$$\frac{dU}{dV} = -\frac{(\delta Z/\delta V)}{(\delta Z/\delta U)} \qquad (3.7)$$

and it is the condition for negativity which demands that this should be negative. In examining whether this condition holds we will begin with the numerator.

$$\frac{\delta Z}{\delta V} = \frac{\delta F}{\delta V} + \frac{\delta Q}{\delta V} - \frac{\delta H}{\delta V} \tag{3.8}$$

It follows from the discussion in the previous chapter that we can expect that

$$\frac{\delta F}{\delta V} < 0, \ \frac{\delta Q}{\delta V} > 0 \text{ and } \frac{\delta H}{\delta V} > 0$$

Hence for the whole expression on the right hand side of (3.8) to be negative, the following condition should hold

$$\left| \frac{\delta F}{\delta V} - \frac{\delta H}{\delta V} \right| > \left| \frac{\delta Q}{\delta V} \right| \tag{3.9}$$

In other words, in equilibrium, an increase in the total stock of vacancies should lead to an increase in hiring and hence a reduction in the level of unemployment, which is big enough to offset the difference between the increase in voluntary unemployment and the decrease in involuntary unemployment (replacement firings only). This requirement is not an unrealistic one, for even ignoring fires, it would be surprising indeed if an increase in vacancies were to increase quits by a greater amount than hires.

Similarly for the denominator in (3.7) to be negative, it is required that

$$\left| \frac{\delta H}{\delta U} - \frac{\delta F}{\delta U} \right| > \frac{\delta Q}{\delta U} \tag{3.10}$$

An increase in unemployment will have a positive effect on replacement fires and a negative effect on new hirings. The only counter effect is again found in the behaviour of quits. But again it would be surprising if this were to outweigh the other two effects. Hence as both the numerator and denominator in (3.7) are likely to be negative, dU/dV should be negative and the condition for a downward sloping U-V curve seems likely to be satisfied. (Besides Phelps, this conclusion is also in agrreement with that of other theorists, see for example Corry and Laidler (1967)).

The condition for convexity is that, in addition to the first derivative being negative the second one should be positive, this second condition works out to be

$$\frac{d^2U}{dV^2} = - \frac{1}{(\delta Z/\delta U)^3}\left[\frac{\delta^2 Z}{\delta V^2}\left(\frac{\delta Z}{\delta U}\right)^2 + \frac{\delta^2 Z}{\delta U^2}\left(\frac{\delta Z}{\delta V}\right)^2 - 2\left(\frac{\delta Z}{\delta U}\frac{\delta Z}{\delta V}\frac{\delta^2 Z}{\delta V\,\delta U}\right)\right] > 0 \tag{3.11}$$

Which is a formidable looking expression, the exact meaning Phelps himself seemed unsure of. But taking the terms in turn it may be possible to unravel its complexities.

Beginning with $-(\delta Z/\delta U)^{-3}$, we have seen that $\delta Z/\delta U$ is likely to be negative, therefore this expression is likely to be positive. Thus in order for d^2U/dV^2 to be positive the expression inside the brackets must also be positive. The first term in the brackets is $(\delta^2 Z/\delta V^2)(\delta Z/\delta U)^2$. The squared term is necessarily positive, the other term is equal to

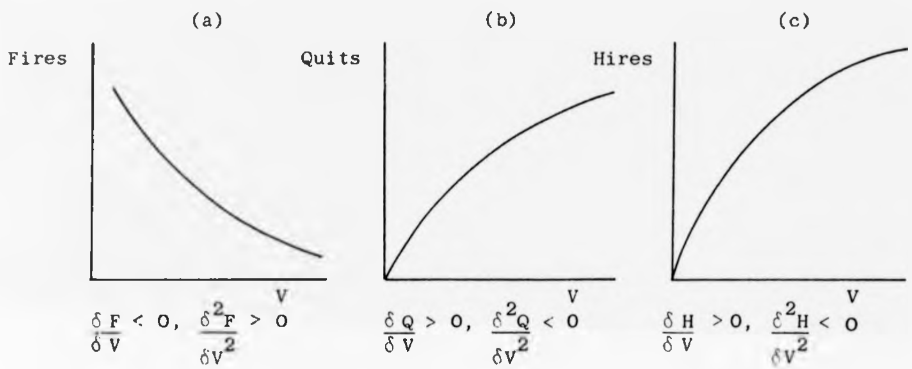
$$\frac{\delta^2 Z}{\delta V^2} = \frac{\delta^2 F}{\delta V^2} + \frac{\delta^2 Q}{\delta V^2} - \frac{\delta^2 H}{\delta V^2} \tag{3.12}$$

Assuming that the functions relating fires, quits and hires, for a given level of unemployment, to vacancies are as shown in figure 3.2 (i.e. they are themselves continuous convex or concave functions), which seems intuitively plausible, then $\delta^2 F/\delta V^2$ will be positive, $\delta^2 Q/\delta V^2$ negative and $\delta^2 H/\delta V^2$ negative. Therefore this term will be positive if

$$\left|\frac{\delta^2 F}{\delta V^2} - \frac{\delta^2 H}{\delta V^2}\right| > \left|\frac{\delta^2 Q}{\delta V^2}\right| \qquad (3,13)$$

On balance we would expect this to be the case as again there are two

Figure 3.2 The Relationships Between Vacancies and Fires, Quits and Hires



terms on the left hand side and only one on the right hand side, and also hires are a quantitatively greater term than quits. But it is possible that for certain values of V, probably high ones, as for low ones the curve in figure 3.2(c) is likely to rise faster than the curve in figure 3.2(b), this condition will not hold and in equation (3.11) the first term in the square brackets will be negative.

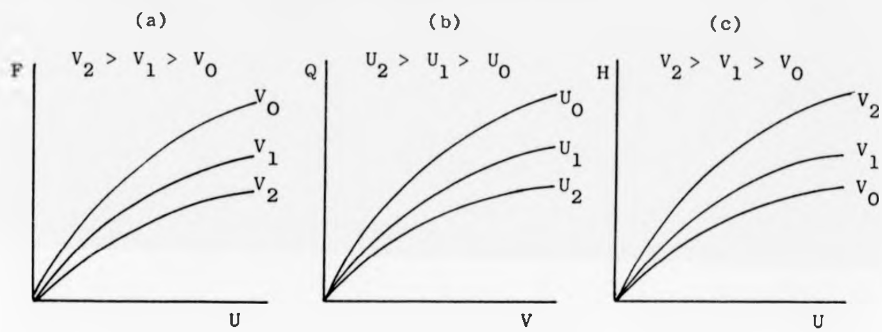
A similar argument applies to the second term, on balance we would expect this to be positive, but at certain levels of unemployment, probably high, it may be negative. Thus the first term in the squared brackets may be negative at high levels of vacancies, and the second at high levels of unemployment, but it is unlikely that they will both be negative at the same time, as along the U-V curve high levels of vacancies and unemployment cannot be observed together.

The third term in the squared brackets is $-2((\delta Z/\delta U)(\delta Z/\delta V)(\delta^2 Z/\delta V\delta U))$. We have seen that both $\delta Z/\delta U$ and $\delta Z/\delta V$ are likely to be negative, the third term is equal to

$$\frac{\delta^2 Z}{\delta V \delta U} = \frac{\delta^2 F}{\delta V \delta U} + \frac{\delta^2 Q}{\delta V \delta U} - \frac{\delta^2 H}{\delta V \delta U} \qquad (3.14)$$

Again we assume that the relevant functions are as depicted in figure 3.3

Figure 3.3 The Combined Effects of Unemployment and Vacancies upon the Labour Market Flow Variables



In figure 3.3(a) as vacancies increase the curve swivels downwards and the slope decreases, therefore $\delta^2F/\delta V\delta U$ is likely to be negative. Similarly $\delta^2Q/\delta V\delta U$ is also likely to be negative. However in figure 3.3(c) as vacancies increase the curve swivels upwards and the slope increases, therefore $\delta^2H/\delta V\delta U$ is likely to be positive. Hence $\delta^2Z/\delta V\delta U$ will be negative.

Therefore all three terms within the squared brackets are likely to have a positive effect, and the term as a whole is likely to be positive. Thus on balance we would expect the convexity conditions in (3.11) to be satisfied. However it is possible that for high values of V or U the convexity conditions may not hold, but for the range of values with which we are concerned in this study, these qualifications are unlikely to be important.

This conclusion is strengthened by consideration of the fact that we are considering the national labour market as a whole, which will be composed of a great many individual labour markets, aggregated across skills and geographically. In this case the condition that the curve be downward sloping is

$$\frac{dU}{dV} = \sum \frac{dU_i}{dV_i} < 0 \qquad (3.15)$$

and the additional convexity condition is

$$\frac{d^2U}{dV^2} = \sum \frac{d^2U_i}{dV_i^2} > 0 \tag{3.16}$$

These conditions are not as stringent as those for the individual markets, as given that we can expect the conditions to be satisfied for the majority of the time in individual markets, on the occasions when they are not, for specific markets, we can expect this to be balanced by the majority of markets where they are satisfied.

Hence for the purposes of the empirical work we will procede on the assumption that the part of the U-V curve we are studying is both convex and downward sloping.

3.4 The Data

The data was originally for the period January 1966 to mid 1972. The regressions themselves were carried out for the period February 1967 to mid 1972 (February 1967, as we used up thirteen observations in calculating lagged values). It was thought advisable to restrict the empirical work to either a recession or a boom as this would reduce the number of disequilibrium factors which invalidate, or complicate the accounting identity (3.1) and the functional relationship (3.2). Thus by restricting the analysis to a recession we have only cyclical fires to allow for, and not, for example, additional workers entering the labour force as employment prospects improve, nor would the backlog of quits as the economy moves out of recession prove such a problem. With respect to cyclical fires we make the assumption that downward adjustments in the desired labour force are mainly achieved by failure to make good losses through natural wastage. To the extent that this is not so it is hoped that any effects they might have on the analysis can be captured by the disequilibrium variables within that analysis, for example underlying changes in unemployment. We chose a recession rather than a boom as in recent years this will yield more observations. Finally the reason why a sample period coinciding with a more recent recession was not chosen was that in the early 1970's data on adult male vacancies alone was discontinued and being as the analysis is restricted to the "adult male labour market", for reasons we explain later, this precluded a more up to date sample base.

A more detailed set of definitions are given at the end of the paper. At the moment our wish is to emphasise a few general points. The data for unemployment and vacancies relate to monthly statistics, for reasons mentioned earlier. The unemployment data has been corrected to exclude adult students who registered as unemployed during the vacations, but are not otherwise seasonally adjusted. We have preferred to account for any seasonal effects explicitly within the regressions by using eleven seasonal dummy variables, each of which took a value of one for a particular month and zero otherwise.

The unemployment and vacancy figures relate to adult males only. We have excluded females on the grounds that fewer of these register as unemployed, as many of them do not qualify for unemployment benefits. However even the male figures are not perfectly recorded. A recent survey by the Department of Employment (1975) found that on average only 16% of employers used the employment exchanges. Similarly the unemployment figures must understate the true number of unemployed, the principal omission being amongst those who quit there job voluntarily, as they will not be able to claim unemployment benefit for six weeks.

As already mentioned the unemployment data relates to the monthly figures. Sometimes, however, we found a five week gap and sometimes a four week gap between the dates on which the counts are made. This will obviously make a difference to the regressions when the independent variable is the monthly change in unemployment. Consequently these monthly changes have been standardised by dividing them by the number of weeks since the previous count and multiplying them by four.

Underlying cyclical changes in unemployment and vacancies will have disequilibrium effects on U-V observations due to their temporary effects on quits, hires and fires. To allow for these effects we need variables which reflect the underlying trends in vacancies and unemployment. For unemployment we defined such a variable as the change in unemployment over a twelve month period, lagged one period, i.e.

$$YRUNL = U_{t-1} - U_{t-13} \tag{3.17}$$

However there seems no reason why the effect of an increase in unemployment should be the same as a decrease. We therefore subdivided YRUNL into two further variables, the first, INYUL, took the value of YRUNL when it was positive and zero otherwise. The second FAYUL took the value of YRUNL when it was negative and zero otherwise. We defined similar variables for vacancies based upon YRVAL (defined similarly to YRUNL), but since in the regressions there was, on the whole, no significant difference between them, we continued to use YRVAL. Also whilst INYUL proved significant, FAYUL did not and has been omitted from the results. We feel that it would be wrong to draw any conclusions from this, due to the fact that the period under study is one of typically increasing unemployment, thus FAYUL took non-zero values for only eight periods.

The unemployment benefits data relates to a single person. In general all the rates, for married people with or without children, and single persons tend to move together. Hence those relating to a single person were chosen as a proxy for all the rates. To isolate the effects of unemployment benefits we have divided the benefits available in any particular period by an index of nett earnings. This approach can be justified if we look again at inequalities (2.4) and (2.5), which determine the optimal length of employee search and his acceptance wage. We reproduce (2.4) below

$$W_0^{elt} - B_t > \sum_{i=0}^{\chi_1} (W_0^{el(t+1)} - W_0^{elt}) \frac{1}{(1 + r_1)^{i+1}} \qquad (3.18)$$

dividing both sides by W_0^{elt} we get

$$1 - \frac{B_t}{W_0^{elt}} > \sum_{i=0}^{\chi_1} \left[\left(\frac{W_0^{el(t+1)}}{W_0^{elt}} - 1\right) \right] \frac{1}{(1 + r_1)^{i+1}} \qquad (3.19)$$

For any levels of vacancies and unemployment we can assume the right hand side of these equations to functions of t, the length of search. Therefore (2.4) and (2.5) can now be written as

$$1 - \frac{B_t}{W_0^{elt}} > h(t) \qquad (3.20)$$

and

$$1 - \frac{B_{t-1}}{W_0^{el(t-1)}} < h(t-1) \qquad (3.21)$$

An increase in benefits relative to W_0^{elt} and $W_0^{el(t-1)}$ may result in these inequalities no longer holding and to restore them the expected length of search will have to be lengthened. The relevant variable for representing the effects of unemployment benefits would be B_t/W_0^{elt}, although we used a proxy, average nett earnings, for W_0^{elt}.

To represent the employers side of the problem we need a measure of the expected net revenue contribution made by the average worker. Again this is a variable about which we have no direct measure. As a proxy we have taken two measures of profits, before and after stock appreciation. It was found on the whole that total gross profits before allowing for stock appreciation gave the best results, and it is these which are reported below.

There were a number of factors which the theory indicated should be included in the regression, but which have been omitted. Firstly we argued that over time the average net revenue contribution of the worker would be increasing, due to productivity growth. We have failed to take any account of this because we felt that the time period within which we were working was too small for this effect to be of importance. Although when we come to the empirical work on the wage equation itself we will be allowing for it. Secondly we have also omitted to include the employers' and employee's own discount rates in the regressions. Unfortunately we failed to find a satisfactory measure for these concepts. In particular we do not regard the use of institutionally determined interest rates as fulfilling this purpose. Therefore no attempt was made to account for this factor in the regressions. Finally we were, as we have already said, unable to find a usable measure for cyclical fires and this had to be excluded from the regressions as well.

3.5 The Results

A representative sample of the results is given in Tables 3.1, 3.2 and 3.3. The first point to report is that of all the functional forms tested, linear, double log and semi-log, the latter, using unemployment and log vacancies gave the best results in terms of R^2's and t statistics.

In Table 3.1 the regressions with changes in unemployment as the dependent variable are given. Both unemployment and log vacancies are significant in nearly all the regressions, and the coefficients have the correct signs. The addition of a profit variable met with success, as did the introduction of INYUL, both were significant and both had the correct signs, the negative sign on INYUL being possibly due to the temporary effect on quits of a sudden increase in unemployment. Unemployment benefits were not significant and therefore an alternative way of isolating its effects were tried. The month to month changes in the ratio of benefits were fairly small, except when either the basic rate of benefit or the

Table 3.1 Summary of Regressions with Changes in Unemployment as the Dependent Variable

Regression	$U_{t-\frac{1}{2}}$	Log $V_{t-\frac{1}{2}}$	Constant	Π_t	B_t	INYUL	DIBDI	DEVDU	DEVD1	YRVAL
1.	-0.013197	-35728.0	397683.0							
	(0.68)	(3.7)	(3.36)							
	$\bar{R}^2 = 0.87$, DW = 1.15									
2.	-0.0759	-51547.0	696251.0	-679919						
	(3.00)	(5.30)	(5.15)	(3.55)						
	$\bar{R}^2 = 0.89$, DW = 1.42									
3.	-0.21743	-128234	1714715	-1393198	9397	-0.097				
	(4.20)	(5.32)	(5.62)	(5.09)	(0.69)	(4.00)				
	$\bar{R}^2 = 0.93$, DW = 1.78									
4.	-0.1907	-115612	1563307	-1265605		-0.087	79389			
	(6.00)	(7.2)	(7.2)	(6.2)		(4.7)	(1.4)			
	$\bar{R}^2 = 0.93$, DW = 2.06									
5.	-0.225	-130348	1767134	-1429719		-0.098	124097	-7593	7299	
	(7.9)	(9.3)	(9.24)	(7.33)		(6.1)	(2.48)	(3.0)	(2.4)	
	$\bar{R}^2 = 0.95$, DW = 2.06									
6.	-0.26	-146147	1975879	-1601317	181	-0.094	117323	-8429	7180	0.0562
	(3.49)	(4.36)	(4.46)	(4.16)	0.26)	(2.65)	(1.84)	(2.79)	(2.24)	(0.4)
	$\bar{R}^2 = 0.95$, DW = 2.06									

Note: $U_{t-\frac{1}{2}} = \frac{1}{2}(U_t + U_{t-1})$, $V_{t-\frac{1}{2}} = \frac{1}{2}(U_t + U_{t-1})$, the eleven seasonal dummies have been omitted because of space.

Table 3.2 Summary of Regressions with Unemployment as the Dependent Variable

Regre-ssion	Log V_t	Constant	Π_t	B_t	YRVAL	DEVDU	DEVD1	INYUL	DIBDI
1.	-434330	5422582							
	(11.96)	(12.99)							
	$\bar{R}^2 = 0.735$, DW = 0.098								
2.	-341318	5085440	-5569428						
	(11.55)	(16.69)	(6.74)						
	$\bar{R}^2 = 0.862$, DW = 0.129								
3.	-438773	5820274	-5066204	5143	1.195				
	(31.0)	(30.35)	(15.38)	(4.60)	(11.9)				
	$\bar{R}^2 = 0.979$, DW = 1.30								
4.	-439513	5807468	-4907650	5107	1.16	-27746	11718		
	(34.59)	(34.78)	(13.68)	(5.05)	(13.30)	(3.40)	(1.32)		
	$\bar{R}^2 = 0.984$, DW = 1.588								
5.	-429677	5811457	-5053037	3534	1.55	-28464	12942	0.139	43562
	(29.6)	(34.4)	(13.54)	(2.1)	(5.3)	(3.45)	(1.44)	(1.4)	(0.24)
	$\bar{R}^2 = 0.984$, DW = 1.66								

Note: The eleven seasonal dummies have been omitted from the results because of space.

Table 3.3 Summary of Regressions with Log Vacancies as the Dependent Variable

Regression	U_t	Constant	Π_t	B_t	YRVAL	DEVDU	DEVD1	INYUL	DIBDI
1.	-0.0000017	12.23							
	(11.96)	(162.0)							
	$\bar{R}^2$ = 0.72, DW = 0.105								
2.	-0.00000216	13.56	-8.67						
	(11.55)	(33.1)	(3.29)						
	$\bar{R}^2$ = 0.76, DW = 0.132								
3.	-0.00000217	13.20	-10.68	0.01029	0.0000028				
	(31.07)	(62.0)	(11.7)	(3.9)	(14.89)				
	$\bar{R}^2$ = 0.972, DW = 1.31								
4.	-0.00000219	13.13	-10.37	0.01076	0.0000027	-0.064	0.02		
	(34.59)	(60.48)	(10.71)	(4.6)	(16.35)	(3.6)	(1.0)		
	$\bar{R}^2$ = 0.979, DW = 1.62								
5.	-0.00000222	13.28	-10.68	0.0093	0.0000032	-0.0647	0.02	0.0000002	-0.025
	(29.6)	(40.02)	(9.9)	(2.4)	(4.47)	(3.44)	(1.03)	(0.7)	(0.06)
	$\bar{R}^2$ = 0.978, DW = 1.67								

Note: The eleven seasonal dummies have been omitted from the results because of space.

earnings related components increased. In these months we would expect a sudden and large jump in the number unemployed. To isolate this effect we included the variable DIBDI in the regressions, this is constructed by taking the monthly change in total benefits, zero in most months, and dividing it by earnings. This variable did then prove significant and had the right sign.

The two variables DEVDU and DEVD1 were included to reflect the effects of the 1967 devaluation. In a more general context it seems possible that certain events might have such an effect upon confidence that they would temporarily disturb the smooth running of the labour market. Widely publicised strikes and general elections are two other candidates for such effects. But in the event, the 1967 devaluation seems to have had the most pronounced effects. This, as we shall see later, confirms, in another field, the recent findings of Carlson and Parkin, who found that devaluation had a very strong impact on the public mind as far as expectations of inflation are concerned.

What seems to have happened in the labour market, in the months following devaluation, was that the uncertainty generated had an impact effect on hires, fires or quits. Of the three quits seem the most likely candidate, with workers defering the decision in a time of general uncertainty. As this uncertainty vanished there would be a backlog of quits appearing. Hence immediately following devaluation one would expect to find U-V observations below the curve, to be followed by a period when they were above the curve. DEVDU was therefore operative for the first four months following devaluation, and DEVD1 for the four months following that. Both of these dummy variables proved significant, moreover the coefficients were pleasingly similar in absolute magnitude, with DEVDU being slightly larger which is as it should be.

One other event seems to have had a particularly destabilising effect upon the labour market. This was the miners' strike of early 1972, which led to power cuts and rationing of electricity supplies. It is hardly surpising that this should be so, employers, for example, might not be so "keen" to fill their vacancies if their existing workforce is not being fully utilised. As this event occurred right at the end of our period we decided to omit these observations altogether, restricting the regressions to the period ending February 1972.

We have now achieved the principal objective of this chapter, i.e. to provide an initial test of the search theory developed in chapter 2. This has been done and the results do on the whole provide a considerable amount of support for the theory. However having done this we shall now turn to examine these results within the context of the U-V curve. In figure 3.4 three representative estimates have been plotted in the unemployment vacancy plane. First, as curve 1, is the U-V relationship derived from the sixth regression in Table 3.1 In this derivation all the disequilibrium terms, INYUL, DEVDU, DEVD1 and DIBDI were set equal to zero. The coefficient of Π_t, the profit variable, was multiplied by the average value of this variable over the period, and added to the constant term, a process which was repeated with B_t. The average value of the seasonal dummies was then also calculated and added to the constant term. This gave us

$$\Delta U_t = 1807110 - 0\ 2612\, U_{t-\frac{1}{2}} - 146150 \log V_{t-\frac{1}{2}} \qquad (3.22)$$

setting $\Delta U_t = 0$ we get

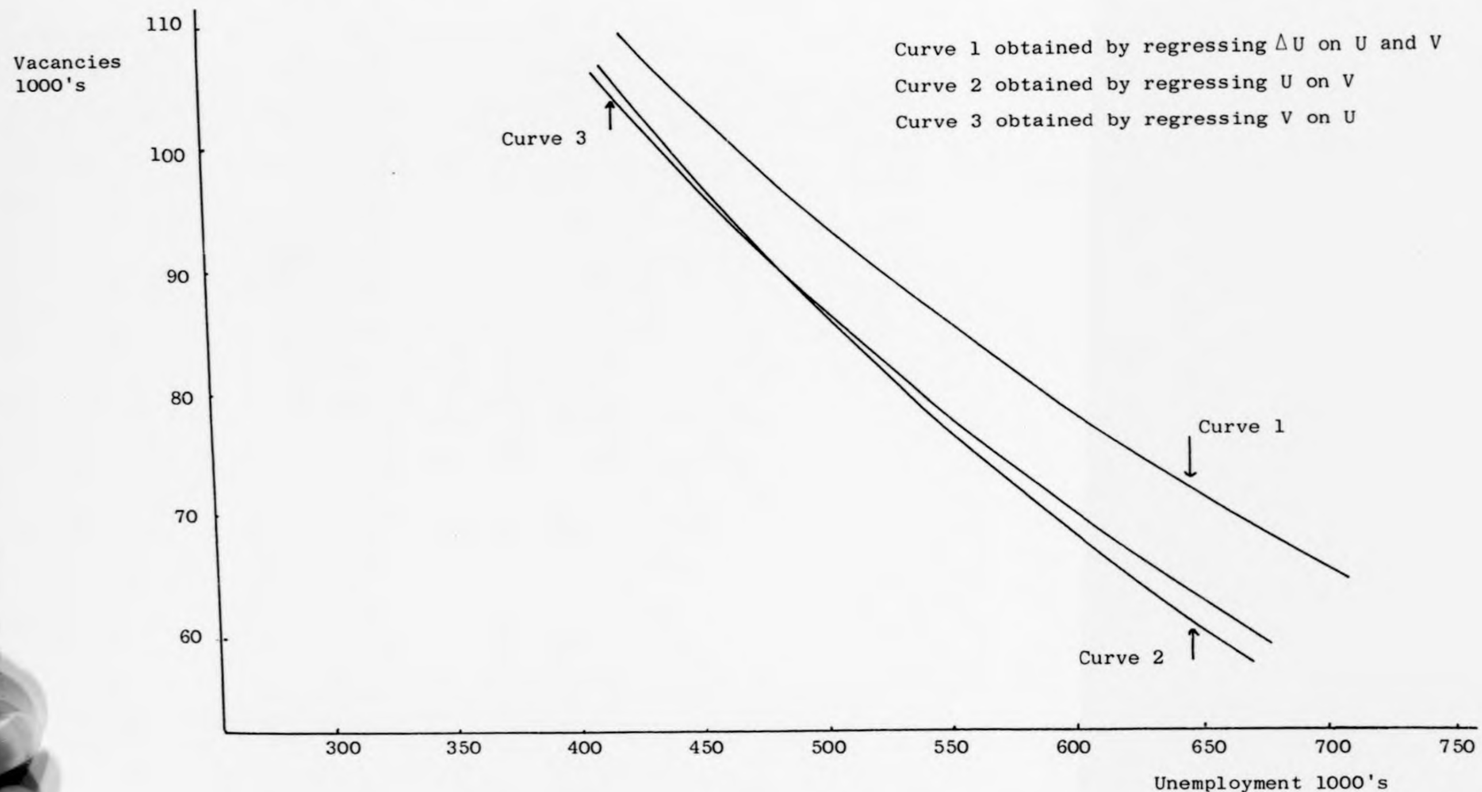
$$0 = 1807110 - 0.2612\, U_{t-\frac{1}{2}} - 146150 \log V_{t-\frac{1}{2}} \qquad (3.23)$$

from which we get

$$U_t = 6918490 - 559533 \log V_t \qquad (3.24)$$

For comparison purposes the U-V curve was also estimated directly by regressing U on log V and vice versa. The results of this are shown in

Figure 3.4 Estimates of the U-V Curve



Tables 3.2 and 3.3. But before examining these it should be noted that the two devaluation dummies are not defined in the same way as before, as in this case the U-V curve is being estimated directly. DEVDU was, therefore, operative for the first three months following devaluation, then there is a two month gap as the U-V observations cross the curve with the restoring of confidence, and DEVD1 is operative for the three months following that.

The principal difference, then, between these results and those in Table 1 is the greater significance of the benefits term. Using a similar method as before we can calculate a relationship between unemployment and vacancies and unemployment. For the fifth regression in Table 3.2, which was the closest counterpart to the regression used to derive (3.24), this is

$$U_t = 5390090 - 429677 \log V_t \tag{3.25}$$

and for the fifth regression in Table 3.3

$$U_t = 5629850 - 449762 \log V_t \tag{3.26}$$

Both of these curves were then superimposed upon figure 3.4. As can be seen all three curves are reasonably similar, but the first one is flatter and lies farther to the N.E. than the other two. Besides the statistical biases which underlie the regressions, a major reason for this difference may be due to the different assumptions which form the basis of the different estimation techniques. The first curve which was estimated by regressing changes in unemployment on unemployment, vacancies and the other independent variables, rested upon the assumption that downward adjustments in the desired labour force are mainly achieved by a failure to make good losses through natural wastage, or alternatively that cyclical fires can be proxied by the disequilibrium variables such as INYUL.

On the other hand the other two curves were derived directly from estimating unemployment, or vice versa. This procedure may have difficulty in taking account of cyclical effects, particularly in a continual, or almost continual recession, as this period was.

Before leaving this section we should point to certain weakness's in the analysis. In particular all of the regressions were estimated by O.L.S., wheras there is reason to believe that there is some simultaneity between the variables. This is particularly likely to be the case in the regressions in Table 3.1, where we are regressing changes in unemployment on $U_{t-\frac{1}{2}}$, which is the average of unemployment in period t and t-1. However, formulating a properly specified simultaneous model would have made this section altogether too lengthy, hence the use of O.L.S.. In doing this,we might note, that we are in sympathy with a substantial body of recent empirical work which prefers the simplicity and robustness of O.L.S. to the more sophisticated simultaneous techniques. Thus, for example, Davidson et al (1979) use O.L.S. in work on the consumption function. Similarly the London Business School in their large scale econometric model have found O.L.S. to give more robust results than other methods, and therefore seem to prefer it over those other methods. One might also note in passing that use of simultaneous equation estimators does not necessarily remove the problem, 2SLS, e.g., gives asymptotically unbiased estimators, however in small samples the bias still remains.

3.6 Conclusions

In this chapter we have presented an initial test of the search theory developed in chapter 2. If this had proved unfavourable to the theory, then there would have been little point in proceeding to analyse its implications for inflation. However, the results did, on the whole, provide significant support for the theory. Thus if, when we come to examine these implications, we find the relevant variables to be significant, we can with some justification claim this as further verification of our search theoretic approach to inflation.

Thus we can now proceed to an empirical analysis of wage inflation itself. This we shall do in chapter 7, however prior to that we shall devote the next three chapters to expectations of inflation, which of course play a central role in theoretical and empirical analyses of inflation. In particular we shall, in the next chapter, be concerned with an examination of the various theories of expectation formation, and the literature which surrounds them.

However before we leave this chapter we should note that in testing the search theory, we were also testing the implications of that theory for the U-V curve. Thus out of this arise several further conclusions which are of relevance for the U-V curve itself. Most importantly we can conclude that, contrary to the conclusion of Warren (1977), there does seem to be some sort of semi equilibrium relationship between unemployment and vacancies. However the position of this within the U-V plane is to some extent determined by the values of certain other variables. The influence of a profit variable in particular seems very strong, thus the greater are profits, the closer is the U-V curve to the origin. Also important, seems to be the ratio of unemployment benefits to nett earnings, although the effect of this is less certain than that of profits.

The position of the U-V curve will also be determined by the parameters of search activity, thus anything which improves the efficiency of search by, for example, increasing the number of interviews for any given levels of unemployment and vacancies, will shift the U-V curve towards the origin. Thus any body concerned with the more efficient working of the labour market should consider, amongst other points, ways of improving the dissemination of information concerning jobs and also ways of improving the transport facilities available to the unemployed. This could be done either by providing them with free transport passes or by improving the transport network as a whole. The former conclusion, concerning the importance of information has, of course, been widely realised, and to some extent acted upon. But the latter conclusion does not seem to have been widely appreciated.

Data Appendix to Chapter 3

Vacancies: These are adult male vacancies reported to the employment exchanges. Source: Department of Employment Gazette.

Unemployment: Adult males who register as unemployed at the employment exchanges, less any students who register as unemployed during the vacation. Source: Department of Employment Gazette (Up to April 1971 the number of adult students are estimates by the Department of Employment).

Profits*: These are gross trading profits seasonally adjusted, arising in the U.K. before allowance is made for stock appreciation. These are quarterly figures, to obtain "monthly estimates" we have used linear interpolations. Source: Economic Trends Annual Supplement.

G.D.P.*: Gross domestic product at factor cost seasonally adjusted.

Unemployment Benefits: These are for a married couple with no children. The amount of earnings related supplement has been calculated on the assumption that the average weekly earnings for October in the relevant tax year represent the average for that year. Source: Department of Health and Social Security.

Earnings: Average weekly earnings of adult male manual workers as estimated by the Department of Health and Social Security, based on the average gross weekly earnings of male, adult, full-time manual workers as determined by the Department of Employment's October inquiry into the earnings of manual workers employed in manufacturing and certain other industries, and the monthly index of average earnings. Source: Department of Health and Social Security.

*Note, to obtain both G.D.P. and profits the following procedure was used to arrive at underlying trends: to get the quarterly figures we used a three month moving average. Thus if for a year actual profit figures are

I 2000

II 2500

III 2800

IV 3000

Then the second and third quarters are amended thus

$$\text{Profits in II} = \frac{2000 + 2500 + 2800}{3} = 2433$$

$$\text{Profits in III} = \frac{2500 + 2800 + 3000}{3} = 2766$$

and June = 2433

July = 2433 + 111 = 2544

Aug. = 2544 + 111 = 2655

Sept. = 2766

Chapter 4

A Review of the Literature on Expectations of Inflation

4.1 Introduction

Expectations as a concept seem to be growing increasingly important, and much of economic theory is now being phrased, or rephrased in terms of expectations. Indeed in future years when economists look back at this era, it may well prove to be that the more complete integration of expectations into economic theory proves to be the thread that links together much of the work being done, in a similar manner as the rejection of the assumption of perfect knowledge characterises much of the work done in the inter-war period.

However this awareness of the importance of expectations is not a new phenomenon. Marshall (1920), for example, was aware of the importance of the concept, though as Shackle (1967) comments, this was a trumpet he chose not to blow too hard. But it was really in Sweden that the importance of expectations in the economic process was first fully appreciated, with the work, amongst others, of Gunnar Myrdal (1939). Whilst in England,at about the same time,Keynes was of course, beginning the journey down the road that was to lead to the General Theory in which expectations are of prime importance.

Most of this work was concerned with the effects of expectations, but not so much with how those expectations were formed. Keynes, at least, thought that some expectations were closely akin to a random variable and hence unexplainable, that is unless a theory of animal spirits can be provided. Since then, and particularly since 1960 a substantial volume of literature has appeared concerned with how expectations are formed. This can be divided into two fairly distinct parts, that dealing with theoretical considerations and that which is mainly empirical in nature. There has, of course, been some interchange between these two avenues of research, but unfortunately this has not been common, and they have by and large remained seperate areas. It is hoped in this survey, not only to summarise these two approaches, but to forge links between them and to reach conclusions based upon conclusions from both of them. We shall also briefly be examining empirical work which has attempted to incorporate expectations within a model of wage inflation.

4.2 Theories of Expectation Formation

One of the first studies to put forward a hypothesis of expectation formation was Exekial's study of the cobweb theorem (1938). He assumed that expectations were "naive", that is the expected price is equal to the most recent known price, although if it were being put forward today, it would probably relate, not to the price level, but its rate of change.

A slightly more sophisticated model was proposed by Hicks (1946), and is known as the extrapolative expectations hypothesis, this can be expressed as:

$$\dot{P}_t^e = a_0 + a_1\dot{P}_t + a_2(\dot{P}_t - \dot{P}_{t-1}) \qquad (4.1)$$

Hicks assumed that $a_0 = 0$ and $a_1 = 1$. An alternative version propsed by Metzler (1941) allowed these parameters to take alternative values. Hicks' original model asserted that inflation for the next period equals the rate of inflation in the current period plus an adjustment which allows for the rate of change of inflation. In other words people are forming their expectations not about the rate of change of prices, but the rate of change of that, i.e. this is basically a second order expectations mechanism. Viewed in this light it seems a rather over sophisticated hypothesis for times of normal inflation. Since Hicks wrote the term extrapolative hypothesis has been used to describe any method of expectation formation which is based upon a distributed lag of actual price changes, i.e.

$$\dot{P}^e_t = \Sigma a_i \dot{P}_{t-i} \tag{4.2}$$

In this form it is probably more acceptable than Hicks' formation and in particular does not necessarily imply that expectations are being formed about the rate of change of the inflation rate.

A third approach to expectation formation, which can be viewed as a special case of the extrapolative hypothesis, has come to dominate much of the work done in expectations. This is the adaptive expectations hypothesis. It was first proposed by Cagan (1956) and Nerlove (1958) and formally states that expectations are revised in accordance with the last recorded error, hence its alternative name, the error learning approach. Algebraically it can be represented as

$$\dot{P}^e_t = \dot{P}_t + (1 - \lambda)\dot{P}^e_{t-1} \tag{4.3}$$

which is equivalent to an extrapolative model with geometrically declining weights:

$$\dot{P}^e_t = \sum_{i=1}^{\infty} (1 - \lambda)^i \dot{P}_{t-i} \tag{4.4}$$

λ is the adjustment parameter and the larger it is the more rapid is the adjustment of expectations to the actual rate of inflation, or alternatively the more rapid the weights decline in (4.4).

Another variation on the extrapolative theme, which has achieved some prominence recently, is the regressive-extrapolative expectations hypothesis. This was first suggested by Duesenberry (1958), and expanded upon by Modigliani and Sutch (1966). They suggest that there may be both extrapolative elements, in the narrow sense, as defined in (4.1), and regressive elements simultaneously. This regression implies a reversion of expectations towards a long-run "normal" level which may in itself be a given parameter of the system, or a lagged function of actual price changes, where the lag may be an extended one over a period of several years. In the latter case the hypothesis merely becomes a special case of the more general extrapolative hypothesis as defined in (4.2).

There is one further major theory of expectation formation, the rational expectations hypothesis. This is somewhat different from the other hypotheses that we have examined in that expectations are not formed on the basis of the present and past behaviour of prices. It was originally proposed by Muth (1961), who argued that expectations are formed in accordance with the "relevant economic theory". In Muth's own words

> "In particular the hypothesis asserts that the economy does not waste information and that expectations depend specifically on the structure of the entire system."

In more formal terms the rational expectations hypothesis proposes that expectations, or more generally the subjective probability distribution of outcomes tends to be distributed,for the same information set,about the prediction of the theory, or the objective distribution of outcomes.

These are the major theories of expectation formation, however some economists, for example Carlson and Parkin (1975), have suggested that actual expectation formation does not correspond to any single one of these hypotheses in their pure form. But elements of several theories may be relevant in the formation of expectations. Thus we have, for example, the rational-adaptive hypothesis, whereby expectations are formed partly by an adaptive mechanism and partly by taking into account non-price information in a rational manner.

How then does one decide between these differing theories? There have been two approaches, the first examines theoretical considerations and the second looks at the empirical evidence. We shall develop the theoretical approach first.

4.3 A Theoretical Evaluation of the Differing Theories

The majority of the work aimed at providing a theoretical justification for any of these hypotheses has been couched in terms of optimal forecasting considerations. The exceptions to this being papers by Turnovsky (1969) and Cyert and DeGroot (1974), who both adopt a Bayesian framework for their analyses. These two papers, although they develop a different approach to the rest of the literature, in several respects also characterise that literature. For example, they concentrate upon the adaptive expectations and the rational expectations hypotheses, which is an approach which characterises much of the literature which we are going to review.

We will begin this part of the review with the two papers already mentioned, namely Turnovsky's and Cyert and DeGroot's. This order of approach is not based upon chronological considerations, but these papers do not fit in easily with the rest of the literature and it was decided to deal with them at the beginning rather than at the end of the review.

Turnovsky's paper shows that if we can regard expectations as being altered in a Bayesian manner over time, and the prior distribution is normal, an assumption he goes some way to justifying, then at period t the expected value in t+1, P^e_t, of a variable P, in his example prices, will be given by the following equation

$$P^e_t - P^e_{t-1} = (1 - W_t/W_{t-1})(P_t - P^e_{t-1}) \tag{4.5}$$

where W_t is the variance of the (normal) distribution of expected prices and P^e_t is the mean of that distribution, and

$$\frac{1}{W_t} = \frac{1}{W_{t-1}} + \frac{1}{\sigma^2_t} \tag{4.6}$$

where σ^2_t is the varaince of prices in period t, which is known by the decision maker.

This is very similar to the adaptive expectations hypothesis, the only difference being that the rate of adaption is not a constant, but varies at a rate which depends upon the relative precision of expectations in period t and t-1. For this to be a constant, k, we require that

$$1 - W_t/W_{t-1} = k \tag{4.7}$$

that is

$$W_t = W_0(1 - k)^t \tag{4.8}$$

which is unlikely to happen in Turnovsky's example.

Turnovsky's paper is interesting in as much as it shows how the parameters may be arrived at within an adaptive expectations formula. However its more general relevance is somewhat limited by the fact that it takes as a basis a time series which is generated by random fluctuations around a given mean. The decsion makers problem is then to find that mean. Then, given, more observations he will become more confident in his estimate and respond less and less to temporary fluctuations, which is what equation (4.5) implies. The problems faced by real world decision makers are however, at least as regards forecasting future inflation rates, generally more complex. More realistic analyses can be built around variants of autoregressive moving average processes with which the remainder of the literature has been primarily concerned with and which seem more capable of generating time series similar to those which we observe in the real world.

Cyert and DeGroot also develop a Bayesian analysis, but to explain the process by which rational expectations may be developed within a market. The model they take is essentially the one Muth used to illustrate the concept of rational expectations which we shall discuss later. Their version of Muth's three equation model is

$$C_t = d_1 - \beta P_t \qquad \text{(demand)} \tag{4.9}$$

$$Q_t = d_2 + \gamma P^e_{t-1} + U_t \qquad \text{(supply)} \tag{4.10}$$

$$Q_t = C_t \qquad \text{(market equilibrium)} \tag{4.11}$$

By solving the market equations we obtain the relation

$$P_t = \frac{d_1 - d_2}{\beta} - \frac{\gamma}{\beta} P^e_{t-1} - \frac{1}{\beta} U_t \qquad (4.12)$$

By taking expected values at t-1, we get

$$E_{t-1}(P_t) = E_{t-1}\left[\frac{d_1 - d_2}{\beta}\right] - E_{t-1} \frac{\gamma}{\beta} P^e_{t-1} - E_{t-1} \frac{1}{\beta} U_t \qquad (4.13)$$

If we make the further assumption that the statistical concept of an expected value coincides with psycho-economic concept of expectations, i.e.

$$E_{t-1}(P_t) = P^e_{t-1} \qquad (4.14)$$

and that each U_t has a normal distribution with zero mean and known precision, it follows that

$$E_{t-1}(P_t) = P^e_{t-1} = E_{t-1}\left\{\frac{d_1 - d_2}{\beta+\gamma}\right\} \qquad (4.15)$$

Suppose that the posterior distribution of D ($D = d_1 - d_2$) at the end of period t-1 is normal with mean m_{t-1} and precision h_{t-1}, then Cyert and DeGroot show that, using Bayes theorem, the expected will be given by

$$P^e_{t-1} = \frac{(h_{t-1} + (\Gamma\gamma(\beta + \gamma))m_{t-1} + \Gamma\beta P_t}{h_{t-1} + \Gamma} \qquad (4.16)$$

and that

$$\operatorname*{plim}_{t \to \infty} \; E_{t-1}(P_t) = \frac{D}{\beta + \gamma} \qquad (4.17)$$

The main difficulty with this result is again its lack of generality. The problem here has been to estimate parameter values within a model. But in general the rational expectations hypothesis supposes that certain variables depend upon the values of certain other variables, and Cyert and DeGroot have little to say about this relationship. Indeed in as much as we can regard the rational expectations hypothesis as having an extrapolative foundation. a statement which is expanded upon later in this section, it would seem that Turnovsky's work has more relevance for the rational expectations hypothesis.

The remainder of the literature is mainly concerned with optimal forecasting considerations. The basis for this approach was laid by Muth (1960). In this paper he showed that, if a time series can be regarded as following the process shown below

$$Y_t = \varepsilon_t + \beta \sum_{i=1}^{\infty} \varepsilon_{t-i} \qquad (4.18)$$

and $\quad E(\varepsilon_t) = 0, \ \mathrm{Var}(\varepsilon_t) = \sigma^2$

then an adaptive expectations measure of expectations is optimal, where the adaptive expectations coefficent is equal to β, i.e.

$$Y^e_t = Y^e_{t-1} + \beta(Y_{t-1} - Y^e_{t-1}) \qquad 0 < \beta < 1 \qquad (4.19)$$

(where Y^e_t represents the forecast made in t-1, for period t.) It should be noted that the time series in (4.18) corresponds to a linear function of random shocks, where the shock associated with each time period has a weight of unity. Its weight in successive time periods however is constant, and lies somewhere between zero and one.

He also shows that the same type of forecasting rule is optimal if the time series approximates a random walk with noise superimposed, i.e.

$$Y_t = \sum_{i=1}^{\infty} \varepsilon_i + \eta_t \qquad (4.20)$$

important in all of this literature is the criteria of optimality which they employ, and here again Muth sets the pattern which most of the studies are to follow. His criteria of optimality is to minimise the error variance,

$$\text{Min } E(Y_t - Y_t^e)^2 \tag{4.21}$$

The criteria of optimality chosen obviously has important implications for the conclusions reached as to the optimal forecasting mechanism, and later we shall consider the specific implications of choosing a minimum variance criteria.

The time series considered by Muth are rather limited in character and some work has been done extending his results to cover more general cases. This work has been summarised by Rose (1972), who examines the optimal forecasting method when the time series can be described as an autoregressive integrated moving average (ARIMA) process. The principal conclusion is that the optimal current period forecast will, in general, be a weighted average of n previous errors, where n will depend upon the exact properties of the time series to be forecast. The adaptive expectations mechanism is then only optimal when the process is such that n equals one.

Denoting the lag operator by B we may write an ARMA (p,q) process as

$$\Phi(B)y(t) = \phi(B)a_t \tag{4.22}$$

where $\Phi(B)$ and $\phi(B)$ are both finite lag operators of order p and q respectively, a_t is a random disturbance term and y_t the dependent variable, or a linear transform of it to remove the mean of the series. If (4.22) has d unit roots we may rewrite it as

$$\Phi(B) = \phi(B)(1 - B)^d \tag{4.23}$$

In this form we have an ARIMA (p,d,q) process, which is basically an autoregressive moving average process stationary, not in y_t as with an ordinary ARMA process, but in the d'th difference of y_t.

If then the time series we are interested in can be described by such a process, the optimal forecast, in terms of minimising the error variance is as we have already said a weighted average of n previous errors, where n will depend upon the characteristics of the ARIMA process, for example, when we have an ARIMA (0,1,1) process, only the previous error will be considered. This is the adaptive expectations mechanism used by Cagan and Nerlove.

An alternative way of looking at the problem of expectation formation, which is usefull for the different perspective that it gives to the problem, is that we can regard it as being a special application of the Kalman filter. Given a model

$$y_t = A_t y_{t-1} + C_t x_t + b_t + u_t \tag{4.24}$$

where lower case letters denote vectors and upper case ones matrices, y_{t-1} is a vector of lagged dependent variables and x_t a vector of exogonous variables. And also given an observation an observation equation

$$s_t = M_t y_t + \eta_t \tag{4.25}$$

which relates the dependent variables' to their observed counterpart s_t. and where the disturbance terms have the usual properties. M_t is assumed to be a known matrix. The problem then is to find the mean vector

$$E(y_t | s_t) = \bar{y}_t$$

Because the problem is to predict y_t from s_t, we might consider the regression of y_t on s_t, and if the solution is to be a revision of the estimate at time t-1, it is appropriate to consider the regression of y_t on s_t given s_{t-1}. The linear regression can be written as

$$E(y_t | s_t) = E(y_t | s_t) + D_t(s_t - E(s_t | s_{t-1})) \tag{4.26}$$

where D is the matrix of regression coefficients. Now from (4.25) we get

$$E(s_t | s_{t-1}) = M_t E(y_t | s_{t-1}) \tag{4.27}$$

and inserting this into (4.26)

$$E(y_t | s_t) = (I - D_t M_t)E(y_t | s_{t-1}) + D_t s_t \tag{4.28}$$

Now taking conditional values of (4.24)

$$E(y_t) = E(y_t | s_{t-1}) = A_t E(y_{t-1} | s_{t-1}) + C_t x_t + b_t \tag{4.29}$$

and combining this with (4.28)

$$\begin{aligned} E(y_t | s_t) &= (I - D_t M_t)(A_t E(y_{t-1} | s_{t-1}) + C_t x_t + b_t) + D_t s_t \\ &= (A_t E(y_{t-1} | s_{t-1}) + C_t x_t + b_t) + \\ &\quad D_t(s_t - M_t(A_t y_{t-1} | s_{t-1} + C_t x_t + b_t)) \end{aligned} \tag{4.30}$$

This is the principle result of the Kalman-filter and it was derived as a conditional expectation of y_t given s_t. As such it is an optimal estimator of y_t, in the sense of being a minimum variance estimator. (The Kalman-filter was originally put forward by Kalman (1960), our analysis of it has drawn heavily on that of Chow (1975)).

The relevance of the Kalman-filter to the adaptive expectations hypothesis was made explicit by L Taylor (1970) and Nerlove (1972). Its use requires a slightly different perspective on expectations to that generally adopted. It requires us to think of a variable as being divided into permanent and temporary components. The permanent component satisfies a p'th order linear stochastic difference equation. We can convert this into a first order system of p equations:

$$y_t = Ay_{t-1} + u_t \tag{4.31}$$

however the observed series is generated by

$$s_t = My_t + \eta_t \tag{4.32}$$

where $M = (1\ 0\ 0\ \ldots\ldots\ 0)$

applying the filtering equation (4.30) to this we have

$$E(y_t|s_t) = (I - D_tM)A(E(y_{t-1}|s_{t-1})) + D_ts_t \tag{4.33}$$

where D_t is a vector of coefficents in the regressions of the p elements of y_t on s_t. When $p = 1$, $E(y_t|s_t)$ will be a linear combination of the prediction in the last period and the currently observed s_t.

This mention of the Kalman-filter is interesting in several respects, in the first place most economic analyses of expectations seem unaware of it and it is therefore of some interest to those concerned with the development of economic ideas. Secondly this alternative way of looking at expectations, as being essentially the filtering out a permanent element from a time series, emphasises something which underlies most theories of expectations, but is seldom made explicit. Namely that we implicitly regard the observed time series as behaving something like (4.32),with permanent and temporary components, and in some sense it is this permanent component which we are trying to isolate. Finally the Kalman-filter provides a justification for the adaptive expectations hypothesis using a different rationale than Muth's and based upon a time series with different properties.

Taken together these results do seem to provide some justification for the hypothesis that expectations are based upon the past behaviour of the variable being forecast. However this result is not without its qualifications. Nelson (1975) shows that if the variable can be regarded as being endogenously determined within an economic model, then in general,rational expectations based upon that model will provide optimal forecasts,and not expectations based upon the past history of that variable. In particular this is so even when the variable can be specified as a linear function of random disturbance terms. For example, consider a structure with only two inputs, x_t and y_t, where

$$x_t = \sum_{i=0}^{\infty} \psi_i u_{t-i}, \text{ and } y_t = \sum_{i=0}^{\infty} \theta_i v_{t-i} \tag{4.34}$$

so that

$$z_t = x_t + y_t$$
$$= \sum_{i=0}^{\infty} \psi_i u_{t-i} + \sum_{i=0}^{\infty} \theta_i v_{t-i} \quad (4.35)$$

we could write z_t as a linear function of its own past history

$$z_t = \sum_{i=0}^{\infty} \lambda_i w_{t-i} \quad (4.36)$$

where w_t is a sequence of uncorrelated distrubances with variance σ_w^2. This follows from the decomposition theory of Wold, since x_t and y_t are both stationary and independent, z_t must be stationary and has a representation as a linear stochastic process of the form

$$z_t = \sum_{i=1}^{\infty} \pi_i z_{t-i} + w_t \quad (4.37)$$

thus both rational and extrapolative expectations may be formed. It was the gist of Nelson's paper that rational expectations based upon (4.35) will have a smaller mean square prediction error than extrapolative expectations based upon (4.37).

This result has since been generalised by Wallis (1977) to apply to all cases where the exogenous variables in the model follow an ARIMA process. This would seem to be the coup de grace, and indeed in the context of the ground rules within which the debate has been conducted it is. If one accepts that the criteria of optimality be based solely upon minimising the error variance then we must conclude that wherever an economic model is applicable then expectations are formed in accordance with that model.

However if we return to Muth's original paper we see that one of the principal justifications for his hypothesis was that

> "If expectations were not moderately rational there would be opportunities for economists to make profits in commodity speculation, running a firm <u>or selling the information to present owners</u>."

Yet we now observe this last phenomenon, economists are now employed by private agencies to formulate forecasts which are sold to firms. This would therefore seem to weaken the foundations upon which the rational expectations hypothesis is built. This conclusion is even more justified if we consider how professional economic forecasters arrive at their forecasts. Do they take advantage of computer technology to construct full scale economic models, the parameters of which are found by regression techniques? Unfortunately they do not, in general forecasts are based upon extrapolative models, for example Box-Jenkins models which have come into vogue in recent years.

There are several possible reasons as to why they do this, Nelson himself suggesting one important possibility

> "Of course unlike the hypothetical rational economic agent who knows the parameters as well as the form of the economic structure he deals with, econometric models may be subject to errors of specification and parameter estimation. We can only speculate that these errors are great enough at the present state of the art to prevent structural models from attaining their potential as tools of prediction"

What Nelson seems to be saying here is that the superiority of rational over extrapolative forecasts is only valid as long as all the parameters are known with certainty, as well, of course, as the correct economic model to use. If this is not the case then he seems to be implying that the problem is indeterminate. However the very fact that professional forecasters use an extrapolative model would seem to suggest that for many time series this at present, and presumably in the past also, represents the optimal method to use in the formation of expectations.

A second, but related, consideration is that of the time profile of the availability of the data. In the simple model described by equation (4.35), for example, where one time series, z_t, depended upon two others, it may be that z_t is known sooner than x_t or y_t. In this case even with complete information about parameter values the extrapolative scheme based upon more up to date information might provide better estimates than those based upon rational expectations.

A further problem with the rational expectations hypothesis is just how individuals obtain their knowledge of the economic system, its structure and parameter values. Unfortunately this has only been partially dealt with in the literature. Some consideration has been given as to how individuals might obtain estimates of the parameters, generally within a least squares or a Bayesian framework. Thus Blanchard (1976) used a discrete time model to investigate the problem of agents discovering the correct specification of the model generating the behaviour of the overall system. His results showed that even given an infinite amount of time in which to learn, agents beliefs about the specification will not necessarily converge to that of the true model, so that expectations will not necessarily become rational in Muth's sense. Taylor (1975) used a continuous time model in which agents already know all aspects of the system except the value of a single parameter in the (correctly) specified equation, describing the behaviour of the monetary policy authority. In this case estimates of the parameter did eventually converge to the true value.

Both these examples are based on extremely simplistic assumptions. More relevant is the question of how individuals, uncertain as to the exact economic structure as well as the parameter values, obtain that information. Moreover even if we could assume that they do,what characterises their expectations during the learning process? This latter question has been considered by Friedman (1979) who concludes that it is extremely unlikely that expectations in the recent past can have been rational, in Muth's sense, particularly in view of the many drastic changes that have taken place in economists views as to the underlying economic process which generates inflation.

4.4 An Evaluation of the Optimality Criteria

Throughout the literature only one type of cost has been considered that of the expectations being in error, and in general this has been considered in only one context, the error variance. This implicitly assumes that the formation of expectations is a costless activity. At first sight this might not appear unreasonable, after all the costs of adapting the previous periods expectations by a proportion of the resulting error are surely minimal. But if one considers the more general extrapolative scheme, this involves the calculation of several parameters, perhaps an infinite number, which weight the same number of lagged observations of the time series, which must also be remembered. Is it reasonable to consider that this is a costless operation, and that it remains costless no matter how many lagged values are included? Or is it not more reasonable to assume that there are costs involved, and that these costs probably increase with the number of parameters being used?

When we consider the rational expectations hypothesis these comments seem even more valid, for here we have not only to consider several sets of parameters, but thought has to be given as to what variables to include within the economic model. Here again we have the analogy with the professional forecasters, for their preference for extrapolative methods of forecasting might also reflect the fact that such methods are probably considerably cheaper than building full scale econometric models. Considerations of cost might also explain why professional forecasters were not very numerous in 1961, when Muth's paper appeared, but have since proliferated rapidly. The reason is not that expectations were rational in 1961, but for some reason have got steadily less so. But simply that with the progress of computer technology such forecasts have become cheaper to produce and hence profitable for firms to purchase.

In slightly more specific terms the cost function should therefore be amended in the following manner

$$C_i = C_{1i} + f(E(y_i^e - y)^2) \qquad (4.38)$$

where the i denotes the method used to form the expectations and C_{1i} the "formation cost" of that method. The second term on the right hand side denotes the cost of being in error. The individual would then choose the forecasting method which minimised the sum of these two costs. This would then be the optimal method of expectation formation. This approach then helps us to explain why individuals do not form expectations on all possible time series. Why for example non-car owners are unlikely to form expectations about petrol prices. This kind of behaviour is incapable of being explained by the standard approach, indeed it has nothing to say about which variables individuals form expectations about and which they ignore. However the modified cost function approach adopted here tells us that individuals will form expectations for those series where the total cost, C_i of the optimal method is less than the cost to the individual of being uninformed about the future values of that series.

Thus in reaching a conclusion about optimal methods of expectation formation two points must be borne in mind, the formation costs of any particular method and its accuracy. Moreover for methods where parameter values have to be learned over a period of time, the transition costs to the final parameters and model (e.g. the incresed error in transition), should be borne in mind. Thus it will not always be the case that the most accurate method, i.e. the minimum variance one, will be optimal, for it may well be that this also involves heavy formation costs. The great advantage of the adaptive expectations hypothesis lies in its simplicity and hence its relatively small formation costs, knowledge is only required of the current value of the time series being forecast and a single parameter. Compare this with the large number of parameters and variables which must be used in calculations using extrapolative, large order error learning or rational schemes, and we have, I think, the real reason for the popularity of the adaptive expectations hypothesis amongst economists.

These two hypotheses have so far been put forward as competing theories and indeed this is largely how it has been approached in the literature. Yet as often happens this has served to obscure how much commom ground there exists between the rational expectations hypothesis and the various extrapolative theories.

The rational expectations hypothesis as propounded so far is not, in general terms, an alternative to an extrapolative hypothesis, it cannot be for it is often based upon extrapolative expectations. An examination of equation (4.35) reveals that expectations for z_t are based upon expectations of two other variables, x_t and y_t, this is the rational content of the hypothesis. But expectations of x_t and y_t are formed in an extrapolative manner, they are based upon the past history of x and y. Although note should be made that when the value of z_t depends upon lagged values of x and y, which are already known, then we can use those values to forecast z, and in this case there is no extrapolative element. But the general point remains that the real debate should not be about whether expectations in general are formed in an extrapolative or a rational manner. Rather it should be which expectations are formed in a rational manner and which are formed by an extrapolative mechanism.

Few economists would deny that some expectations are formed rationally. Although the theory probably has most relevance within the context Muth originally placed it, the decision making process of the firm, it would seem that even outside the firm there are grounds for believing that some expectations are formed in a rational manner. However with respect to the theory of inflation, the most important set of expectations are those which concern future price levels and are held by the average working man. We are now far removed from the simple single good, supply and demand context within which Muth introduced his hypothesis. The most striking difference is that there is no universally accepted model of inflation. What we do have are a number of competing theories, none of which seem capable of explaining the inflationary process in a completely satisfactory manner. For any economist to assume that such expectations are formed in accordance with the particular theory he favours seems completely unjustifiable, even more so when they call for the working man to have a detailed knowledge of the money supply and how it interacts with the price level.

However it would seem almost as unlikely that individuals base their expectations upon a pure extrapolative scheme. One cannot dismiss Tobin's (1972) claim that people obtain information about the economic system through the newspapers that easilly. The media is important, and when they read or hear of a forthcoming prices and incomes policy, of the devaluation of the pound, or of oil price rises, then it seems likely that they will use this information in forming their expectations. However Tobin's statement, in order to be taken as a justification for the rational expectations hypothesis, must establish two facts. Firstly, the newspapers, and this means basically the tabloid newspapers, and television, need to give regular price forecasts based upon the "relevant theory", and secondly these have to be seen and believed by the working population as a whole. Neither of these propositions seem likely to be true. What seems more likely is that expectations are formed in a semi-rational, semi-extrapolative manner, the rational-extrapolative hypothesis. By this is meant that, as Muth stated,the economic system does not waste information and though it would seem likely that expectations are based partly upon an extrapolative mechanism, outside factors such as those already mentioned may have an effect upon expectations.

Here then we conclude this section by foreshadowing a conclusion which we might make in more definite terms at a later stage in the analysis. It is, for applied economists, not an encouraging conclusion, but it seems inescapable. The problem of modelling peoples expectations is an extremely difficult one. It does not seem likely that one particular mechanism is used all the time. The most likely mechanism is the rational-extrapolative one with the weights of the different components varying with time. It may be that the rational component is increasing with time as knowledge of the economic system increases both among the general public and amongst economists themselves. It may also be that the parameters within the extrapolative scheme vary with time, so that in some periods expectations adapt more slowly to the actual rate of inflation than in others. But exactly when this change in behaviour takes place, and how people take account of external information such as commodity/raw material price rises, devaluations etc is not obvious. This implies that it is going to be very difficult, if not impossible, to generate a series for expectations, for use in time series analyses. Nor can we easilly get round the problem by trying to estimate expectation formation parameters within the complete model of the inflationary process. But the attempt must be made, if the theory indicates that expectations are an important explanatory variable, then those expectations must be proxied. But success will not this time be measured principally in statistical terms, but as should always be the case, in terms of how well do the estimated parameters fit in with the predictions from theory.

4.5 Empirical Evidence on Expectation Formation

Empirical work on expectation formation has proceeded in two general directions. The first uses actual data on expectations, whilst the second and more indirect method, includes the expectation mechanism within the structure of the model being estimated. We shall here concentrate upon the first of these two methods before turning, briefly, to examine the second.

Direct tests on the formation of expectations have been comparitively limited. This is principally because of the difficulty of obtaining data on expectations. There have been two general methods of proceeding, the first is to obtain data directly from sample surveys. The second derives the data indirectly by observing the consequences of peoples behaviour when expectations enter the decision making process. In practice this generally implies observing the difference between the interest rates on price indexed and non-price indexed bonds.

One of the first studies to use survey data was Turnovsky's (1970). He derived the data from the Livingstone Survey of Business Economists in the United States. This is a bi-annual survey, whereby business economists are asked for predictions of a number of economic series, including the consumer price index. Using this data Turnovsky found that there appeared to be a change in behaviour around 1963/4. Prior to this neither the adaptive expectations or the extrapolative hypotheses worked very well. Expectations appeared to be constant with some correction being made for past trends, when businessmen tended to extrapolate. However in the later period both the adaptive and extrapolative models fared better, by the standard statistical measures. In addition the sum of the coefficents in the adaptive expectations model is not statistically different from one. The coefficent of adaption is approximately 0.78, which suggests rapid adjustment of expectations to the actual rate of inflation. However it should be noted that they are forced, by the nature of the data, to assume that expectations are revised at six monthly intervals, and it is possible that if expectations are in fact revised at more frequent intervals, the estimate of the adjustment coefficent will be biased. This is a point to which we will return later. Finally it should be noted that he also included the rate of unemployment in the regressions, but this was not significant.

Turnovsky also used the Livingstone data in a second paper in conjunction with Wachter (1972), where they test extrapolative, adaptive and rational theories of expectation formation. The results are shown in Table 4.1 and suggest, that in this case rational expectations furnish a superior explanation of expectation formation than simple adaptive or extrapolative schemes. The particular model proposed is a simple

Table 4.1 Turnovsky and Wachter's Results

Model	Equations	$\bar{R}^2$	D.W.
Extrapolative	$\dot{W}^e_t = 0.809\dot{W}_t - 0.318(\dot{W}_t - \dot{W}_{t-1})$ (9.566) (2.293)	0.148	1.12
Adaptive	$\dot{W}^e_t = 0.533\dot{W}_t + 0.337\dot{W}^e_{t-1}$ (4.896) (2.798)	0.242	1.86
Rational	$\dot{W}^e_t = 1.531 + 33.617U^{-1}_t - 30.713U^{-1}_{t-1} + 0.503\dot{P}_t$ (1.262) (3.493) (3.335) (3.256)	0.490	1.59
	$\dot{W}^e_t = 1.185 + 28.88U^{-1}_t - 23.273U^{-1}_{t-1} + 0.624\dot{P}^e_t$ (1.009) (2.985) (2.440) (3.76)	0.527	2.14

Notes: The expectations are revised bi-annually and are for six months ahead. They relate to the period 1949 - 69. The figures in brackets are t statistics.

expectations augmented Phillips curve. The most plausible explanation for the two unemployment variables is that both the level of unemployment and its rate of change are considered within the rational model.

However in evaluating these results it should be borne in mind that there are a number of shortcomings with the data. These have been analysed in a paper by Carlson (1977) who points out that the data collected by Livingstone relate to price levels, and that it is from these that the expected inflation rates are derived. The main difficulty with this is that the predictions are made for June and December, i.e. six months after they are published. But the predictions are not made in the months in which they are published, but in the previous months, that is November and May. Moreover the latest data available in those months relates to the months before those, that is October and April. Carlson therefore concludes that the forecasts should more correctly be regarded as eight month forecasts.

But the chief qualification to these results must be that they are formed by business economists, therefore they may not be representative of the way the population as a whole form their expectations. This qualification is important for economists are much more likely to form their expectations in accordance with the relevant economic theory than the rest of the population. In addition Livingstone provides the respondents with up to date information about the economy and therefore the problem of how people perceive the rate of inflation is not tackled. These considerations impose serious limitations on the results, yet it does not render them completely invalid, and it seems possible that several of the characteristics of these expectations might be carried over to expectations in general.

For example the relative insensitivity of these expectations to actual price changes between the end of the Korean War and 1965 may reflect a lack of concern with price changes by the population as a whole during this period. Within the theory developed in the previous section this could be explained by the total cost of the optimal expectations mechanism exceeding the costs of remaining ignorant about future price trends. Hence either no expectations are formed at all, or alternatively a constant expectation is held.

The second characteristic which we might bear in mind for future discussion is that typically the expectations appear to underestimate the actual change. This appears to have occured primarily in periods of "unusually high inflation", such as the Korean War or early seventies. Apart from these periods the expectations do not seem to either consistently overpredict or underpredict the actual rate of inflation.

Carlson and Parkin (1975) were faced with a different set of problems from those trying to use the Livingstone data. They had qualitative data for the U.K., on a monthly basis, over the period 1961-73. The data was obtained from Gallop Poll's surveys of approximately 1000 quota sampled individuals who were asked whether they expected prices to rise, fall or stay the same. The principal problem that Carlson and Parkin were faced with was how to convert this data into a quantitative form which would be more amenable to empirical analysis. In solving this they made a number of assumptions:

1) Some fraction of the population are incapable of developing any view about what will happen to prices.

2) Each individual, of those who are capable, has a subjective probability function over the expected price change. It may vary across individuals and across time.

3) There is a range of price change about zero which the respondent cannot distinguish from zero. This range of imperceptibility is what experimental psychologists have called the difference limen, and is defined as the increment in physical stimulus necessary to produce a just noticeable difference in sensation.

4) The expected rate of price change over all individuals is distributed normally

5) Finally they assume that over the entire sample period the expected rate of inflation is equal to the actual rate of inflation.

Given these assumptions Carlson and Parkin are then able to derive a quantitative data series on expectations. They then use this data to test several versions of the adaptive expectations hypothesis. Their results are shown in Table 4.2.

Equation 1, in the table, represents the simple adaptive expectations model with a dummy variable added to represent the effects of devaluation in 1967. This dummy variable is highly significant, but the coefficents on actual inflation and lagged expectations sum to only 0.877, as opposed to their theoretical value of one. Although there is a constant term in this regression, which has no theoretical justification and might be biasing the coefficents downwards.

The other regressions are all testing a second order learning mechanism which the authors suggest could be appropriate if people took account, not only of the current recent rate of inflation, but also its rate of change. However this is not an entirely correct interpretation of the model they actually estimate. This can easilly be seen by an examination

Table 4.2 Carlson and Parkin's Results

Time Period	Constant	P_t	P_{t-1}	P^e_{t-1}	P^e_{t-2}	D	$\bar{R}^2$
1. "Entire" March 1961-Dec. 1973	0.618	0.132		0.745		6.340	0.75
	(2.57)	(2.92)		(15.14)		(5.69)	
2. " "	0.560	0.300	-0.201	0.597	0.191	6.527	0.76
	(2.32)	(1.62)	(1.10)	(8.08)	(2.56)	(5.95)	
3. "Low inflation" March 1961-June 1967	1.005	0.038	0.043	0.390	0.237		0.35
	(2.67)	(0.24)	(0.26)	(3.30)	(1.87)		
4. "High inflation" July 1967-Dec 1973	2.472	0.755	-0.719	0.544	0.040	5.759	0.48
	(3.33)	(2.20)	(2.11)	(5.31)	(0.38)	(4.33)	
5. " "		0.340	-0.196	0.660	0.196	6.583	
		(3.50)	(2.03)			(4.77)	

Note: The dependent variable in all equations is P^e_t, D is the devaluation dummy variable taking the value 1 in November 1967 and zero elsewhere.

of their equations, for example equation 3. The second order error component will only affect expectations when $\dot{P}^e_{t-2}$ is not equal to $\dot{P}_{t-1}$. Yet these two variables can still be equal when people are taking into account the rate of change of inflation in forming their expectations. This will be the case, for example, when expectations are correct.

One way of incorporating the rate of change of inflation into the mechanism of expectation formation is to do so directly. Assume that expectations are formed about the rate of change of inflation, the expected rate of inflation can then be found by adding this to the present rate of inflation

$$\ddot{P}^e_t = \ddot{P}^e_{t-1} + \lambda(\ddot{P}^e_{t-1} - \ddot{P}_t)$$

and

$$\begin{aligned}\dot{P}^e_t &= \dot{P}_t + \ddot{P}^e_t \\ &= \dot{P}_t + \ddot{P}^e_{t-1} + \lambda(\ddot{P}_t - \ddot{P}^e_{t-1}) \\ &= \dot{P}_t + \dot{P}^e_{t-1} - \dot{P}_{t-1} + \lambda(\dot{P}_t - \dot{P}_{t-1} - \dot{P}^e_{t-1} + \dot{P}_t) \\ &= (1 - \lambda)\dot{P}^e_{t-1} + (1 + 2\lambda)\dot{P}_t - (1 + \lambda)\dot{P}_{t-1} \qquad (4.39)\end{aligned}$$

An alternative interpretation of their conclusion that a second order learning mechanism appeared to be operative after June 1967, but before that date a simple autoregressive interpretation seems appropriate, may be that the rate of inflation was more variable and on average much higher after 1967. It might be that this reflected an underlying change in the inflation generating mechanism -i.e. viewing inflation as an ARIMA process, a change in the parameters - or at least a perceived change. As a result of this perceived change the optimal method of forecasting changed to a second order learning mechanism.

We therefore have two possible interpretations for the apparent change in forecasting techniques after 1967. The first is that the ARIMA process changed, or was believed to have changed from an ARIMA (p,1,q) process to an ARIMA (p,2,q) one, and that as a result of this change individuals began forming their expectations, not about the rate of change of the price level, but about the rate of change of the rate of change of the price level. In the terminology adopted by Fleming (1976) people had changed up a gear in their expectation formation mechanism. Alternatively we could view the process as having changed in such a way that the expected error variances of the various methods of expectation formation had changed. Because of this a more complex second order learning mechanism was now optimal and was being used to form expectations.

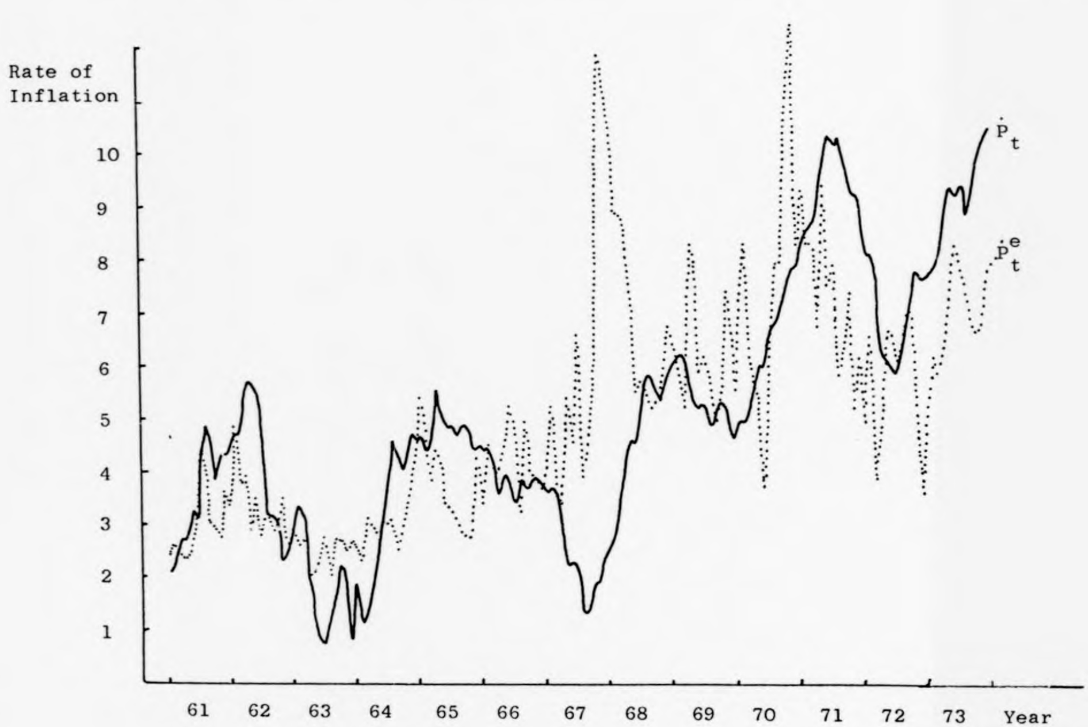
This study, by Carlson and Parkin, also provides some evidence in favour of a mixed rational-adaptive hypothesis. This comes from the significance of the devaluation dummy variable, D, in Table 4.2, which suggests that the devaluation of sterling in Novemeber 1967 increased peoples expectations of inflation. Thus taken as a whole these equations furnish some support for the hypothesis that, although expectations of inflation seem to be formed in an adaptive manner and not in a rational way based upon some model of the economy, nonetheless external factors are sometimes taken account of. Thus implying that, though the population as a whole are not in possession of a complete economic model of the inflationary process, neither are they in complete ignorance of such a model. They are able to link certain events, such as a devaluation of the currency, with changes in the inflation rate.

However these conclusions rest upon the quality of the data Carlson and Parkin use, and this in turn rests upon the method they use to convert the qualitative responses from the survey into quantitative form. This method has been criticised in a paper by Foster and Gregory (1977), who question the assumptions they make, particularly the normality assumption. Foster and Gregory conclude that the nature of the distribution is not a theoretical question, but an empirical one. They cite evidence by Carlson (1975), who rejects the normality property for the Livingstone data, and reports distributions showing more positive skewness in periods when inflation was strong or accelerating, and more negative skewness when deflation was considered possible. The reason for the skewness being one or two outlying predictions which he characterises as legitimate "wild hunches". On the basis of this evidence Foster and Gregory conclude, firstly that over the inflationary cycle as it existed up to 1969 the Carlson-Parkin series would produce systematic downward bias in the average expected rate of inflation at cyclical peaks, and an upward bias in troughs. Secondly, as the overall trend of prices throughout the whole period was upwards, this will result in a downward bias for the whole period, and particularly for the second half of the period. But because the average expected rate of inflation is made equal, by assumption, to the average rate over the whole period, this will result in underprediction from 1970 onwards, to be offset by overprediction prior to this.

There are also difficulties in applying the method when there is a zero response in any interval. Carlson and Parkin encountered several such periods, and Foster and Gregory feel that the method adopted to cope with these will also result in an upward bias. These criticisms cast some doubt on the validity of the Carlson-Parkin data. The normality assumption in particular seems unlikely to be valid. This seems to be borne out by the data as shown in figure 4.1, for although the general trend in expectations seems to follow that of the actual inflation rate there does seem to be a systematic downward bias from the beginning of 1971 onwards. In particular one notes that in the three years 1971 - 1973 the expectations series exceeded the actual series in only four months. Moreover during the first half of this period inflation was falling, hence these underpredictions are not solely attributable to expectations lagging behind the actual rate of inflation.

The Carlson-Parkin method is faced with particularly strong difficulties when there is a high inflation rate which is mirrored by high

Figure 4.1 The Carlson-Parkin Expectations Series



expectations. They, themselves seem to favour an adaptive expectations hypothesis. In which case differences in expectations presumably arise due to differences in adjustment coefficents, perceptions and individual shopping baskets. But such differences cannot possibly result in anybody expecting prices to fall when prices themselves have not fallen for any length of time during the whole of the post-war period. Much the same comments apply if one assumes that expectations are formed either extrapolatively or rationally. If then we are to accept any of these hypotheses we must also accept that the expectations of those who expect prices to fall are formed in some way which is not representative of those of the majority of the population, and as such we can deduce little about the behaviour of the majority from these deviants.

This does not invalidate all of Carlson-Parkin's conclusions, for example it seems likely that if the exogenous impact of devaluation was great on the deviant it probably also influenced the calculations of the majority. But considerable doubt is cast upon the parameters they obtain from the adaptive expectations formula, and it would also seem to invalidate the use of these expectations within a general wage inflation equation.

A similar method for converting qualitative into quantitative data was developed by Knobl (1974). He essentially uses the same method as Carlson and Parkin, although it is described within a slightly different framework. It is therefore open to much the same criticisms as is theirs. The data is based upon the responses of German businessmen, for the period 1965 - 73, to the question of whether they expect the selling price to rise, fall or stay about the same in the next three to four months. The survey itself seems to be carried out every quarter. Unlike Carlson and Parkin's data this does not represent the opinions of the general public about the future course of prices as a whole, which of course they have no direct influence upon. Instead it relates to the expectations of one specific sector of the community, whose behaviour may or may not be representative of the remainder, about one specific good or a limited number of goods, with which they have intimate knowledge and whose price they ultimately determine.

When they tested methods of expectation formation using this data they found that the adaptive expectations hypothesis did not give good results and that when the lagged inflation rate was used as the only explanatory variable the following regressions were adjudged the best

$$\dot{P}^e_t = 0.7256\,\dot{P}_t + 0.5272\,(\dot{P}_t - \dot{P}_{t-1})$$
$$\qquad (16.271) \qquad (2.830)$$
$$\bar{R}^2 = 0.807$$
$$DW = 0.598 \tag{4.40}$$

$$\dot{P}^e_t = 0.2976 + 0.6608\,\dot{P}_t + 0.5451\,(\dot{P}_t - \dot{P}_{t-1})$$
$$\qquad (1.500) \quad (10.747) \qquad (2.981)$$
$$\bar{R}^2 = 0.815$$
$$DW = 0.601 \tag{4.41}$$

When in addition to past actual rates of inflation, a demand pressure variable was included in the regression the results were

$$\dot{P}^e_t = 1.1146 + 0.2876\,\dot{P}_t + 0.3536\,(\dot{P}_t - \dot{P}_{t-1}) + 0.2589\,DP_{t-1}$$
$$\qquad (4.830) \quad (3.093) \qquad (2.426) \qquad\qquad (4.651)$$
$$\bar{R}^2 = 0.892$$
$$DW = 0.598 \tag{4.42}$$

where DP_{t-1} is a lagged measure of the pressure of demand. It should be noted that the Durbin Watson statistics are far from satisfactory in these equations. However if we ignore this we may construe these results as providing further evidence for a rational-extrapolative hypothesis.

One final study which we must look at is that by Paunio and Suvanto (1977). They derive a monthly series for expectations in Finland from the different interest rates on indexed and non-indexed bonds issued by the Finnish government. The index clause generally provided for fifty percent compensation for rises in the consumer price index. Because the number of dealers in the bond market is small, consisting mainly of banks and private bankers, they felt that these expectations were representative of those held by the well informed section of the business community and not by the public as a whole, and in interpreting these results this should be borne in mind.

When price expectations are held with certainty a measure for expectations can be found by subtracting the rate of interest on the indexed linked bond from that on the other, and then adjusting for the proportion of index linkage, this being the straightforward Fisherian approach. However when investors are not risk neutral and expectations are not held with complete certainty, the calculations are not so simple. Paunio and Suvanto overcome the problems involved by assuming, as did Carlson and Parkin within a different context, that the expected rate of change of prices is equal to the actual rate of change in the long run. It should also be noted that in order to make these calculations they divide the period into two, 1963(1) - 1968(3) and 1968(4) - 1974(12), as around 1968 "there occured several institutional changes which may have affected the formation of expectations". The difficulties with this approach centre on the manner in which the uncertainty problem is circumvented. They assume a linear risk aversion function, where risk is measured by the standard deviation of the expected value of the total return, and that this is constant during times of high and low inflation.

Having obtained this data they then test a first order adaptive expectations mechanism, they also tested a second order mechanism but this did not improve the results, the results were

1963(1) - 1968(3)

$$\dot{P}^e_t = \underset{(3.7)}{0.305}\,\dot{P}_{t-1} + \underset{(9.1)}{0.720}\,\dot{P}^e_{t-1}$$

$$\bar{R}^2 = 0.777$$

$$DW = 1.61 \qquad (4.43)$$

1968(4) - 1974(12)

$$\dot{P}^e_t = 0.120\,\dot{P}_{t-1} + 0.885\,\dot{P}^e_{t-1}$$
$$(2.3) \qquad (15.17)$$
$$\bar{R}^2 = 0.889$$
$$DW = 1.93 \qquad (4.44)$$

(Note, uniquely lagged actual price inflation appears to have been used in these regressions, although no comment upon this is made). These results, they ajudge to be reasonably satisfactory.

Less satisfactory is a simple extrapolative model of the form shown in (4.1), the $\bar{R}^2$ is low as is the Durbin Watson statistic. They also test a regressive-extrapolative model, but the results are not good. Finally they found that the devaluation of October 1967, by 31%, had an impact effect which served to increase expectations of inflation by nearly 4%.

The results of these various studies are summarised in Table 4.3 and though at first glance there appears to be a great deal of difference between them, a deeper inspection reveals some consistency between the findings. Firstly several of the studies note a difference in expectation formation in times when inflation is high compared to times when it is low, when expectations seem to be formed by a simpler mechanism. Secondly several of the authors find a rational element in expectation formation which augments the basic extrapolative/adaptive mechanism. That is they provide support for a rational-extrapolative or a rational-adaptive hypothesis. However there seems no general concensus as to which of the models of expectation formation is the "best" one. This lack of agreement may be because of the inadequacies of the data, and this possibility should not be underestimated. However it may also reflect the fact that the expectations in the various studies are formed by different sets of people about different subjects. Thus it should not really surprise us that American business economists seem to form some of their expectations in accordance with economic theory, the relevant question is, can this result

Table 4.3 Summary of the Various Studies of Expectation Formation

Study	Frequency and revision period	"Optimal model"	Expectations held by	Subject of expectations
Turnovsky and Wachter	6 months	Rational model	Business economists	Wages
Turnovsky pre 1964	" "	Basically constant with some correction for past trends	" "	Prices
Turnovsky post 1964	" "	Both adaptive and extrapolative work well	" "	" "
Carlson and Parkin 1961-1967	1 month	Expectations basically autoregressive	General public	" "
Carlson and Parkin 1967-1973	" "	A second order error learning mechanism works quite well, the 1967 devaluation also seems to have had an impact	" "	" "
Knobl	3 months	A rational extrapolative model works well	West German businessmen	Their own product price
Paunio and Suvanto	1 month	A rational adaptive model works best	The well informed section of the Finnish business community	Prices

be generalised to other expectations held by different sectors of the community.

There are also other differences between the studies. Important is the different frequencies at which the data becomes available, this ranges from every six months for the Livingstone data, to every month for the Carlson and Parkin series. This is important as all the researchers have nearly always assumed a revision period equal to the frequency at which the data becomes available. Hence Carlson and Parkin assume expectations to be revised every month, wheras Turnovsky and Wachter have a minimum revision period of six months.

Which, if any, of these is correct will, of course, depend upon how frequently actual expectations are revised. At the individual level it might be supposed that the shortest possible revision period corresponds to the frequency with which the individual comes into contact with the relevant stimulus. When, for example, the expectations concern the rate of inflation of the general price level, the stimulus occurs every time the individual buys a commodity, or hears of a coming price rise via the media. In actual fact the revision period may well be longer than this and may, like the actual method of expectation formation, be the outcome of an optimising process by the individual. Thus it may be that when the actual rate of inflation is subject to severe fluctuations, the revision period is much shorter than when it is relatively stable.

In the aggregate,expectations are likely to be a much smoother function of time than for the individual, and it may be that the revision period in the aggregate becomes so small as to be almost continuous. Although there are difficulties with this if individuals follow a similar behaviour pattern and are subject to similar stimuli. If, for example, most individuals do the bulk of their shopping on any particular day then expectations will not be such smooth functions of time.

The consequences of assuming a too-long revision period will be to increase the error term in the equation, thus biasing the results against acceptance of the adaptive expectations hypothesis. One could imagine, for instance, situations where the expectations are revised weekly in an adaptive manner, but if a six month revision period is assumed the explanatory power of the adaptive expectations mechanism becomes quite low. To some, though perhaps a lesser extent, these comments also apply to tests of the other methods of expectation formation. It must be stressed therefore, that what Turnovsky and Wachter are in fact testing is not simply the adaptive expectations hypothesis, but the adaptive expectations hypothesis with a six month revision period. Bearing this in mind it is perhaps significant that the adaptive expectations hypothesis seems to work best in those studies which assume a relatively short revision period.

From this we can see that the empirical work on expectations has been far from satisfactory. Basically this is because good relevant data about expectations is just not available. Either the data itself is good, but the expectations are not held by representative sections of the population about price inflation in general, but by a particular set of individuals about one particular price. Or alternatively the characteristics of the expectations are relevant for inflation theory, that is they are held by the general public about prices in general, but the quality is dubious. This is not to criticise the economists who have worked in this field. Information about expectation formation is vitally important in many areas of economics. These economists have made valiant attempts to provide that information, and because of the importance of the subject their work is important too. But it is also important to realise the limitations of their work and the very serious qualifications that must be placed against their conclusions. Above all it is important to realise the need for good, relevant data about expectations, and the only place this can really come from is the government statistical service. It is highly desirable that they conduct a regular sample survey of the public about their expectations not increase the error term in the equation, thus biasing the results against acceptance of the adaptive expectations hypothesis. One could imagine, for instance, situations where the expectations are revised weekly in an adaptive manner, but if a six month revision period is assumed the explanatory power of the adaptive expectations mechanism becomes quite low. To some, though perhaps a lesser extent, these comments also apply to tests of the other methods of expectation formation. It must be stressed therefore, that what Turnovsky and Wachter are in fact testing is not simply the adaptive expectations hypothesis, but the adaptive expectations hypothesis with a six month revision period. Bearing this in mind it is perhaps significant that the adaptive expectations hypothesis seems to work best in those studies which assume a relatively short revision period.

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4.6 Incorporating Expectations into the Wage Equation

In this final section we are going to examine, briefly, those empirical studies which have attempted to allow for expectations in the inflationary process (For a further discussion see the introductory chapter). There have been three principal approaches to this problem, using directly observed data, such as the Livingstone data, generating a series using some formula, or attempting to incorporate the expectation formation process into the specification of the basic model to be estimated. To some extent the results of introducing expectations into the wage equation in these ways have already been dealt with in chapter 1, and we are at the moment more concerned with the general validity of these three methods of incorporating expectations into the wage equation.

The appropriateness of using directly observed data, as for example Parkin, Sumner and Ward (1975) and Riddel (1979) have done, with the Carlson-Parkin and Livingstone data respectively, depends upon the accuracy of that data. In the previous sections serious question marks were raised on this point, and we feel that the value of such empirical work is somewhat limited.

The second method too depends upon the underlying validity of both the model and the parameters used to generate the series. In particular we have grave reservations about the use of one mechanism to generate data on expectations over any length of time. For, as was emphasised earlier, it seems likely that different methods of expectation formation are used at different times. With more complex methods being used when inflation is either changing or at a high level. Thus studies which have used either of these two methods must be examined extremely carefully, with respect either to the mechanism used to generate the data, or the accuracy of the directly observed data. This should particularly be borne in mind when considering evidence about the value of the coefficient on expectations in the wage equation.

The third method consists of including the formation process within the general empirical structure to be estimated. When expectations are formed according to a first order adaptive mechanism such as

$$\dot{P}^e_t = \dot{P}^e_{t-1} + (1 - \lambda)\,\dot{P}_t \tag{4.45}$$

and the wage equation is

$$\dot{W}_t = f(X_t) + \dot{P}^e_t + u_t \tag{4.46}$$

where X_t represents the explanatory variables, other than expectations, and u_t is a white noise error term. Then lagging (4.46) one period and rearranging we get

$$\dot{P}^e_{t-1} = \dot{W}_{t-1} - f(X_{t-1}) - u_{t-1} \tag{4.47}$$

Combining this with equations (4.45) and (4.46) we get

$$\dot{W}_t = f(X_t) + \dot{W}_{t-1} - f(X_{t-1}) + (1 - \lambda)\,\dot{P}_t + u_t - u_{t-1} \tag{4.48}$$

We can estimate this and estimates for λ, the first order adaptive coefficient, obtained, as well as for the coefficients of the other explanatory variables. The only difficulty in this estimation process being the liklihood of induced negative serial correlation, as indicated by the composite error term in (4.48).

When expectations are formed rationally, this too can be incorporated into the empirical specification of the model. Thus suppose that the wage equation is again as in (4.46), but that price expectations are now a lagged function of changes in the money supply, i.e.

$$\dot{P}^e_t = \beta(L)\dot{M}_t \tag{4.49}$$

We can incorporate (4.49) directly into (4.46) and get

$$\dot{W}^e_t = f(X_t) + \beta(L)\dot{M}_t \tag{4.50}$$

Both of these approaches are open to the same criticisms made previously that, in general, they imply the same method of expectation formation regardless of the economic conditions. In addition the latter approach suffers from all the criticisms which we have levied at rational models in general, as does an approach adopted by McCallum (1975) amongst others.

He makes use of the property that rational expectations should differ from the actual event by a random forecast error, with mean zero, only. Thus as a proxy for $\dot{P}^e_t$ he uses $\dot{P}_{t+1}$. A similar approach has been adopted by Wallis (1977), in the case where the expectations are about the dependent variable, and in this case we have

$$Y_t = \alpha Y^e_t + \pi X_t \tag{4.51}$$

Assuming expectations are formed rationally we get

$$Y_t = \frac{\pi}{1 - \alpha} X_t \tag{4.52}$$

Although there are certain difficulties here when α is equal to one. (Wallis' analysis is slightly more complex than this would indicate, as it is carried out within the context of a set of simultaneous equations).

Thus economists attempting to proxy expectations are faced with a difficult choice. They can make use of the random forecast error of rational expectations. Alternatively they can use directly observed data, which is often of dubious quality. Finally they can incorporate, directly or indirectly, within the economic model some mechanistic form of expectation formation, which is insensitive to changing economic conditions and is in any case, often of only dubious validity in itself.

The choice that we make in choosing a method to proxy expectations for use in the empirical work is thus unlikely to be ideal. In making this choice we shall, in the next chapter, make use of some original sample survey data on expectations of wage inflation. In particular we will be interested in determining what appears, on empirical grounds, to be the most acceptable method of expectation formation.

Chapter 5

An Empirical Analysis of the Formation of Expectations

5.1 Introduction

In the previous chapter we reviewed the theoretical and empirical work which has been done on the formation of expectations. We concluded that much of the empirical work, although often ingenious, was less than satisfactory. The basic problem being the lack of good, relevant data about expectations of inflation.

The purpose of this chapter is twofold, firstly to test the various models of expectation formation which we analysed in the previous chapter, and secondly to obtain either direct data upon wage inflation expectations, or alternatively, with the model of expectation formation which appears most appropriate, generate a series which we can use in its place. The purpose being that we can use this data in a direct test of the search theoretic model of inflation developed in chapter 2.

In order to achieve these tasks we make use of sample survey data which had not previously been developed within this context. This data, though not perfect, would appear to suffer less from the objections made against other studies. Thus it is hoped that the use of this data will provide usefull and original insights into the expectation formation process.

5.2 The Data

The data upon which this analysis is based is derived from the Financial Times Survey of Business Opinion. It is carried out monthly for the Financial Times by the Taylor Nelson Group who collect the data by means of personal interviews with the chairmen, managing directors or other executive directors of public companies. The sample is based upon the 400 companies that constitute the F.T. actuaries index. To provide a workable sampling framework the thirty industrial groupings of that index have been reduced to eleven major categories, the first two, for example, being, electrical engineering and construction and building materials. Each month three groups are surveyed, this means that the whole index is covered every four months, non-electrical engineering, a particularly large and important group being surveyed every two months. About a dozen interviews are obtained in each of the three groups, making an average of thirty to fourty interviews a month.

The data for wage expectations comes in the form of a frequency distribution, the figures being in the form of four monthly moving totals representing the expectations of all eleven industrial groupings. The figures under the heading September - December are assumed to represent expectations in the middle of that period, i.e. on November 1. Since the survey began this distribution has had several structures. In answer to the question "Do you expect hourly wages in the next year to rise by" these were

(a)	(b)	(c)
0 - 3%	0 - 4%	0 - 4%
3 - 5%	5 - 9%	5 - 9%
more than 5%	10 - 14%	10 - 14%
stay the same	15 - 19%	15 - 19%
decrease	more than 20%	20 - 24%
no answer	stay the same	25 - 29%
	decrease	more than 30%
	no answer	stay the same
		decrease
		no answer

For the purpose of calculating the mean of the frequency distribution they were amended in the following manner:

(a)	(b)	(c)
0 - 3%	0 - 5%	0 - 5%
3 - 5%	5 - 10%	5 - 10%
5 - 10%	10 - 15%	10 - 15%
0	15 - 20%	15 - 20%
0 - -3%	20 - 25%	20 - 25%
	0	25 - 30%
	0 - -5%	30 - 35%
		0 - -5%

The assumption was also made that the proportion who did not answer had expectations distributed in similar proportions to those who did, and the percentage of answers falling in each interval was adjusted accordingly. Although the survey has been published continuously since it began, not all the data is suitable. Because during the periods December 1969 - October 1971 and February 1975 - June 1975, more than fifty percent of the replies fell in an open ended category. Consequently the empirical work has been done by combining together all those observations which fell outside these two periods. This has one unfortunate consequence, as we omit periods where expectations reached unprecedented heights. This, being omission on the basis of the dependent variable, may induce sample-selection bias in the results in this section.

The measure of wage inflation which was adopted was the percentage increase in any one month, adjusted to represent an annual rate of inflation, i.e.

$$\dot{W}_t = \left[\left\{ \frac{W_t - W_{t-1}}{W_{t-1}} + 1 \right\}^{12} - 1 \right] . 100 \qquad (5.1)$$

In making this assumption we are making a fundamental departure from previous studies, which typically assume that the period people consider when revising their expectations is the same length as that for which they are held. Thus if expectations are about the coming twelve months, then it is usually assumed that the relevant stimulli are the events of the previous twelve months.

The reason for making this break with accepted practice is partly theoretical and partly empirical. On the theoretical side we take the position that the relevant period to consider when revising expectations is equal to the frequency with which expectations are revised. Thus if expectations are revised at monthly intervals, as we are assuming here, then people will consider the events of the previous month when adapting their expectations from those which were held in the previous month. The alternative view implies that people change or adapt their expectations every month, on the basis of what has hapenned in the previous twelve months. Yet surely the spirit of the adaptive expectations hypothesis implies that they will adapt their expectations to take account of information which was not available in the previous period.

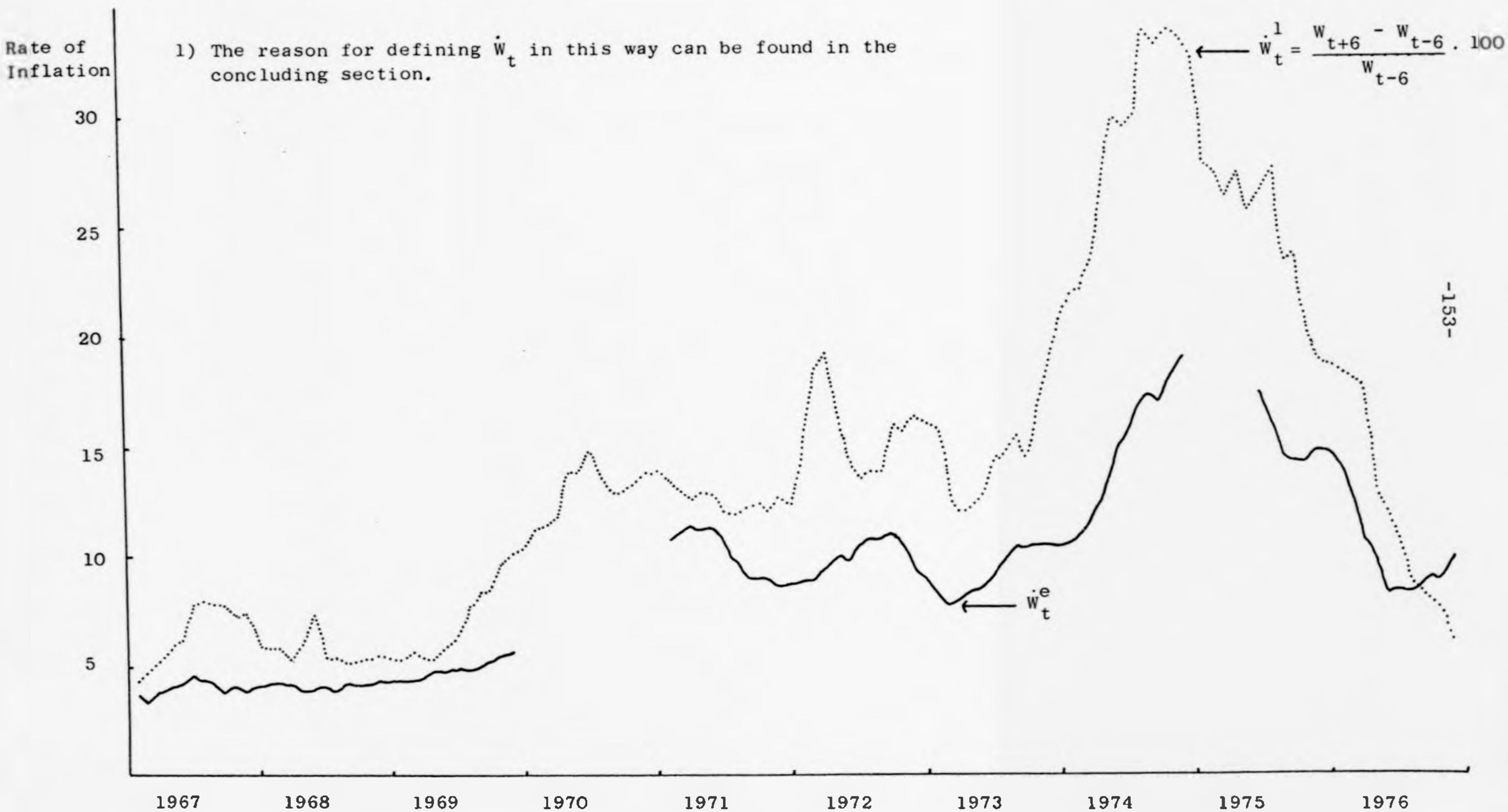
The empirical evidence comes from an examination of figure 4.1. This shows the expectations of inflation derived by Carlson and Parkin (1975), together with their measure of actual inflation, which is the actual rate of inflation in the preceding twelve months. From this it can be observed that the actual series seems to lag behind the expectations series. Thus, there are, for example, four fairly clear peaks in the inflation rate series, these occur in 1962, 1965, 1969 and 1971. Each of these seem to occur after the corresponding peak in the expectations series, with the lead time appearing to be about four months. But theoretically this, in this particular case (in general terms this could happen given second and third order time derivatives taking certain values, in a higher order adaptive expectations mechanism, but this is not the case here), is nonesense. If we take an adaptive expectations mechanism, then expectations adapt to the present rate of inflation, they cannot lead the rate of inflation.

However, if we assume that the annual rate of inflation is a proxy for the inflation rate in the central month, we could by shifting the P_t series six months to the left convert it into a proxy for the monthly inflation rate (as we shall demonstrate later in this chapter). This would then lead to a situation when at least two of the peaks in the actual inflation rate preceded those in the expected rate. The two series would then be more in line with theoretical expectations. Similar comments apply if we examine expectations derived in other empirical work, see for example figure 2 in Paunio and Suvanto's (1977) paper, which we referred to in the previous chapter.

5.3 The problem of Perceptions

It can be seen from figure 5.1 that expectations were, apart from three observations near the end of the series, always below the actual rate of inflation. There are several possible explanations for this which we shall consider. Firstly there is the possibility that the expectations could contain a regressive element. This is superficially at least, attractive, as it explains why, in the last three months of the sample, October, November and December 1976, expectations of inflation exceeded the actual rate of inflation, this being at its lowest level for several years. According to this view, expectations were regressing up to some 'normal' level, where the concept of normality is based on experience extending over a several year period. In addition, this hypothesis is also capable of explaining why expectations of inflation were less than the actual rate of inflation between February 1971 and September 1976. But it cannot explain the similar phenomenon which occurred throughout the period prior to June 1969. In this period expectations consistently underestimated the actual rate of inflation, varying between 3.57% to a maximum of 4.69%,

Figure 5.1 Actual and Expected Rates of Inflation 1967 - 1976



1) The reason for defining $\dot{W}_t$ in this way can be found in the concluding section.

with an average value of 4.12%. Yet as can be seen from Table 5.1, the actual inflation rate in the previous five years was always in excess of 4.12%, and in general above 4.69%. It would therefore appear that an explanation of this phenomenon cannot be given in terms of expectations containing some regressive element, as defined above.

Table 5.1 The Annual Rate of Wage Inflation: 1960 - 1966

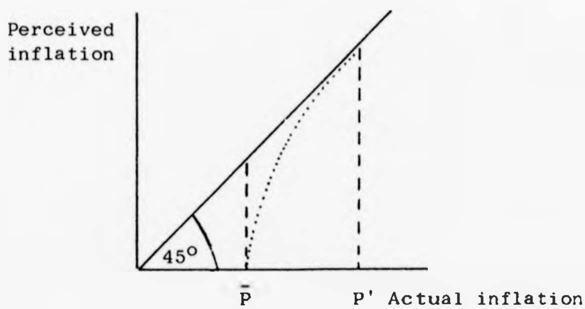
Year	Rate of Inflation
1960	6.60%
1961	5.16%
1962	4.83%
1963	4.54%
1964	4.89%
1965	6.83%
1966	4.49%

An alternative explanation might be found within the various hypotheses of expectation formation that we have already discussed, for example it might be that an extremely small first order adjustment coeffícent in the adaptive expectations model together with a larger second order coefficent, which is operative in certain periods only, might be capable of generating an expectations series similar to the actual one. Although one would not expect expectations to decrease in this case if the actual rate still exceeds the expected rate, something which we observe happening several times over a sustained period of time in this series. Yet, here again, a rational-adaptive explanation might suffice, whereby account is taken of the likely effects of incomes policies.

However there is an alternative explanation which must also be considered. This is that people do not always correctly perceive the rate of inflation. This concept of perception has been largely ignored within the literature. But upon consideration it becomes clear that the correct specification of the simple adaptive expectations hypothesis, for example, should be conceived in terms of the perceived rate of inflation rather than the actual rate of inflation. It is therefore an explicit assumption in most of the empirical work that the inflation rate is fully perceived.

Carlson and Parkin's approach to this question is a little inconsistent, for even though they assume that expectations are based upon the actual rate of inflation. They do not fully accept that people always perceive the actual rate of inflation, rather they adopt an intermediate position. They assume that below a certain critical level inflation will not be perceived, yet above this level it will be fully perceived. This is shown in figure 5.2

Figure 5.2 Perceived and Actual Inflation



where $\bar{P}$ denotes this critical value.

Whilst this hypothesis is plausible enough it is not the only one that could be made, or even perhaps the most likely one. An obvious alternative retains the concept of a critical value below which inflation is too small to be perceived, but supposes that even above this value inflation rates will not be fully perceived until they are greater than a second critical value, P'. The perception curve, in this case will lie along the horizontal axis until the initial perception point, $\bar{P}$, is reached, after which it will lie between the horizontal axis and the 45° line until the full perception point P', from then on it coincides with the 45° line.

This concept of a perception curve is entirely general, in that it can be adapted to include, not only the Carlson-Parkin special case, but also the situation where the rate of inflation is fully perceived. The difficulties lie on the empirical side, in attempting to estimate a perception curve to find out which, if any of the special cases we have mentioned so far best fits the data. The reason being that there is no data on perceptions.

We did try to derive such data from the information we have on expectations and actual inflation, this was done using the following formula, derived from a first order adaptive expectations mechansim

$$\dot{W}^p_t = \frac{(1-\lambda)}{\lambda}\dot{W}^e_{t-1} + \frac{1}{\lambda}\dot{W}^e_t$$

An estimated value for λ being used in these calculations, but the conclusions which followed from an analysis of this data were inconclusive. We could neither establish that people fully perceive the actual rate of inflation, nor that they do not. Thus the most suggestive evidence for the hypothesis that people do not fully perceive the rate of inflation still comes from figure 5.1. It seems very unlikely to us that if people do correctly perceive the true rate of inflation then, with the exception of four observations right at the end of the series, their expectations would continually lie below the actual rate of inflation. However there the debate must rest, and in the remainder of the empirical work we will use the actual inflation rate series as a proxy for the perceived inflation rate. (Although in the empirical work on the wage equation itself, we will experiment with alternative specifications).

5.4 The Results [1]

We first tested a first order adaptive expectations hypothesis, for the period as a whole, the results are shown below

1. The sample period was from February 1967 to December 1976 excluding those periods noted on page 150, the data was monthly, thus there were 100 observations.

$$\dot{W}^e_t = 0.98\,\dot{W}^e_{t-1} + 0.013\,\dot{W}_t$$
$$(104.24) \qquad (2.89)$$
$$R^2 = 0.979$$
$$DW = 1.01 \qquad (5.2)$$

The explanatory power of the equation is quite high and the t statistics are both significant at the 95% level. But the Durbin Watson statistic[1] is low which might point to the possibility of specification error. In addition the sum of the two coefficients is not all that different from their theoretical value of one. However the coefficient on $\dot{W}_t$ is very small, implying an extremely low rate of adaption. One reason for this, and the specification error, may be the extreme amount of noise present in $\dot{W}_t$. This is a possibility we shall return to later, when faced with the task of filtering the signal element from the noise more efficiently. A further reason may be the introduction of numerous incomes policies throughout the period, and a seperate dummy variable was introduced into the regression for each of them. Each dummy variable took a value of one in the month immediately after it was introduced, and zero otherwise. These incomes policies and the corresponding dummy variables are listed below, in Table 5.2.

The results are shown in equation (5.3). It can be seen that of the eight dummy variables, six have a negative sign, which is what we should

$$\dot{W}^e_t = \underset{(103.27)}{0.992\,\dot{W}^e_{t-1}} + \underset{(2.37)}{0.0104\,\dot{W}_t} - \underset{(0.02)}{0.0116\,YPD1} - \underset{(0.73)}{0.403\,YPD2}$$
$$- \underset{(2.26)}{1.255\,YPD3} - \underset{(1.20)}{0.667\,YPD4} + \underset{(0.49)}{0.272\,YPD5} + \underset{(0.29)}{0.162\,YPD6}$$
$$- \underset{(2.94)}{1.657\,YPD7} - \underset{(1.54)}{0.852\,YPD8}$$
$$R^2 = 0.982$$
$$DW = 1.297 \qquad (5.3)$$

expect if incomes policies had a negative impact upon expectations.

1. The Durbin Watson statistic in this and several other equation which follow is biased towards two by the presence of a lagged dependent variable. If serial correlation were present this would bias the t statistics.

Table 5.2 Incomes Policies Introduced in the Sample Period

Dummy Variable[1]	Incomes Policy Details	Date Introduced
YPD1	$3\frac{1}{2}$% ceiling on pay increases, except those associated with productivity	March 20, 1968
YPD2	CBI asks industry to avoid price increases over following twelve months, or to limit them to 5% in unavoidable cases	July 15, 1971
YPD3	90 day statutory freeze	Nov. 6, 1972
YPD4	Freeze extended by 60 days	Jan. 17, 1973
YPD5	Phase II, pay increases restricted to £1 + 4% of average wage bill	April 1, 1973
YPD6	Phase III, pay increases restricted to £2.25 or 7% of average wage bill + threshold agreements	Nov. 1, 1973
YPD7	Government adopts £6 a week policy	July 9, 1975
YPD8	Chancellor suggests a pay limit of 3%, finally agrees a limit of $4\frac{1}{2}$% with the TUC.	April 6, 1976

We shall for the present leave this rational-adaptive approach to expectation formation, and test some of the other hypotheses that have been put forward, using the above results for purposes of comparison. We began by testing the simple extrapolative hypothesis. However, the results were not very good, and as a consequence we have not reported them here. When we looked at the more general form of the extrapolative hypothesis, as specified in equation (4.2), the results were considerably better. For the purposes of this estimation we used an Almon lag, with a third order polynomial fitted over twelve periods. The coefficients and calculated t statistics are shown below in Table 5.3.

The overall explanatory power of this regression is impressive. It is

1. The dummy variable was operative only in the month immediately after the incomes policy was introduced.

Table 5.3 The Almon Lag Estimates of an Extrapolative Model

Variable	Coefficient	t statistic	Adaptive Expectations Lag Structure
$\dot{W}_t$	0.082	7.76	0.082
$\dot{W}_{t-1}$	0.074	12.19	0.075
$\dot{W}_{t-2}$	0.067	12.92	0.069
$\dot{W}_{t-3}$	0.062	11.30	0.063
$\dot{W}_{t-4}$	0.057	11.03	0.058
$\dot{W}_{t-5}$	0.053	12.27	0.053
$\dot{W}_{t-6}$	0.048	13.93	0.049
$\dot{W}_{t-7}$	0.044	12.13	0.045
$\dot{W}_{t-8}$	0.038	8.41	0.041
$\dot{W}_{t-9}$	0.032	5.92	0.038
$\dot{W}_{t-10}$	0.023	4.47	0.035
$\dot{W}_{t-11}$	0.013	3.58	0.032
$\dot{W}_{t-12}$	constrained to be zero.		

$R^2 = 0.740$ DW = 0.289

not as high as that of the adaptive regression model, though it must be remembered that as that contained a lagged dependent variable, with the lag relatively short, the fit is almost bound to be good. In addition the size of the parameters is more satisfactory than in that model. However, the Durbin Watson statistic is very small, and again this might indicate specification bias. (The Durbin Watson statistic is now a valid indicator of the existence of serial correlation, unlike equations (5.2), (5.3) and (5.4), which contained lagged dependent variables.[1]) We might also note that, the resulting lag structure, up to t-6, is very similar to what we would get from an adaptive expectations mechanism, with an adjustment coefficient of 0.082.

We repeated the regression, but this time allowing for the effects of incomes policies, as before. The results were not good and have not been reported here. This, again might indicate that the model has been mis-specified. However this might be it would appear that there are serious

1. The existence of serial correlation would have biased the t statistics

doubts as to the validity of the extrapolative hypothesis, in the spirit of Exekial's proposal. In as much as expectations do seem to be related to past actual rates of inflation, it would seem that this relationship is approximately that which would result from an adaptive expectations mechanism.

Turning now to the rational expectations hypothesis, the first task is to specify the'relevant economic theory'. The one chosen was a variant of the price expectations augmented Phillips curve. The variable chosen to represent demand conditions within the labour market was also derived from the F.T. business survey. All of the respondents were asked which of a number of factors were currently affecting production, one of the factors being manual labour. We took the percentage of respondents referring to this as our measure of excess demand. The price expectations variable was defined as

$$\dot{P}^e_t = \frac{P_{t+12} - P_t}{P_t} \cdot 100 \qquad (5.5)$$

which is the rate of inflation in the coming twelve months. The justification for this is that if expectations are formed rationally, then they will equal the actual rate of inflation in the future period, plus a random error term. The results from including this in the regression were

$$\begin{aligned} \dot{W}^e_t &= \underset{(6.60)}{3.057} - \underset{(5.12)}{0.126}\, ML_t + \underset{(13.55)}{0.591}\, \dot{P}^e_t \\ R^2 &= 0.68 \\ DW &= 0.15 \end{aligned} \qquad (5.6)$$

These results are clearly very poor. The coefficient on the labour demand variable, ML_t, is the wrong sign, whilst that on price inflation expectations is too low. In addition the Durbin Watson statistic is very low indeed. Nor did these results change significantly when we allowed for the effects of incomes policies.

It might be argued that equation (5.6) bears little relation to the rational expectations hypothesis as interpreted by the monetarists. Where the relevant economic theory centres on changes in the money supply. However this is only true for the price equation. Equation (5.6) is quite consistent with the monetarist model of wage inflation, and therefore with a monetarist based rational expectations mechanism.

Returning to the adaptive expectations hypothesis, we have so far tested a simple first order rational-adaptive process, by which expectations are basically formed by a first order mechanism, but external factors such as incomes policies are taken account of. We now wish to examine some of the more sophisticated forms of the adaptive expectations mechanism. Taking first the simple "second order adaptive expectations hypothesis" tested by Carlson and Parkin, but including in the regressions the incomes policy dummy variables (which have been omitted from the results for the sake of brevity), we get

$$\dot{W}^e_t = \underset{(15.84)}{1.603}\,\dot{W}^e_{t-1} + \underset{(0.46)}{0.0019}\,\dot{W}_t - \underset{(6.08)}{0.595}\,\dot{W}^e_{t-2} - \underset{(1.29)}{0.0051}\,\dot{W}_{t-1}$$

$$+ \text{ Incomes Policy Dummy Variables}$$

$$R^2 = 0.987$$

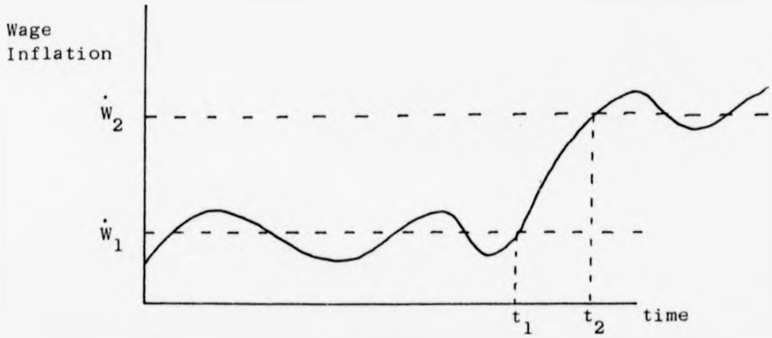
$$DW = 2.23 \qquad (5.7)$$

These results are clearly not very good, with the coefficients being very different from what one would expect on theoretical grounds. One possible reason may be that the second order mechanism only becomes relevant when the underlying parameters of the actual inflation rate series appear to have changed, as a result of which a first order mechanism no longer produces optimal forecasts, as the expected mean square error of the first order mechanism has increased. If therefore we could isolate those periods when such a change in the underlying parameters occurred we could redo the regressions restricting the second order variables to those periods. The criteria adopted for structural change is if the actual rate of inflation has been increasing or decreasing for four or more successive months by more than 0.1%. If in succeeding months the rate of inflation falls and then rises, the second order variables will not be operative in the month inflation falls, but will be so in the succeeding month when it continues its upward trend (and vice versa when there is a sustained downward trend).

There are two possible justifications for supposing that such periods are ones of perceived structural change. Firstly, in such periods peoples perceptions of the underlying time series might change from ARIMA(p,1,q) to ARIMA(p,2,q). In other words people might, in the changed situation be forming expectations not simply about the rate of inflation, but about its rate of change. Although as we argued earlier, a second order mechanism is not the most accurate description of this particular hypothesis.

The second possible justification is that if the proposed structural change takes the form shown in figure 5.3, where the underlying time series fluctuates about a mean of $\dot{W}_1$, but at time t_1 changes and the new equilibrium level about which it fluctuates is $\dot{W}_2$, where the adjustment to this new equilibrium is not instantaneous, but takes place between t_1 and t_2. Then the continual increase in the inflation rate between t_1 and

Figure 5.3 Structural Changes in the Inflationary Process



t_2 will be a signal that the underlying process is undergoing structural change. Thus an expectations mechanism which yields optimal results in normal times, will not necessarily do so during the extended transition period during which individuals learn the new parameters of the system.

Thus in the following regressions a ' denotes that that variable was operative during a period of perceived structural change, where this is defined as when $\dot{W}_t$ has been increasing (or decreasing) for four or more successive periods by more than 0.1%.[1] This being a signal to the individual that the series is changing in this fundamental manner.[2] The results were, where the basic time period is again a month.

$$\dot{W}^e_t = \underset{(102.48)}{0.992\dot{W}^e_{t-1}} + \underset{(1.87)}{0.0085\dot{W}_t} + \underset{(5.48)}{0.850\dot{W}^{e\,\prime}_{t-1}} - \underset{(5.52)}{0.838\dot{W}^{e\,\prime}_{t-2}}$$

$$- \underset{(0.94)}{0.0084\dot{W}'_t} - \underset{(0.16)}{0.0015\dot{W}'_{t-1}} - \underset{(0.02)}{0.0085YPD1} - \underset{(0.80)}{0.388YPD2}$$

$$- \underset{(2.56)}{1.246YPD3} - \underset{(1.38)}{0.671YPD4} + \underset{(0.58)}{0.281YPD5} + \underset{(0.12)}{0.060YPD6}$$

$$- \underset{(3.30)}{1.635YPD7} + \underset{(1.44)}{0.849YPD8}$$

$$R^2 = 0.987$$

$$DW = 1.885 \qquad (5.8)$$

The R^2 and the Durbin Watson statistic are both satisfactory, although the latter will again be biased towards two by the presence of a lagged dependent variable. However this result provides relatively little support for the amended second order error learning hypothesis. For neither the coefficient on $\dot{W}'_t$, the actual rate of inflation during periods of perceived structural change, nor that on $\dot{W}'_{t-1}$ are significant. However, the coefficients on $\dot{W}^{e\,\prime}_{t-1}$ and $\dot{W}^{e\,\prime}_{t-2}$ are both significant and very similar in their absolute values. This seems to imply that in normal times, ignoring any external effects, expectations are formed

1. If in succeeding months inflation falls and then rises, the second order variables will not be operative in the month inflation falls, but will be so in the following month, once it continues its upwards trend (a similar rule applies when there are deviations from a sustained downward trend).
2. That is that the series is perceived to be between t_1 and t_2, where the length of this transition period will vary with circumstances.

according to a simple first order mechanism. But in periods of perceived structural change, in addition to this basic mechanism the change in expectations lagged one period, $(\dot{W}^e_{t-1} - \dot{W}^e_{t-2})$, is an important factor in the formation of expectations.

Such a mechanism would appear to coincide with none of those which we have examined in the theoretical literature. However an alternative interpretation of this is that it merely changes the lag structure in an extrapolative model. This alternative scheme would have the same weight on $\dot{W}_t$ but, apart from this, more weight is given to more recent observations, viewed in this light the mechanism appears not unreasonable.

The second order scheme we have just been considering was originally suggested by Carlson and Parkin on the grounds that a slightly more sophisticated error learning mechanism would take account both of the recent rate of inflation and its rate of change. However we argued earlier that a second order mechanism was not valid as an interpretation of the hypothesis that people take account of both the rate of inflation and its rate of change. We then argued that if people are forming expectations about the rate of change of inflation according to formula (4.39), then expectations of the rate of inflation will be equal to

$$\dot{W}^e_t = (1 - \lambda)\dot{W}^e_{t-1} + (1 + 2\lambda)\dot{W}_t - (1 + \lambda)\dot{W}_{t-1} \qquad (5.9)$$

When this was estimated with the incomes policy dummy variables added the results were not good, as can be seen from (5.10) where they are reported without the incomes policy variables. However it might be that

$$\begin{aligned} \dot{W}^e_t &= \underset{(82.53)}{0.992}\,\dot{W}^e_{t-1} + \underset{(2.36)}{0.0105}\,\dot{W}_t - \underset{(0.085)}{0.00039}\,\dot{W}_{t-1} \\ R^2 &= 0.982 \\ DW &= 1.299 \end{aligned} \qquad (5.10)$$

expectations of the rate of change are only formed when inflation is seen to be changing in a systematic manner, either consistently upwards or downwards. That is in times of accelerating or deaccelerating inflation, expectations are formed according to (5.9), amended for external factors, but in more normal times expectations are formed by a simple rational first order adaptive process. Hence again we need to define times of accelerating or deaccelerating inflation. For this we used the same criteria as that upon which we defined the structural change periods before, i.e. the actual rate of inflation has been increasing for four or more successive periods by more than 0.1%. If in succeeding months the rate of inflation falls and then rises, the dummy variable will not be operative in the month inflation falls, but will be so in the succeeding month. The results were again clearly unsatisfactory, and have not been reported here. All the coefficients on the specially defined variables were not only insignificant, but very much smaller in absolute terms than their theoretical values. Hence we must reject the underlying hypothesis behind these equations, namely that in periods of accelerating or deaccelerating inflation expectations are formed about the rate of change of inflation according to (5.9).

5.5 Conclusion

From these results we can make several conclusions with varying degrees of confidence. Firstly expectations do seem to have been influenced on several occasions by the introduction of incomes policies. The extent of this effect varies from incomes policy to incomes policy, but that there was an effect seems indisputable.

Secondly of the various hypotheses which we have tested, rational-adaptive expectations seem to work particularly well. We could find little evidence that expectations were formed in a pure rational, in Muth's sense of the term, manner. Neither did an extrapolative based hypothesis seem acceptable, except that it could be regarded as a different form of an adaptive hypothesis. In addition a variant of the rational adaptive hypothesis, which contains autoregressive elements during periods of perceived structural change, seems to provide the most acceptable explanation of expectation formation on statistical criteria, as well as being acceptable on theoretical grounds.

However, the implied coefficient of adaption is, in 'normal' times, implausibly low. One possible reason for this, as we have already mentioned, is that the signal element in the actual inflation variable is small when compared to the noise component. This arises because the inflation rate is the monthly one as defined in equation (5.1). This will fluctuate not only with the underlying rate of inflation, which constitutes the signal element, but also with the number of wage settlements, which is a major constituent of the noise component. A large number of wage settlements, or a few very important ones (e.g. the coalminers, the engineers, etc.) will cause the wage index to rise by an unusualy large amount, and vice versa. We shall now turn to other possible ways of filtering this noise element.

One obvious possibility is to use the annual rate of inflation in the previous twelve months, i.e.

$$\dot{W}_t = \frac{W_t - W_{t-12}}{W_{t-12}} \tag{5.11}$$

This is after all the inflation rate which most other researchers have used as we saw in the previous chapter. Lipsey (1960) has agued that this is equivalent to the monthly rate of inflation in the middle of the period, i.e. at t-6. Wheras we have already argued that we require the rate of inflation since expectations were last formed, which in this case means the inflation rate in the previous month. Following Lipsey's argument the best indicator of this would be the annual rate of inflation centred on the month in question, i.e.

$$\dot{W}_t = \frac{W_{t+6} - W_{t-6}}{W_{t-6}} \tag{5.12}$$

This is in fact the variable we shall use, although there are some problems with it, strictly interpreted it could be regarded as implying that the individual has prior information at period t of the exact inflation rate in t+6. However that is not the interpretation being placed upon it here. To repeat the point, it is merely being used as a proxy for the rate of inflation in the central month, in a similar manner to which, not only Lipsey, but also Phillips (1958) used a similarly defined inflation rate.

Using this then as a proxy for the monthly inflation rate, we re-estimated all the equations in this chapter. The general conclusions were much the same, of all the models tested the adaptive expectations model seems to give the best results, although this time with more acceptable coefficients as we shall see later. The incomes policy dummies were generally negative, several significantly so. In many respects the most interesting regression was again that which contained the "occasional second order mechanism" as in equation (5.8):

$$\begin{aligned}
\dot{W}^e_t = {} & \underset{(26.82)}{0.936}\,\dot{W}^e_{t-1} + \underset{(2.01)}{0.044}\,\dot{W}_t + \underset{(3.91)}{0.690}\,\dot{W}^{e\prime}_{t-1} - \underset{(4.37)}{0.683}\,\dot{W}^{e\prime}_{t-2} \\
& + \underset{(0.95)}{0.066}\,\dot{W}'_t - \underset{(0.96)}{0.075}\,\dot{W}'_{t-1} - \underset{(0.001)}{0.00035}\,\mathrm{YPD1} - \underset{(0.55)}{0.265}\,\mathrm{YPD2} \\
& - \underset{(2.76)}{1.298}\,\mathrm{YPD3} - \underset{(1.89)}{0.891}\,\mathrm{YPD4} + \underset{(0.45)}{0.211}\,\mathrm{YPD5} + \underset{(0.58)}{0.281}\,\mathrm{YPD6} \\
& - \underset{(3.58)}{1.714}\,\mathrm{YPD7} + \underset{(1.06)}{0.613}\,\mathrm{YPD8}
\end{aligned}$$

$$R^2 = 0.988$$

$$DW = 1.740 \qquad (5.13)$$

Again the most interesting feature of this equation is the similarity in the absolute values of the coefficients relating to $\dot{W}^{e\prime}_{t-1}$ and $\dot{W}^{e\prime}_{t-2}$. Once more this carries the interpretation that, in 'normal' times, ignoring any external effects, expectations are formed according to a simple first order mechanism. But in periods of perceived structural change, in addition to this basic mechanism, the change in expectations lagged one period, $(\dot{W}^{e'}_{t-1} - \dot{W}^{e'}_{t-2})$, is an important factor in the formation of expectations. The coefficient of adaption lies somewhere between 0.044 and 0.064, the upper value being quite similar to the implied value from the Almon equation in Table 5.3. The two coefficients do not now sum to one, but this may be because people do not fully perceive the rate of inflation.

This is in fact the mechanism (with actual inflation defined as in (5.12)) which we shall be using when we come to generate an expectations series to be used later in the thesis when testing various wage equations. (We could not use the survey data as it does not go back far enough). This does not represent a hard and fast conclusion that this was the particular method used by individuals throughout the entire period under study, but merely that this provides us with a data series which in our opinion is likely to be as acceptable as we can obtain at the moment.

To use this mechanism we need to obtain estimates of the parameters. For this purpose we estimated the following equation on a reduced sample basis, omitting those periods which marked the introduction of incomes policies. We used the Cochrane-Orcutt procedure within TSP to estimate the equation, as when we used OLS the existence of serial correlation was indicated.

$$\dot{W}^e_t = \underset{(33.51)}{0.920}\,\dot{W}^e_{t-1} + \underset{(3.53)}{0.060}\,\dot{W}_t + \underset{(4.96)}{0.780}\,\dot{W}^{e'}_{t-1} - \underset{(4.92)}{0.796}\,\dot{W}^{e'}_{t-2}$$

$$R^2 = 0.991$$

$$DW = 0.116 \qquad (5.14)$$

The exact details on how the expectations were generated will be given in chapter 7 when we test the search theory of inflation developed in chapter2. Meanwhile we will, in the next chapter, temporarily depart from the main line of development of the thesis to consider the degree of certainty with which expectations are held.

Chapter 6

Expectations and Uncertainty

6.1 Introduction

In the previous chapter we tested various hypotheses of expectation formation, concluding that a variant of the rational-adaptive hypothesis seemed best to explain the data on wage inflation expectations derived from the F.T. survey of business opinion. In the next chapter we will use a series on expectations, generated from the estimated coefficients of this model, in testing the search theoretic model of inflation developed in chapter 2.

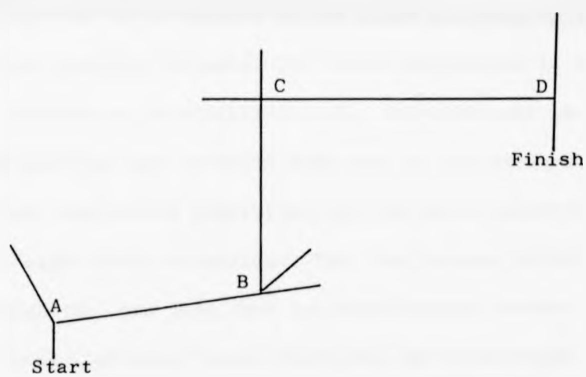
The purpose of this present chapter is to analyse the degree of certainty with which expectations are held. As such it is somewhat at a tangent to the general line of development of the thesis. The justification for this being that we feel the subject matter to be important, a feeling that as we noted in chapter 1 is apparently shared by others, see, for example, Laidler and Parkin (1975), and in an area which has received only little attention elsewhere.

In that paper Laidler and Parkin, within the context of expectations, drew attention to two different concepts of uncertainty. The first which we will call cross section uncertainty may be defined as the extent to which individuals hold different expectations. The second we will call individual uncertainty and can be defined as the degree of certainty with which individuals hold their expectations.

6.2 Individual and Cross Section Uncertainty

To understand the determinants of uncertainty we must look as Katona (1951), Ozga (1965), Carlson and Parkin (1975) and others in this field have done for help from the realm of psychology. In this respect the concept of "reinforcement" seems important. In standard psychological theory this relates to the learning process. Adcock (1960) illustrates this concept by giving an example of a maze as shown in figure 6.1, where the subject has to work out a serial pattern of responses. Consider the case where there are four choice points A, B, C and D. The correct choice at D leads immediately to the exit and is therefore immediately rewarded. We tend to remember this choice whilst still very confused or uncertain about

Figure 6.1 The Maze Example



our wanderings in the earlier part of the maze. But now when we make the correct choice at C we immediately recognise that we know the rest of the way. The way is now open for reinforcement of the correct choice at B and so on.

When applied to expectations of inflation reinforcement will take place when those expectations prove correct or very nearly so. This will increase our confidence in the mechanism by which our expectations are formed, and in the following period expectations formed by that mechanism will be held with greater certainty.

This concept of reinforcement is also of use in understanding how an individual makes use of the extra information provided by the introduction of incomes policies and the occurrence of well publicised wage strikes etc. Because these occur relatively infrequently, and also because to a certain extent each event occurs in unique cirumstances different from what has gone before, it is difficult for the individual to interpret the evidence they provide. This may be done in ways which can be best illustrated for an incomes policy. We may suppose that the individual's initial distribution of expectations[1] to be normal,centred around a mean of 20%, we may also suppose that the inflation rate is 20%. If expectations are formed by a simple first order adaptive mechanism, then the fact that the expectations were correct will result in a reduction of the variance around an unchanged mean. The introduction of an incomes policy aimed at reducing inflation to 5% will have three possible effects. The first possibility is that the incomes policy carries no credibility at all, in which case the distribution of expectations will be what it would have been in the absence of such a policy altogether. The second possibility is the polar opposite to the first for individuals might feel so confident that the incomes policy will work that not only does the mean fall, but the distribution becomes more concentrated around that mean, hence there will be a reduction in individual uncertainty as measured by the variance of the distribution. The third possibility lies between these two polar extremes, the individual does take account of the incomes policy but there is difficulty in judging how successful, if at all, it will be. In this case the distribution may be bimodal, and because, as we have stressed, the evaluation of the likely effectiveness of an incomes policy is difficult due to the scarcity of relevant precedents, this is the most likely one. Those individuals who believe that the incomes policy will probably be effective will hold expectations with the majority of the distribution centred around the first mode. Others who place less faith in its effectiveness, will have the majority of the distribution centred around the second mode. In both cases the mean of the distribution will fall, but the variance,measuring individual uncertainty is likely to increase.

(1) Thus we make the assumption that individuals can be thought of as having a probability distribution for possible outcomes, the variance of which provides a measure of uncertainty.

A similar analysis also applies when evaluating the effects of wage strikes on individual uncertainty, except that expectations would be shifted upwards, as opposed to the introduction of incomes policy which shifts them downwards.

There is a second manner in which reinforcement may take place which can best be illustrated by returning to our maze example. If at point B we meet another individual also seeking the exit and we both agree as to the correct direction, then our confidence that we have found the correct way will be increased. When carried over to the problem of expectations of inflation this implies that when an individual meets another and their expectations are similar, then their confidence in those expectations will be increased, the opposite happening if their expectations differ markedly. Thus individual uncertainty will also depend upon cross section uncertainty.

Cross section uncertainty has been defined as the extent to which individuals hold differing expectations. In analysing why this may occur we will assume that expectations are formed by a simple adaptive mechanism, and later examine more sophisticated possibilities. Within this context the first reason why expectations might diverge is that the stimuli, i.e. actual wage inflation itself, might be perceived in different ways. This will be so for several reasons, firstly individuals in different firms will be exposed to different stimuli, because different firms, even in the same industry, will have a different mix of workers, some for example having a higher percentage of skilled workers than others, in addition of course contracts will be renewed at different times. However not all of the stimuli will be internal to the firm. Wages and wage changes in neighbouring firms or of firms in the same industry will also provide part of the evidence upon which individuals base their expectations, as will wages in totally seperate parts of the economy. For example if several large wage increases are granted in the public sector, or any other sector of the economy, then they are likely to affect the expectations of both workers and employers in other sectors of the economy.

However, even if individuals were to be faced with exactly the same stimuli they might still perceive it in different ways. Katona (1951) showed that this could be explained by the hypothesis of Gestalt psychology the basic principle of which is that our perceptions of the world around us are not those of individual elements combined into a whole, but a whole which gives a meaning to the elements. If we look at a drawing we do not perceive evry line of it, we perceive the picture of a man into which the lines combine, and the lines only so far as they are relevant to the perception of the man. If some lines are withdrawn from the drawing they may have no effect upon our perception of the man. We may not even notice the lines have been removed.

Furthermore the same elements may be seen either as one whole or as some other according to our inner attitudes and dispositions. If the drawing of a man is not very clear we may need some time to perceive him, or we may also perceive something else if we looked at it in another way. Therefore what we perceive will to some extent depend upon what we expect to perceive. A more economic orientated example is provided by a firm with several groups of workers each of which get an increase in wages but by different amounts ranging from small to large increases. The way this evidence is seen as a whole may vary from person to person, and this perception may well be influenced by prior expectations. If a person expects high wage inflation he may well see the large wage increases of some groups as confirming those expectations, placing relatively little emphasis on the smaller wage increases, and vice versa. This raises the interesting possibility that, within the expectations mechanism, not only are expectations adapting towards the actual rate of inflation, but so are our perceptions of that rate.

The second reason expectations might diverge, when formed by a purely adaptive mechanism is differences in λ, the adjustment coefficient. Those individuals who react strongly to changed stimuli will have a large adjustment coefficient, therefore when inflation is accelerating their expectations will lag behind perceived inflation less than those with a smaller adjustment coefficient. The time period over which expectations are revised will also differ from individual to individual. Some may revise their expectations several times a month others less frequently the revision period probably being related to the frequency they come into contact with fresh stimuli (see discussion in chapter 4).

The nett result of this is that expectations are likely to diverge, and hence cross section uncertainty increase in times of either accelerating or deaccelerating inflationary expectations. Moreover these conclusions are likely to remain valid even when we consider a more complex expectation formation mechanism, such as the adaptive autoregressive model, as in equation (5.8). As we discussed earlier the autoregressive element only becomes operative during times of perceived structural change, and it is at such times that expectations will be changing rapidly, partly due to the autoregressive element.Such times will also be characterised, not only by a high degree of individual uncertainty, but also by a high degree of cross section uncertainty. The reason for the latter being that people will differ in classifying periods of perceived structural change, and also in the parameters of the autoregressive element.

Cross section uncertainty will also be affected by the rational element in expectations formation, i.e. by how different individuals take account of the extra information about the economic system in the form of incomes policies, widely publicised wage strikes etc. But it is difficult to specify, a priori, just what these effects are likely to be. When an incomes policy is introduced we saw that individuals might react in one of three ways. They might ignore the incomes policy, believing it to be ineff- ective, they might believe very strongly that it will be effective, or they might adopt a position between these two extremes. If everybody reacted in the first way then their would be no effect upon either expectations or the certainty with which they are held. But if people reacted in either of the other two ways, then although the mean would fall, in both cases the standard deviation of the aggregate distribution might either increase or decrease.

But of course not everybody will react in the same way, and because of this one might expect cross section uncertainty to increase, with some taking no notice of the incomes policy and others adjusting their expectations by varying amounts. However it is not possible to be certain upon this, and one can envisage situations where after a period of rapid inflation resulting in considerable cross section uncertainty, the introduction of a credible incomes policy concentrates expectations around some lower rate of inflation, thus reducing uncertainty.

Therefore the provision of extra information might either increase or decrease cross section uncertainty. Moreover because the introduction of one incomes policy in a particular period results in an increase in cross section uncertainty, this is no guarantee that the introduction of similar incomes policies in different periods will also have the same effect. Much will depend upon the exact context in which they are introduced. Similar remarks also apply about the effects of major wage strikes with the additional complication that they provide two peices of information about the economic system. Firstly they give information about the rate of wage increases workers in other sectors of the economy, and perhaps by extension workers in general, are seeking. Secondly they give information about the miltancy of workers and how strongly they will pursue a wage claim.

6.3 The Data

In testing these hypotheses we are going to use data derived from

Figure 6.2 The Proportion Who Decline to Answer the Survey Question

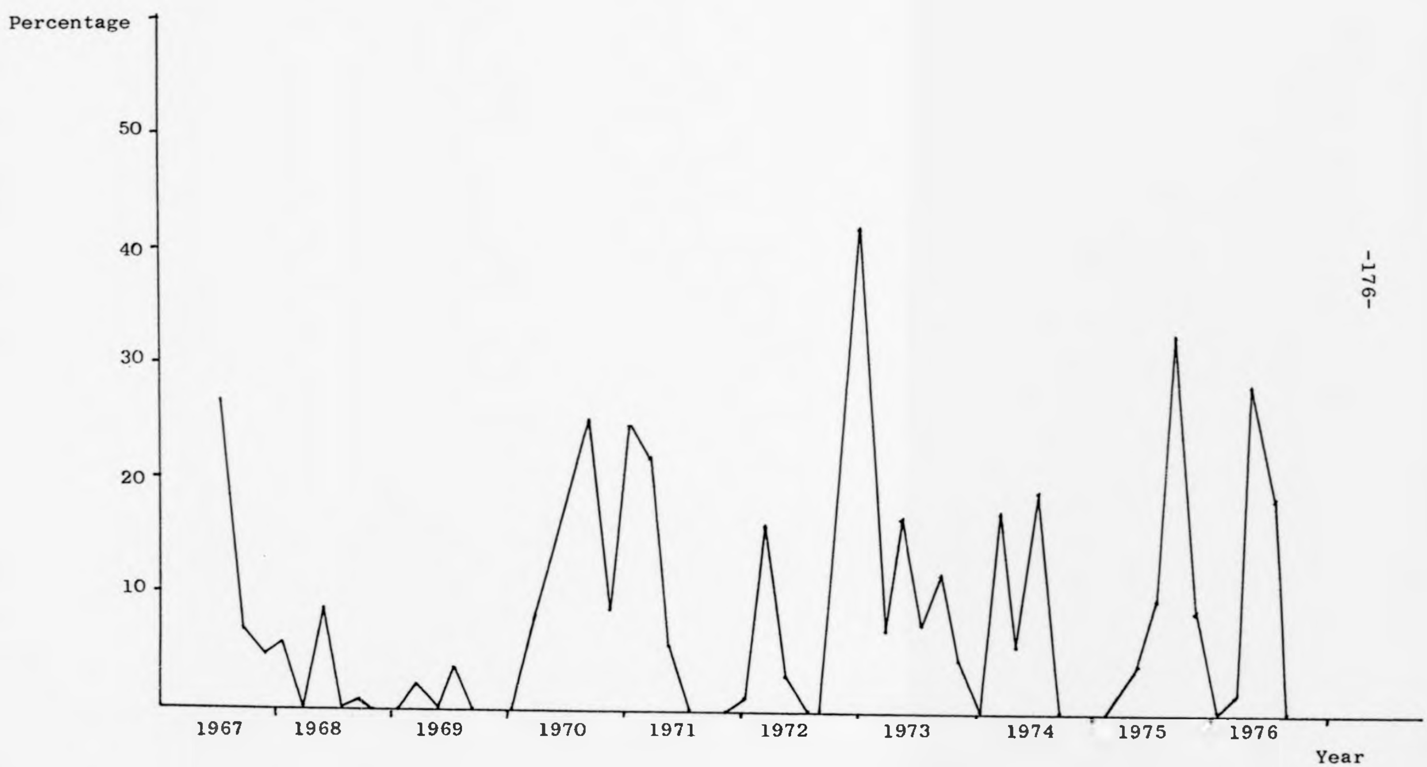
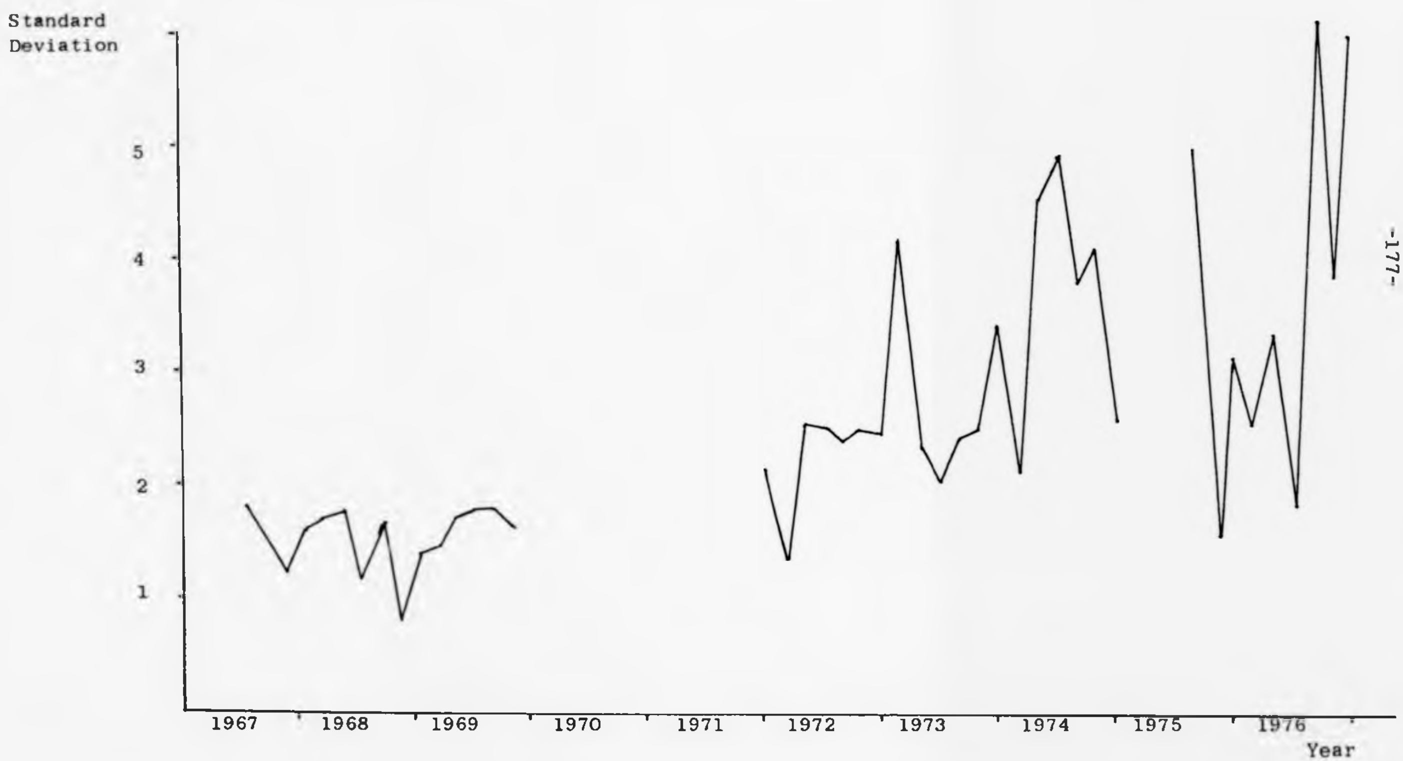


Figure 6.3 The Standard Deviation of the Distribution of Expectations



the same sample survey used in the previous chapter. However for reasons which will become apparent we will not be using the data relating to the whole sample, the all-industry data, but that relating to a particular group, namely non-electrical engineering.

Our first problem was to find a measure for individual uncertainty, this has been defined as the degree of certainty with which individuals hold their expectations, and suggested that it could be measured by the variance or standard deviation of their probability distribution of possible outcomes. Unfortunately this measure is not available, although there is no reason why some measure of it could not be derived by surveys asking respondents to give upper and lower estimates as well as a central one. We can however use a proxy measure of average individual uncertainty at a given time, which is the proportion of respondents declining to answer the question.

In providing a justification for this we should first remember that all the respondents to this particular survey have first agreed to participate and that they are in general answering a number of other questions to do with expectations of profit, output, costs etc. In addition there seems no reason why they may be particularly sensitive to questions about wage inflation and decline to answer for this reason, as they might be about future profits or their own personal prospects. Thus we can rule out, as perhaps we could not do with other surveys, the possibility that respondents decline to answer for reasons such as they don't take part in surveys, they have'nt the time or they are particularly sensitive to the question.

We now make an assumption which is critical to the analysis. This is that the respondents will decline to answer if the variance of their probability distribution of possible outcomes is greater than some critical value, which we assume to be constant throughout the sample period. This is equivalent to the hypothesis that there is a level of individual uncertainty above which they will be reluctant to give specific answers to questions on expectations. If we also assume that changes in individual uncertainty affect all the population in much the same manner, that is if some peoples individual uncertainty is increased this will not be offset by a reduction in other peoples' uncertainty. Then an increase in the proportion who decline to answer the question will reflect an increase in individual uncertainty for some which is not offset by a reduction for others. In this case the percentage who decline to answer provides a valid measure of the degree of individual uncertainty and an increase in this percentage reflects an increase in individual uncertainty for the population as a whole.

However this is by no means an ideal measure of individual uncertainty. The first criticism that may be levied against it is that it is capable of measuring uncertainty only above some critical minimum value. Secondly, and related to this first point, it is a discrete measure of a continuous variable. One might also criticise the assumptions that were made in order tojustify the measure. Of these assumptions it seems to us that the first, that respondents decline to answer above some constant critical value, is the most debatable. Yet it seems to us that for the purpose of this chapter, namely to test the hypothesis laid out in the previous section, none of these objections are vital, and that the percentage who decline to answer is an acceptable proxy for individual uncertainty. This is especially so when one considers the difficulties faced by workers in this field, and perhaps the even more "heroic" assumptions made by those authors in deriving measures of expectations themselves.

We have defined cross section uncertainty as the extent to which people hold differing expectations. A measure of this type of uncertainty is provided by either the variance or the standard deviation of the distribution derived from the survey. Of the two the standard deviation is probably the best measure as it is linearly related to cross section uncertainty, whereas the variance, being the sum of the squared deviations, is non-linearly related. This measure of uncertainty, unlike that for individual uncertainty, is not entirely original. Carlson (1977) in a brief appendix to the main paper used the standard deviation of the distribution of the responses derived from the Livingstone survey of inflationary expectations in America as a measure of the "divergence of opinion", as have Carlson and Parkin (1975).

It was not possible to use the all industry data to calculate the standard deviation as this is in the form of four month moving average totals. An example will serve to illustrate why this is not suitable. Suppose that the period in question is September to December, which we may take as representing expectations upon November 1, and that the standard deviation remains constant in all four months. Assume also that from September to December expectations increase from 4% to 7%, at the rate of 1% per month. Using the all industry data for the calculations would result in a standard deviation relating to the distribution over the four months as a whole. This is much greater than that for any of the individual months, which reflects the fact that the standard deviation for the individual months stems solely from the differing views of different respondents at the same time. But the all industry standard deviation also reflects the differing views of the same respondents at differing times. Thus when expectations are in great flux the standard deviation of the all industry data will be biased upwards. Therefore instead of using the all industry data for the empirical work, the data relating to a single group was used. The group chosen was non-electrical engineering, this category being surveyed twice as frequently as the others, i.e. every two months. The percentage who decline to answer are shown in figure 6.2, and the standard deviation in figure 6.3.

6.4 Empirical Representation and Results

It was argued earlier that individual uncertainty would be increasing if expectations were changing rapidly. This would be the case if, for instance, expectations were being formed by a simple adaptive mechanism, when a large increase in expectations would indicate that expectations held in the previous period were substantially in error. Hence via the reinforcement principle this would increase individual uncertainty. It would also be the case if expectations were formed by a more complex adaptive autoregressive process as described in the previous chapter. In this case rapidly changing expectations would indicate a period of perceived structural change, and again result in increased individual uncertainty.

We may test this hypothesis by regressing individual uncertainty, or rather its proxy, the percentage who decline to answer the question, NA_t, on, lagged uncertainty and the percentage change in the mean of the distribution, $\dot{E}_t$.

The essence of the second part of the reinforcement hypothesis was that when an individual meets another and their expectations are similar, then each will have their confidence in those expectations increased. This kind of reinforcement is more likely to take place the smaller the degree of cross section uncertainty. Conversely the greater the degree of cross section uncertainty the less likely an individual is to come into contact with others of similar expectations, and the more likely to meet people with different opinions, in which case his own expectations will be held with less certainty.

It was also argued that events which provide extra information to the individual would, because of their novelty, be likely to increase individual uncertainty. The obvious examples of such events were, as we have already said the introduction of incomes policies, and widely publicised strikes. Turning first to incomes policies, we basically used one overall dummy variable to capture the impact of the introduction of the policies listed in Table 5.2. The reason being to economise on degrees of freedom, as for this analysis we had less than half the number of observations available to us when analysing the formation of expectations[1]. However this is not entirely satisfactory, for by using dummy variables we implicitly assume that all of the incomes policies had the same initial impact upon uncertainty. Partially because of this we introduced a second dummy variable D2 (the first being D1), to capture any possible additional effects caused by the introduction of the incomes policy in Novemeber 1972. We argued earlier that uncertainty occured in these cases because of the unfamiliarity of the evidence. To a degree this unfamiliarity will always be present, as each incomes policy will be introduced in circumstances unique to it. But it seems possible that the introduction of this particular incomes policy would pose unusually large problems in interpretation, as there was very little it could be compared with. It was introduced some four years after the previous official incomes policy, more than twice as great as the gap which seperated any other two incomes policies. Moreover it was introduced by a conservative government, which had hitherto argued consistently against the use of incomes policies. There was also the problem of how the trade unions would react to this curb on their members incomes by a government with which it was already in violent conflict with over the industrial relations act. For all these reasons it seems likely that, as we have already said, the introduction of this particular incomes policy would pose more problems and generate more uncertainty than the others.

Turning now to major strikes over wages, the ones that had the greatest impact on the general public were undoubtedly the two coal mining strikes which resulted in large scale electricity cuts throughout

1. Because, as explained on page 180, the basic time period is now two months. The total number of observations is now 43, as shown in Appendix Table A3.

the country to both domestic and industrial users. (An initial attempt was made to discover whether these had any effect upon the formation of expectations themselves. But this met with little success, and the results were not reported). The first took place in 1972 and lasted from January 10 to February 25, electricity supplies being restricted upon a rota basis from February 10 to March 1. The second disturbance began with an overtime ban by the miners which led to the introduction of the three day week for industry and commerce beginning on January 1 1974. The actual strike itself began on February 10 and ended on March 9, with the calling of a general election. Thus to test the hypothesis that these strikes had an effect on uncertainty a third dummy variable, D3, was constructed, operative for February 1972 and February 1974.

When these three dummy variables are added to the others the equation we are going to estimate becomes

$$NA_t = \beta_1 NA_{t-1} + \beta_2 \dot{E}_t + \beta_3 \sigma_t + \beta_4 D1 + \beta_5 D2 + \beta_6 D3 \quad (6.1)$$

where all the coefficients are expected to be positive. The equation was estimated by O.L.S., and the results were (t statistics again in brackets)

$$\begin{aligned} NA_t = {} & \underset{(0.55)}{0.056} NA_{t-1} + \underset{(3.02)}{15.17} \dot{E}_t - \underset{(0.02)}{0.01} \sigma_t + \underset{(2.09)}{5.79} D1 \\ & + \underset{(4.87)}{33.78} D2 + \underset{(3.27)}{15.03} D3 \end{aligned}$$

$$R^2 = 0.58$$

$$DW = 1.81 \quad (6.2)$$

The Durbin Watson statistic is included in the above equation even though, because of the existence of a lagged dependent variable it is not strictly valid. However as Johnston(1972) has pointed out, the Durbin Watson statistic is still a good, if not ideal, indicator of the presence of serial correlation even with the presence of a lagged dependent variable. It is for this reason that we have included it. It lies between the upper and lower critical bounds, therefore even taking the statistic at its face value, it is inconclusive. If we re-estimate the equation without the lagged dependent variable we obtain the following results

$$NA_t = \underset{(3.07)}{15.24\,\dot{E}_t} + \underset{(0.20)}{0.11\sigma_t} + \underset{(2.26)}{6.08\,D1} + \underset{(5.06)}{34.34\,D2} + \underset{(3.28)}{14.87\,D3}$$

$$R^2 = 0.57$$

$$DW = 1.75 \qquad (6.3)$$

The Durbin Watsom statistic is now valid, however it again lies in the inconclusive zone.

All ofnthe coefficients have the expected signs. The insignificance of the lagged dependent variable indicates that individual uncertainty is relatively quickly resolved. The standard deviation, included as a measure of cross section uncertainty, is also insignificant. This might reflect the possibility that in order for reinforcement of expectations to take place, individuals must not only meet others with similar expectations, but this similarity must be communicated. Now whilst it seems possible that such communication takes place on a general plane, for example whether an incomes policy will work, or whether a large wage claim awarded to one group of workers will be transmitted to other workers. It is perhaps less likely that communication takes place in a more specific manner about exactly how much they expect wages to rise in the future. Therefore this hypothesis, although theoretically an attractive one cannot be accepted on the basis of the evidence presented here.

All of the other coefficients are significantly different from zero at the 5% level of significance. We can therefore accept the hypotheses that individual uncertainty will be greater in times of accelerating or deaccelerating inflation, and that events such as the introduction of incomes policies and widely publicised wage strikes also affect individual uncertainty.

Turning now to cross section uncertainty, we argued earlier that expectations would diverge, and hence cross section uncertainty increase, when expectations themselves were changing rapidly. Basically this is because some adapt their expectations more rapidly in response to changed stimuli than others. Similarly when expectations are relatively stable we would expect expectations to converge, as the more cautious catch up those who respond more rapidly. Therefore we can relate the level of dispersion to the level in the previous period and the absolute change in the previous period. It is the absolute change in this case, not the percentage change, as the mechanism which generates cross section uncertainty is the adaptive expectations method, and the same amount of cross section uncertainty will be generated if expectations are being adapted from 1% to 5%, as would be if they were being adapted from 21% to 25%.

However if, after a prolonged period of generally rising expectations, they begin falling, then initially expectations will converge, with those holding the highest expectations adapting them rapidly downwards. The same phenomenon happening when after a prolonged period of falling expectations they begin rising. Hence when the general trend in expectations is either upwards or downwards and their are deviations from this we should also observe a reduction in cross sectiion uncertainty as expectations converge. To test this hypothesis we constructed a shift dummy variable on lagged uncertainty which was operative in such periods (and which is referred to as σ'_{t-1}).

A constant term and the mean of the distribution, E_t, should also be included in the regression as it was argued that there would always be some differences in the stimuli facing entrepeneurs and that these differences would result in some minimal level of cross section uncertainty. Moreover the variation in the stimuli which the employers receive is likely to be related to the rate of inflation itself, at least until the economy has fully adjusted to that rate of inflation, a period which may take several years. Even then there may still be considerable scope for variations in stimuli, as workers fall behind one year to catch up another. There will also be more scope for interpretation of this stimuli.

As with individual uncertainty events which provide extra information about the economic system might also affect cross section uncertainty. We therefore included the same two dummy variables, D1 and D3, as before, in the regressions. The dummy variable D2, which was constructed to take account of the possible special effects on individual uncertainty of the incomes policy introduced in November 1972, was not however included. For although it again appears unlikely that all incomes policies will have equal effects on cross section uncertainty, this differentiation will not be related in any simple manner to the novelty of the incomes policy, but to factors such as the difference between the actual rate of inflation and the target rate of inflation.

Consequently the equation now becomes

$$\sigma_t = \alpha_0 + \alpha_1 E_t + \alpha_2 \sigma_{t-1} + \alpha_3 \sigma'_{t-1} + \alpha_4 \Delta E_t + \alpha_5 D1 + \alpha_6 D3 \tag{6.4}$$

where α_0, α_1, α_2 and α_4 are all expected to be positive, α_3 is expected to be negative and the other two coefficients may be either positive or negative. The estimated regression, which was again estimated by O.L.S., is shown below

$$\begin{aligned} \sigma_t = {} & \underset{(0.61)}{0.26} + \underset{(3.94)}{0.19 E_t} + \underset{(0.01)}{0.17\sigma_{t-1}} + \underset{(0.32)}{0.038\sigma'_{t-1}} + \underset{(2.28)}{0.25\Delta E_t} \\ & + \underset{(2.56)}{0.95\,D1} + \underset{(1.05)}{0.72\,D2} \\ R^2 = {} & 0.55 \\ DW = {} & 1.33 \end{aligned} \tag{6.5}$$

The same comments apply to the Durbin Watson statistic as before, and again it lies between the upper and lower bounds, therefore even at its face value it is inconclusive. Of those variables whose signs we were able to specify, α_1 and α_4 have the expected signs and are significant at the 5% level of significance. α_2, α_3 and α_0, the two coefficients on lagged uncertainty and the constant term were insignificant. This would seem to indicate that cross section uncertainty is quickly resolved. Within the context of the adaptive expectations model this would occur if, within the two month period which is our basic unit of time in this analysis, expectations were frequently revised by individuals.

The regression was then redone, but omitting the lagged dependent variable and the shift dummy variable

$$\begin{aligned} \sigma_t &= \underset{(0.67)}{0.27} + \underset{(5.32)}{0.19}\,E_t + \underset{(2.39)}{0.25}\,\Delta E_t + \underset{(2.74)}{0.97}\,D1 - \underset{(1.06)}{0.71}\,D3 \\ R^2 &= 0.55 \\ DW &= 1.28 \end{aligned} \qquad (6.6)$$

The Durbin Watson statistic is now valid, but still lies in the intermediate zone. The constant remains insignificant at the 5% level of significance. The coefficient of the incomes policy dummy variable, α_5, is positive and significant at the 5% level, indicating that during this period the introduction of incomes policies tended on average to increase cross section uncertainty. Conversely α_6 is negative, although not significant at the 5% level. However in interpreting this result it should be borne in mind that widely publicised wage strikes tended to increase individual uncertainty. Thus sixteen percent of those questioned declined to answer during the first strike and seventeen percent during the second. It may well be that, contrary to what we have assumed, their expectations were not distributed in a similar manner to those who did answer. In which case had their expectations been recorded the level of cross section uncertainty would have been higher than the measure we have taken.

6.5 Conclusion

This chapter has been concerned with the degree of certainty with which expectations are held. Two types of uncertainty have been identified, individual uncertainty or the degree of uncertainty with which individuals hold their expectations, and cross section uncertainty, or the extent to which expectations differ between individuals. In determining individual uncertainty the concept of reinforcement seems important, in an economic context this will take place when the expectations prove correct or nearly so. The greater the error in recent expectations the more uncertain the individual will be about present expectations. In addition external factors which provide additional information to the individual about the economic system may also affect expectations. Their impact upon individual uncertainty will be related to the "novelty" or "uniqueness" of the information. When there is little with which it can be compared with, individuals will be uncertain as to how to intepret the information, and the more novel it is the more uncertain they will be.

In analysing cross section uncertainty we started from the basic assumption that expectations are formed according to the simple adaptive expectations hypothesis. Differences then arise due to differences in the adaptive coefficients, the stimuli individuals receive and the way they perceive them. These differences will then increase cross section uncertainty most noticeably when inflation is either accelerating or deaccelerating.

It was also argued that external events which provide information about the economic system were also capable of affecting cross section uncertainty although whether they would increase it or decrease it would depend upon the circumstances. In the period we were studying, incomes policies tended to increase cross section uncertainty whilst strikes appeared to decrease it, although this latter conclusion is less firm.

Throughout the chapter we have pointed to shortcomings both in the data and the assumptions made in the empirical work. However these do not seem to us either unusual or serious within an empirical economic context, particularly with respect to work done on expectations. In particular they do not appear to be serious enough to invalidate the empirical work, which in the main supports the theories advanced. Perhaps one of the most important implications of this work is that the individuals who particip- ated in these surveys did take account of external factors which provided extra information about the economic system. They did not form their expectations in a purely mechanical way, either by the adaptive expectations mechanism or some other. This then, taken as a whole, provides further support for the rational-adaptive hypothesis we have been advocating in previous chapters. They are also consistent with the more complex mechanism of equation (5.8), where an autoregressive element is present during periods of perceived structural change.

Therefore this diversion, from the principal line of development within the thesis, has been usefull in providing this indirect confirmation. It is also hoped that it has been of interest as an attempt to develop an analysis of uncertainty along the lines suggested by Laidler and Parkin. Moreover we shall later be using some of the conclusions from this chapter when attempting to integrate uncertainty about expectations within our model of wage inflation. Meanwhile in the next chapter we return to the central theme of the thesis, and in particular attempt to test directly the search theoretic model of inflation developed in chapter 2.

Chapter 7

An Empirical Analysis of the Wage Inflation Equation

7.1 Introduction

We have so far formulated a search theoretic model of wage inflation. The theory has already been tested, but with respect to its implications in a different area to inflation, namely the labour market flow variables, quits, fires and hires. We have also devoted considerable attention to an analysis, both theoretical and empirical, of expectations of inflation.

In this present chapter we will be concerned with testing directly the search theoretic model of wage inflation already referred to. In the course of doing this we shall also make use of much of the work done in the three chapters on expectations, in particular using an expectations series generated from the parameters of a regression estimated in chapter 5 (equation (5.12)).

Initially the analysis will cover the period 1951(1) - 1969(2), the first date was set largely by the inavailability of data prior to that. Whilst the second by the assertion, made by many authors (e.g. Williamson and Wood (1976)), that this was about the time when excess demand based theories of inflation finally seemed to break down. Clearly before attempting to see whether this is also so for the particular theory developed here, we should see whether it can satisfactorily explain inflation prior to that date. After doing this, we can then examine events after 1969.

7.2 The Data

An appendix at the end of the chapter will contain a detailed set of definitions of the variables used in this part of the study. This particular section is therefore devoted to points of particular interest or importance, although it should be noted that many of the variables used in this chapter have already been discussed in chapter 3.

The first problem we were faced with, then, was how to divide the year into quarters. The division that was decided upon was

Quarter 1	End December	- End March
Quarter 2	End March	- End June
Quarter 3	End June	- End September
Quarter 4	End September	- End December

Having done this we then turned our attention to the specification of the dependent variable. There are several possible"wages" which may be used in empirical work, e.g. wage rates, weekly or hourly, or earnings, again weekly or hourly. We have chosen basic rates rather than earnings primarily because earnings will be correlated with labour demand variables merely because overtime working will increase when the market is "tight". In addition quarterly data on earnings was not available during the 1950's. We also chose hourly wage rates in preference to weekly wage rates, as this more closely reflects the cost to the employer of labour as well as the reward to the employee. Although to some extent it is perhaps not critical which of these variables we choose, to quote Lipsey (1960)

> "...although a priori reasoning can suggest many reasons why rates and earnings may not move together, they do in fact stay, over a very long period of time, remarkably close together, so that any theory that explains one will go a long way to explaining the other"

Even so a lot of effort has been expended in discussing the relative merits of these, and others, as appropriate bases upon which we can measure wage inflation. As always, an excellent summary of these points can be found in Trevithick and Mulvey (1975).

A second question, of considerable importance, concerns the best way to proxy the quarterly rate of change of the wage rate. There are two chief candidates, firstly the annual rate of change,centred on the quarter in question, which we shall denote by $\hat{W}_t$, algebraically

$$\hat{W}_t = \frac{W_{t+2} - W_{t-2}}{W_t} \, . \, 100 \qquad (7.1)$$

Secondly several economists have used the simple quarterly rate of change, denoted by $\dot{W}_t$, where

$$\dot{W}_t = \frac{W_t - W_{t-1}}{W_{t-1}} \, . \, 100 \qquad (7.2)$$

The chief advantage of the first of these two measures over the second is that it is much less volatile, in the terminology of Parkin, Sumner and Ward (1975), usage of $\hat{W}_t$ reduces the noise to signal ratio. The chief disadvantage is that the signal tends to get muted in the process. Thus if the underlying trend has distinct peaks and troughs, these will be truncated by an annual measure of inflation. In other words, the amplitude of $\hat{W}_t$ will be less than the amplitude of the true underlying series we are trying to proxy. We shall be returning to these points later, when discussing the nature of the disturbance terms.

Turning now to the independent variables, we shall first look at unemployment. The measure we use relates to the wholly unemployed in Great Britain, both males and females, excluding adult school leavers and students, and not seasonally adjusted. This contrasts to the analysis in chapter 3, where we used adult male vacancy and unemployment data. There are two reasons for this change, firstly data on adult male vacancies alone is not available after the early 1970's, and as we will be examining the period until 1975 this would have presented serious difficulties. Secondly the wage rate data relates to all workers, both men and women, therefore data relating to both also had to be used when proxying the number of job searchers and available vacancies.

The figures for adult students have only been collected since July 1971, prior to this date they have been estimated by the Department of Employment. As our basic period is one quarter we take the three monthly figures in each quarter and obtain an average. In some months two estimates are available, relating to the beginning and the end of the month, and in this case we include both estimates when calculating the average. In the empirical work we use unemployment as a percentage of the working population (This contrasts with the practice adopted in chapter 3, and for a discussion of these differences see the appendix at the end of this chapter).

The vacancy figures were also expressed as a percentage of the working population. They relate to seasonally unadjusted vacancies notified to the employment exchanges, and remaining unfilled. Prior to April 1962 nurses were excluded from the general vacancy register, having had their own. Seperate nursing statistics are available for this period, but it is not a simple matter of adding these to the general vacancy figures as it appears that not all of those who used the nurses register transferred to the general register. For example, in December 1961, the last date on which figures are available, there were 25453 nurses on the nurses register. Yet it was reported that the actual merger added only some 19200 to the register. Consequently all the figures on the register, prior to April 1962, have been multiplied by 192/255 before being added to the general vacancy figures.

The most difficult data of all to obtain, and in some respects the most crucial, was that relating to expectations of wage inflation. The difficulties arise because the survey data we had only extended back to 1967. Consequently, having rejected the rational expectations hypothesis, we had no alternative to constructing a series on expectations, based upon the empirical work in chapter 5. At the end of that chapter we concluded that, both on theoretical and empirical grounds, the rational-adaptive hypothesis, of all the alternatives considered, appeared to provide the most acceptable explanation of the manner in which expectations are formed. In particular we concluded that a rational-adaptive mechanism, with autoregressive elements operative during periods of "perceived structural change", would be capable of generating a data series on expectations which is likely to be as valid as any we can obtain at the present moment. We also estimated the parameters of such a mechanism, and these are given in equation (5.14).

Using this equation, we then constructed four series to represent expectations. The first of these was a simple first order adaptive expectations scheme, whereby expectations are revised according to the following formula

$$\dot{W}^e_t = 0.920\,\dot{W}^e_{t-1} + 0.060\,\dot{W}_t \qquad (7.3)$$

We assume that inflation is fully perceived, but it should be noted that the coefficients sum to less than unity, and a possible explanation of this might be that in fact expectations are not fully perceived. Thus this mechanism will result, even in equilibrium, in expectations being equal to only three quarters of the actual rate of inflation. Thus if the actual rate of inflation is 4%, then the long run equilibrium value for expectations is only 3%.

We began constructing the series in March 1949, and assumed that in the previous month expectations of inflation were in fact zero. Any bias this might cause will lessen with time, and it is hoped that by the first quarter of 1951, when the empirical work began, the bias would be very small. We then constructed a second series of expectations, also based on (7.2), but allowing explicitly for the possibility that expectations were not fully perceived. Specifically we adopted the Carlson and Parkin (1975) assumption that inflation rates below 2.5% will not be perceived at all, whilst those above 2.5% are fully perceived.

We then turned to the full, part autoregressive, part rational-adaptive process, as defined in (5.14), which is reproduced below

$$\dot{W}^e_t = 0.920\,\dot{W}^e_{t-1} + 0.060\,\dot{W}_t + 0.780\,\dot{W}^{e\,\prime}_{t-1} - 0.796\,\dot{W}^{e\,\prime}_{t-2} \qquad (7.4)$$

where the dash denotes that the variable is operative only in periods of perceived structural change, as defined in chapter 5. In addition we constructed a fourth series of expectations, also based upon (7.4), but with the actual rate of inflation not being perceived below 2.5%. For all four series we took the average of the three monthly figures in any one quarter.

We should emphasise that none of these variables can be regarded as perfect proxies for expectations. In particular it seems unlikely that the parameters within any expectation formation mechanism would remain unchanged throughout a twenty year period. However we believe, as we have said before, that this is the best that can be achieved at the present.

Finally, before we leave this section on the data, we should note that the underlying cyclical change variables, included in chapter 5, such as INYUL etc, did not appear to improve the explanatory power of the wage inflation equation, and have been omitted from the regressions. In addition the profit and unemployment benefits data was defined as before. However, as the sample period is now a lengthy one, we have to make some allowance for productivity growth increasing the net revenue contribution of the average worker. This was done, not simply by including a time trend, but by linking that time trend to the profits variable itself in a multiplicative manner.

7.3 The Specification of the Disturbance Term

Surpisingly enough there are not many papers which contain an explicit discussion of the nature of the residuals. However such a discussion can be found in Wallis (1971), who argues that the type of differencing procedure employed in (7.1) results in negative fourth order serial correlation.

Because a high value for W_{t+2} will lead to a high value for $\hat{W}_t$, but in four periods time a low value for $\hat{W}_{t+4}$. Thus implicit to this argument is the assumption that the residuals properly relate to the wage level itself. Rowley and Wilton (1973 and 1974) argue however that the disturbance term relates to the "underlying quarterly rate of inflation", and that the residuals, in a wage equation where the dependent variable is $\hat{W}_t$, can be regarded as following a fourth order moving average process. Explicit in their approach is the assumption that the same group of workers receive an increase in their wages once a year in any given quarter, less explicit is the assumption that this operates so that one quarter of all workers receive an increase in each quarter.

We believe that neither of these approaches, nor the conclusions which stem from them are entirely valid. We shall expand upon this criticism within the context of Wallis's approach. Basically we question the assumption that the residuals, which relate to the wage equation, are serially independent. The existence of this disturbance term can be justified on several grounds, one of the most important being the variation in the number of people who receive increases in a given time period. Thus, in times of inflation, if a large number of workers receive wage increases in a quarter we might expect the wage rate to be higher than one would expect, given the state of the independent variables, i.e. we would expect there to be a positive residual. Similarly if relatively few workers receive wage increases in a quarter, then we would expect a negative residual. However given that there are only a finite number of workers, and that there is in practice a limit to the frequency with which their wage rates are revised, there will be a finite number of workers receiving wage increases in, for example, a twelve month period. In which case if a large number of workers receive wage increases in one period, there will be relatively fewer wage increases in the succeeding three periods. However the effect of a large number of wage increases in period t, besides tending to result in a positive residual in that period, will also have some effect on the residual in t+1, probably resulting in that residual also being positive despite the relatively few workers receiving wage increases in that period. Hence one would expect there to be positive first order serial correlation present. However by period t+2, and even more so by period t+3, we might expect this to be reduced, and it is even possible that the fact that relatively few workers are receiving wage increases will result in negative second and third order serial correlation. If this were the only reason for the disturbance term, we would expect for the U.K., the wage level to exhibit regular fluctuations, with a four period cycle, around an underlying trend as in figure 7.1. In which case we would expect there to be positive first and negative second and third order serial correlation. This is in fact what we do tend to observe, in

Figure 7.1 Possible Annual Fluctuations in the Wage Level

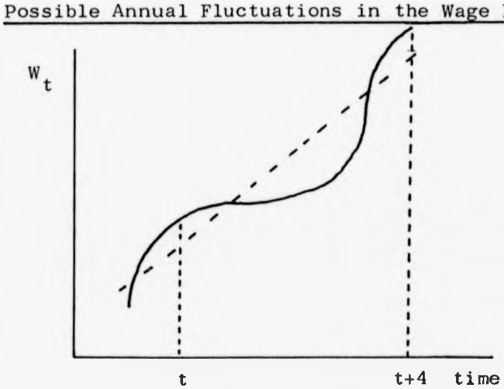
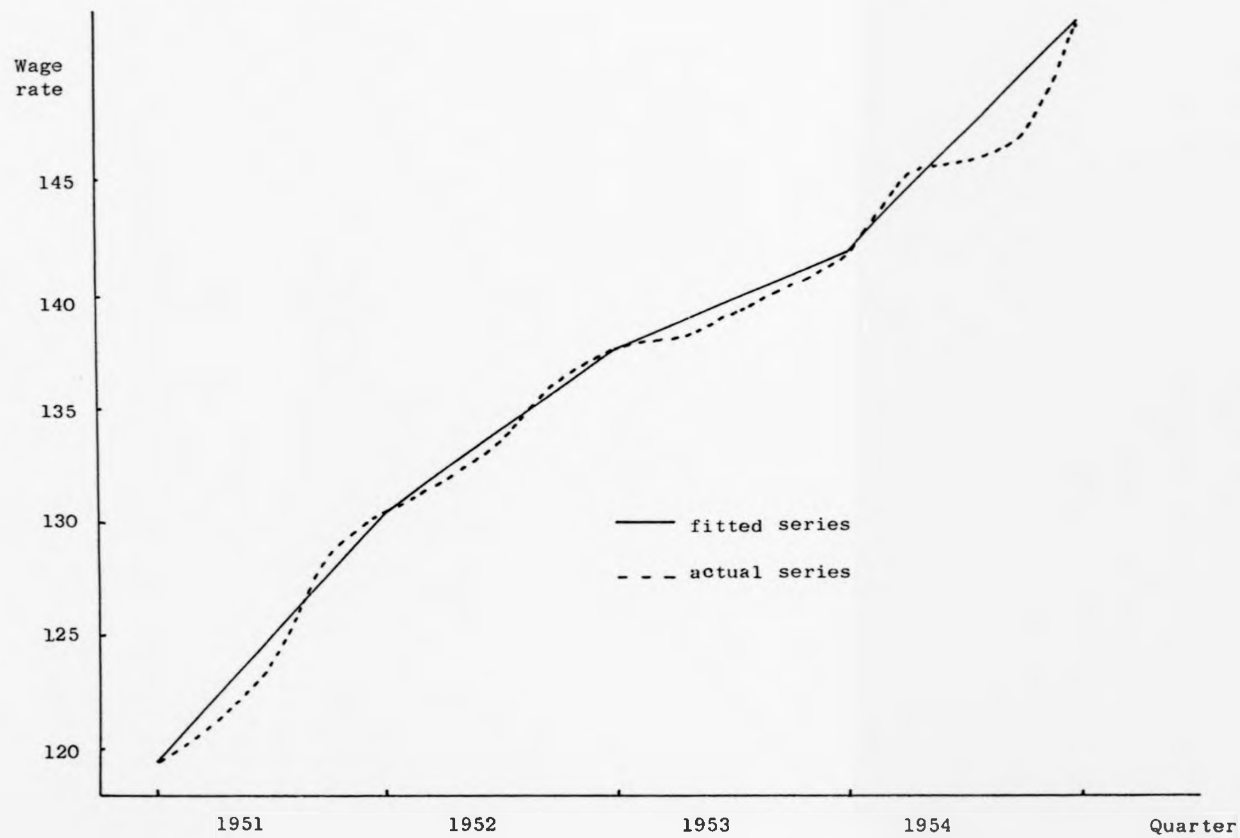


figure 7.2, for example, we can see the course of the wage rate between 1951(1) and 1955(1). The trend line in this diagram was found by linking together observations from the first quarter of each year, and it is quite clear that the residuals do indeed follow this pattern.

However there will be other disturbances causing the actual wage rate to deviate from its trend value. Individual workers in any one period may

Figure 7.2 The Wage Rate 1951(1) - 1955(1)



receive wage rates in excess of, or less than, that which one would expect given the underlying economic conditions. Now, because published wage rate statistics represent an average of all workers wages, an above average wage award for a large number of workers in one period will not only cause the wage rate to be above the trend level in that period, but also in the succeeding periods, until those workers wages are renegotiated, which we may assume to be at approximately yearly intervals. This is similar to the effect noted by Rowley and Wilton and because of it we would expect there to be positive first, second and third order serial correlation.

What are the implications of this for $\hat{W}_t$, the annual measure of inflation? A higher than 'normal' wage settlement to a group of workers in period t will lead to the wage rate being higher, not only in period t, but until those same workers' wages are revised again. Assuming that wages are revised annualy, the wage rate will then be higher than normal - i.e. have a positive disturbance term, in periods t, t+1, t+2 and t+3. Providing we assume independence of the error term relating to annual wage rates for the same group of workers over time, we would expect the next settlement to be less than normal, and wage levels to return to their expected values. (This last argument is implicitly the same as Wallis's.) This process will lead to positive first, second and third order serial correlation, in addition to negative fourth order serial correlation. If we couch the arguements in terms of a higher number, than normal, of wage settlements, then the same conclusion emerges. Although it should be noted that the first order serial correlation is likely to be stronger than the other orders, as the original disturbance term gets muted over time.

Thus in comparing these conclusions with Wallis's it can be seen that they differ in as much as we suggest the existence of a more complex autoregressive scheme than he thought likely. Whilst regarding the work of Rowley and Wilton, we believe that their assumption that the same workers receive an increase at the same time every year to be much too rigid, and indeed omits an important factor when considering the correct specification of the error term. To repeat what has already been said, the fact that there will be only a finite number of wage increases in a given twelve month period, implies that a large number of increases in any one period will be followed by a relatively low number of increases in the succeeding three periods. This has important implications for the correct specification of the error term which cannot be captured in the rigid manner attempted by Rowley and Wilton. Indeed we believe that their attempt to do so in this way invalidates much of their empirical analysis.

This interest in the residuals of $\hat{W}_t$ has not been extended to the purely quarterly measure of the inflation rate, $\dot{W}_t$, as defined in equation (7.2), that is apart from Parkin, Sumner and Ward's comment that this appears to be a very noisy series. However it seems likely that this noise is not pure white noise, as seems to have been assumed hitherto. Specifically we argue that the residuals are subject to negative, first,second and third order serial correlation. The argument is thus, over a given period of say a year, we can, as we have already said, expect there to be some upper limit on the number of workers receiving increases, which is determined by the size of the workforce, if we assume that each worker recieves only one increase in that period. If then in the first quarter of the period a large number of workers receive wage increases, this will leave fewer to receive increases in the succeeding three quarters. This effect will be muted by two other factors, firstly not all workers will receive an increase once every twelve months, and secondly not all workers will receive the same wage increase. Note should also be made that this is also consistent with a positive fourth order serial correlation specification, but that allowing for negative first second and third order serial correlation will probably lead to better results, as these disturbances are nearer in time to the period in question.As for the size of the three serial correlation coefficients, being as a positive disturbance is likely, ceteris paribus, to produce equal effects in the following three quarters, we would expect the three serial correlation coefficients to be approximately -0.33.

We regard these observations regarding the disturbance term to be very important. For not only does the existence of serial correlation tend to invalidate, somewhat, the statistical validity of the empirical work. Taking account of it can lead to an increase in the significance of the explanatory variables.

Before finishing this discussion on the disturbance term, we should note that there has, in recent years, grown up an awareness of the fact that changes in the wage rate index can result either from changes in the size of settlements, or the number of settlements. Economists have in general been interested in the size of settlements, which they feel can be regarded as being more representative of the "underlying rate of inflation". One approach to this filtering problem has been to adjust the official index to take account of the frequency of settlements (Johnston and Timbrell (1973) and Ashenfelter and Pencavel (1975)), but as Elliott and Dean (1978) have argued this has not been satisfactorily accomplished to date. A second approach has been to construct seperate indices detailing the size and frequency of settlements, and to seek the determinants of each (Elliott and Shelton (1978). Or alternatively to use the individual, raw settlement data as the independent variable (Riddell (1979)). Both of these approaches are relatively new and it is still too soon to have formed any definite conclusions as to their degree of success. However to the extent that the problem has been to allow for the differring number of settlements within the specification of the wage equation, we suggest that the method adopted here, i.e. incorporating the effects of these factors within the specification of the disturbance term, can be considered as an alternative to the above two approaches. Moreover it is an alternative which is considerably more general in its potential use, as data on wage settlements is by no means easily available.

7.4 The Results: 1951(1) - 1969(2)

The first set of regressions were concerned with $\hat{W}_t$, the annual rate of change of the wage rate, centred on the t'th quarter. The set of independent variables were in general the basic ones indicated by the search theory. The expectations series which worked best, and which was used in the regressions throughout this chapter, was that based upon the more complex semi autoregressive mechanism defined in equation (7.4), and where the rate of inflation was fully perceived. Initially we used O.L.S. to estimate the equations and the results were, omitting the seasonal dummy coefficients

$$\begin{aligned}
\hat{W}_t = & \underset{(3.97)}{-10.79} + \underset{(3.78)}{63.52}\Pi_t + \underset{(1.59)}{2.93}\,V_t + \underset{(1.62)}{0.11}\,t\Pi_t - \underset{(0.05)}{0.054}\,U_t \\
& + \underset{(2.29)}{6.03}\,B_t + \underset{(3.12)}{0.45}\,\dot{W}^e_t \\
R^2 = & \ 0.67 \\
DW = & \ 1.20 \qquad\qquad (7.6)
\end{aligned}$$

(Again it should be noted that, as throughout the thesis, the figures in brackets are t statistics). These results are reasonably good, all the coefficients have the expected sign and with the exception of unemployment all are significant, at least at the 10% level. In addition the value for R^2 is reasonably high. However the Durbin Watson statistic is significant at the 5% level and indicates the presence of positive first order serial correlation.

We argued earlier in this chapter that under certain conditions we would expect the residuals to be characterised by first, second, third and fourth order serial correlation, therefore the significance of the Durbin Watson statistic should not be too surpising. There are several standard techniques for estimating equations with serially correlated residuals, however they tend to get somewhat complex when there are more than one serial correlation coefficient to allow for. Consequently we shall be using none of these techniques, but a method based upon a non-linear least squares procedure. In any case, this links up well with some of the later regressions which are nonlinear in any case.

The basic method is fairly simple, given an equation [1]

$$Y_t = \beta X_t + u_t \tag{7.7}$$

where the error term is characterised by a first order autoregressive process

$$u_t = \rho_1 u_{t-1} + \varepsilon_t \tag{7.8}$$

where ε_t is a white noise error term, we can estimate ρ_1 as follows

$$Y_t = \beta X_t + \rho_1 (Y_{t-1} - \beta X_{t-1}) + \varepsilon_t \tag{7.9}$$

It being a perfectly straightforward procedure to extend this method to any number of serially correlated coefficients.

The nonlinear program used to estimate these equations is one of the standard features of the TSP package program at Warwick University. It is based on a modification of the Gauss-Newton method (see Hartley (1961), Hartley and Booker (1965) and the TSP manual). The method is as follows, given a model

$$Y_t = f(X_t, \beta) + \varepsilon_t \tag{7.10}$$

The least squares estimator of the m parameter vector, b, minimizes

$$S(b) = \{Y - f(b)\}'\{Y - f(b)\} \tag{7.11}$$

Let F be an n x m matrix of partial derivatives

$$\frac{\delta f_t}{\delta \beta_j} \quad \begin{array}{ll} t = 1, \ldots\ldots, n & \text{(the number of observations)} \\ j = 1, \ldots\ldots, m & \text{(the number of coefficients)} \end{array} \tag{7.12}$$

1. Where b_0, β, Y, and f are all row vectors.

The t'th row of F gives the derivatives of f_t with respect to $b_1, b_2, \ldots, b_m$.

Now let F_0 be the value of F evaluated at the initial value $b_0 = (b_{10}, b_{20}, \ldots, b_{m0})$. The Gauss-Newton method then consists of taking a linear[1] expansion of f(b) around b_0, the vector of initial starting values, and then using ordinary least squares. We therefore minimize with respect to the sum of squared residuals, i.e. with respect to

$$\{Y - f(b_0) - F_0(\beta - b_0)\}'\{Y - f(b_0) - F_0(\beta - b_0)\} \qquad (7.13)$$

This gives

$$F_0'\{Y - f(b_0) - F_0(\beta - b_0)\} = 0$$

$$F_0'(Y - f(b_0)) = F_0'F_0(\beta - b_0)$$

and the change from the initial to the new estimate is given by

$$d = \beta - b_0 = (F_0'F_0)^{-1}F_0'(Y - f(b_0)) \qquad (7.14)$$

A new estimate of β, b_1, is obtained as $b_1 = b_0 + d$. The process is then repeated until convergence is achieved.

The modification suggested by Hartley, and used here, involves setting the new estimate of b_i equal to $b_{i-1} + \lambda d$, where λ lies between 0 and 1. The convergence criterion is that if $|d_{ji}/b_{j(i-1)}| < \delta$ (δ is in fact set equal to 0.01), for j = 1,....,m, then the procedure has converged. If not λ is searched over, starting at $\lambda = 1, \frac{1}{2}, \frac{1}{4}, \ldots,$ until $S^{(i)} < S^{(i-1)}$, b_i is then set equal to $b_{i-1} + \lambda d$, and the process is repeated.

If we assume that the errors, ε_t , are independently and identically distibuted with mean 0 and variance σ^2, and if b is the final estimate of β, then

$$\hat{\sigma}^2 = \frac{1}{n}\,SSE(b) \qquad (7.15)$$

(1) Specifically a first order Taylor series expansion, where Y is approximated by: $Y \approx f(b_0) + F_0(\beta - b_0)$

and the nonlinear least squares estimator b is approximately normally distributed with mean β and covariance matrix $\sigma^2\{F(b)'F(b)\}^{-1}$.

Using this method to estimate equation (7.6), with a first order serial correlation term, we get (again omitting the seasonal dummy coefficients, which we shall continue to do).

$$\hat{W}_t = \underset{(1.39)}{-6.23} + \underset{(2.00)}{39.00}\Pi_t + \underset{(1.53)}{3.16}V_t + \underset{(0.27)}{0.033}t\Pi_t - \underset{(0.06)}{0.079}U_t + \underset{(1.71)}{5.76}B_t + \underset{(1.55)}{0.40}\dot{W}^e_t$$

$$R^2 = 0.73 \qquad \rho_1 = 0.48\ (3.16)$$

$$DW = 1.82 \tag{7.16}$$

The initial starting values for the coefficients were set equal to the O.L.S. estimates, the serial correlation coefficient, ρ_1, being set at zero. Again the results are reasonably good, there is some reduction in the significance of the coefficients, and indeed the time trend/profits variable now becomes insignificant. But taken as a whole the results still provide some measure of support for the hypothesis being tested. Detailed discussion of the size of these coefficients will be delayed until the end of the chapter. For the moment it is perhaps usefull to compare these results with those obtained from a more standard method of allowing for serially correlated residuals, namely the Cochrane Orcutt iterative technique.

$$\hat{W}_t = \underset{(1.33)}{-5.34} + \underset{(1.85)}{35.19}\Pi_t + \underset{(1.33)}{2.76}V_t + \underset{(0.47)}{0.049}t\Pi_t - \underset{(0.21)}{0.26}U_t + \underset{(1.77)}{5.58}B_t + \underset{(1.94)}{0.40}\dot{W}^e_t$$

$$R^2 = 0.71 \qquad \rho_1 = 0.47\ (4.61)$$

$$DW = 1.83 \tag{7.17}$$

As can be seen this provides very similar results to the previous equation estimated by nonlinear least squares.

However we have previously indicated, that we would not only expect positive first order serial correlation, but probably second and third order positive correlation in addition to negative fourth order serial correlation. Consequently we re-estimated the equation allowing for this,

$$\hat{\dot{W}}_t = \underset{(2.85)}{-8.77} + \underset{(2.68)}{43.64\Pi_t} + \underset{(2.26)}{3.94\,V_t} + \underset{(1.67)}{0.12\,t\Pi_t} + \underset{(0.25)}{0.25\,U_t}$$

$$+ \underset{(1.65)}{4.21\,B_t} + \underset{(2.38)}{0.47\,\dot{W}^e_t}$$

$$\rho_1 = 0.46\ (3.35)$$
$$\rho_2 = -0.21\ (1.49)$$
$$R^2 = 0.76 \qquad \rho_3 = -0.017\ (0.12)$$
$$DW = 1.97 \qquad \rho_4 = -0.23\ (1.84) \qquad (7.18)$$

These results have improved somewhat in as much as there has been a general increase in the t statistics, although there is some reservation as to the coefficient on expectations, which is significantly less than one. As for the serial correlation coefficients, the first order one remains positive and significant at the 5% level. The fourth order one is also significant at this level, with the sign expected. The second and third order coefficients are both negative, but insignificant at the 5% level.

Turning our attention now to $\dot{W}_t$, the quarterly rate of change in wages, we first estimated the basic equation using O.L.S.

$$\dot{W}_t = \underset{(1.08)}{-2.21} + \underset{(2.00)}{25.47\Pi_t} - \underset{(0.59)}{0.82\,V_t} + \underset{(1.18)}{0.062\,t\Pi_t} - \underset{(0.84)}{0.66\,U_t}$$

$$+ \underset{(0.91)}{1.81\,B_t} + \underset{(2.26)}{0.25\,\dot{W}^e_t}$$

$$R^2 = 0.31$$
$$DW = 2.34 \qquad (7.19)$$

These results are clearly not very good, the R^2 is much lower than before, although this is only to be expected as the quarterly rate of inflation is considerably more volatile than the annual rate. However, of the coefficients, only two, profits and expectations are significant. The Durbin Watson statistic is in the indeterminate range, and consequently no firm conclusion can be drawn as to the possible existence of first order negative serial correlation.

However we argued earlier that there were very strong theoretical reasons for believing that the residuals would be characterised by negative first, second and third order serial correlation. Consequently equation (7.19) was re-estimated using the nonlinear method described earlier, the results were

$$\dot{W}_t = \underset{(3.60)}{-3.27} + \underset{(2.54)}{18.90}\Pi_t + \underset{(0.59)}{0.49}V_t + \underset{(2.23)}{0.050}\,t\Pi_t - \underset{(0.16)}{0.076}U_t$$

$$+ \underset{(1.15)}{1.30}B_t + \underset{(4.39)}{0.21}\dot{W}^e_t$$

$$\rho_1 = -0.38\ (3.13)$$

$$R^2 = 0.49 \qquad \rho_2 = -0.50\ (4.17)$$

$$DW = 2.06 \qquad \rho_3 = -0.34\ (2.76) \qquad (7.20)$$

These results suggest a considerable improvement upon those obtained by using O.L.S., four of the coefficients are now significant at the 5% level. In addition all the serial correlation coefficients are significant, providing impressive support for the theoretical arguments advanced earlier, especially as none of the coefficients are significantly different from their theoretical value of -0.33.

However neither vacancies, unemployment or the unemployment benefits variable are significant in this equation. This may be due to problems of multicollinearity making it difficult to isolate the significance of individual coefficients, even though the three variables as a whole might be significant. Because of this possibility the equation was re-estimated with unemployment, the least significant of the three variables, omitted. The results were

$$\dot{W}_t = -3.32 + 18.04\,\Pi_t + 0.62\,V_t + 0.049\,t\Pi_t + 1.14\,B_t$$
$$(3.96)\quad(3.40)\qquad(1.91)\qquad(2.24)\qquad(2.05)$$

$$+\ 0.22\,\dot{W}^e_t$$
$$(4.48)$$

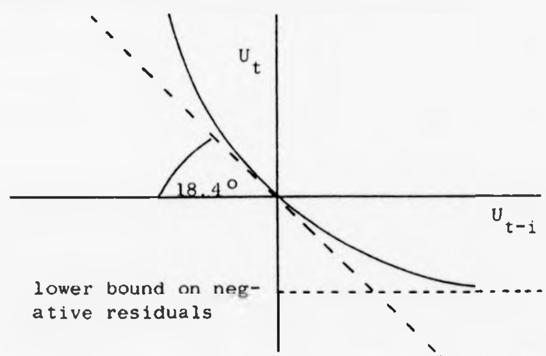
$$\rho_1 = -0.38\ (3.16)$$
$$R^2 = 0.49 \qquad \rho_2 = -0.50\ (4.30)$$
$$DW = 2.06 \qquad \rho_3 = -0.34\ (2.80) \qquad (7.21)$$

All the coefficients are now significant at the 5% level, and we shall now turn to examine these.

The coefficient on the profits variable is 18.04, whilst the profit ratio itself varied between 0.1 and 0.2. This implies a difference in the inflation rate, between these two extreme values, of about 1.8% a quarter, or 7.3% a year, which represents a considerable effect The coefficient on the combined time trend/profits variable is 0.049, which implies that over a twenty year period, with a profit share ratio of, for example, 0.15, the effect of increasing worker productivity on wage inflation would be to increase it by 0.74% a quarter. The coefficient on the benefit ratio is 1.14, a measure of the impact of this on inflation can be found by calculating the effect of the introduction of the earnings related supplement in the fourth quarter of 1966. In effect this increased the unemployment benefit ratio from about 0 26 to 0.51, i.e. almost doubling it. This would have tended to increase inflation by about 0.29% a quarter, or 1.1% in a full year. Turning now to the coefficient on wage expectations, we can see that the coefficient is 0.22, however the wage expectations variable is in annual terms so we must also convert this coefficient to an annual one, which gives a value of 1.21. This is greater than unity, its theoretical value, but not significantly so. Finally we turn to the coefficient on vacancies which is 0.62. Vacancies themselves varied from about 0.4% of the working population to about 1.4%, thus making a difference to inflation of 0.62% a quarter or about 2.5% a year.

The residuals from this last equation are shown in figure 7.4. There are several points to note. Firstly, if these are compared with the actual rate of inflation in figure 7.5, we see that, although the equation does reasonably well in predicting the timing of the peaks, it does not do so well in capturing the heights of those peaks, in fact it underpredicts everyone. One possible reason for this might be that the disturbance term is nonlinear. The reason being that, although there is an obvious lower bound to negative residuals in this present sample period, due to the fact that in general wages were never falling. There is no such compelling reason to believe in the existence of an upper bound on positive residuals. Consequently we might expect the relationship between u_t and u_{t-i}, i = 1, 2, 3, to look something like that shown in figure (7.3). The angle is 18.4^{o}

Figure 7.3 An Example of Nonlinear Serial Correlation



as this is equal to $\tan^{-1}(-\rho_i)$ (i=1,...,3,) $= \tan^{-1}(1/3) = 18.4^{o}$.

Such a relationship can be approximated algebraically as

$$u_t = \rho_i u_{t-i} + \rho_i' u_{t-i}^2 \tag{7.22}$$

where $\rho_i < 0$ and $\rho_i' > 0$

and this can be estimated as

$$Y_t = \beta X_t + \sum_{i=1}^{3} (\rho_i(Y_{t-i} - \beta X_{t-i}) + \rho_i'(Y_{t-i} - \beta X_{t-i})^2) \tag{7.23}$$

Figure 7.4 Residuals from Equation (7.21)

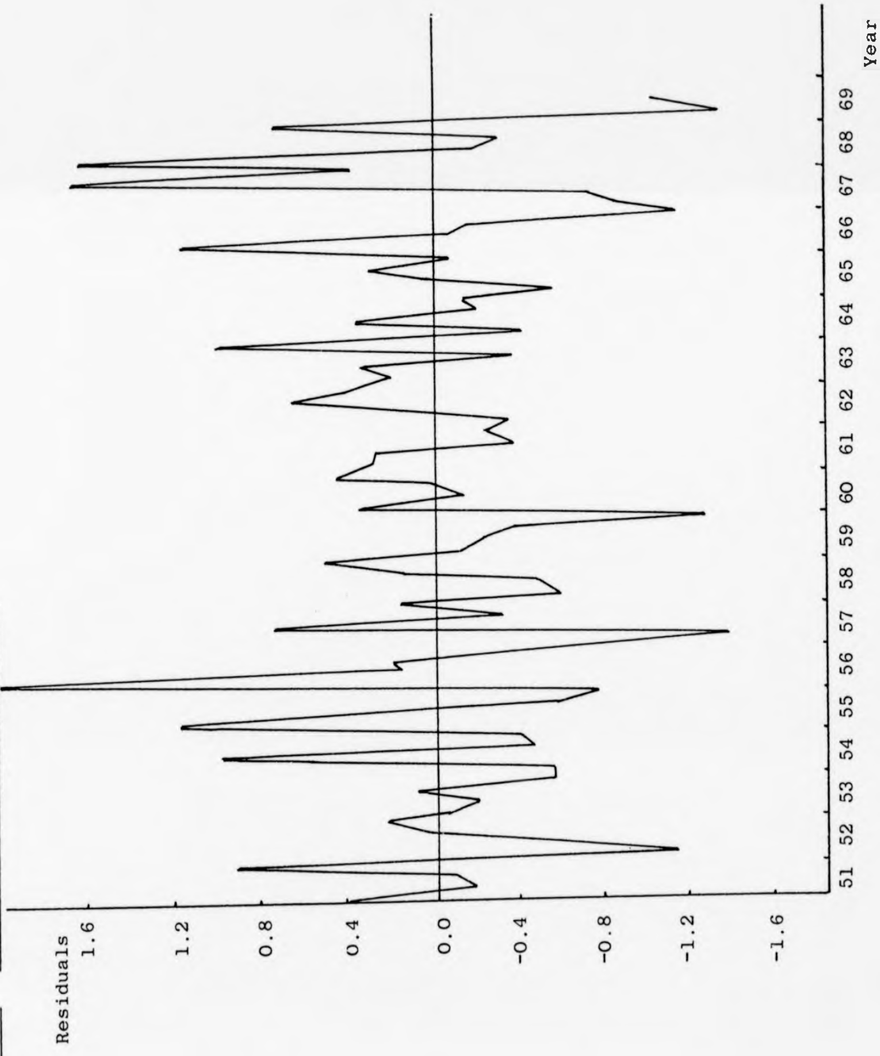


Figure 7.5 The Quarterly Rate of Wage Inflation 1951(1) - 1969(2)

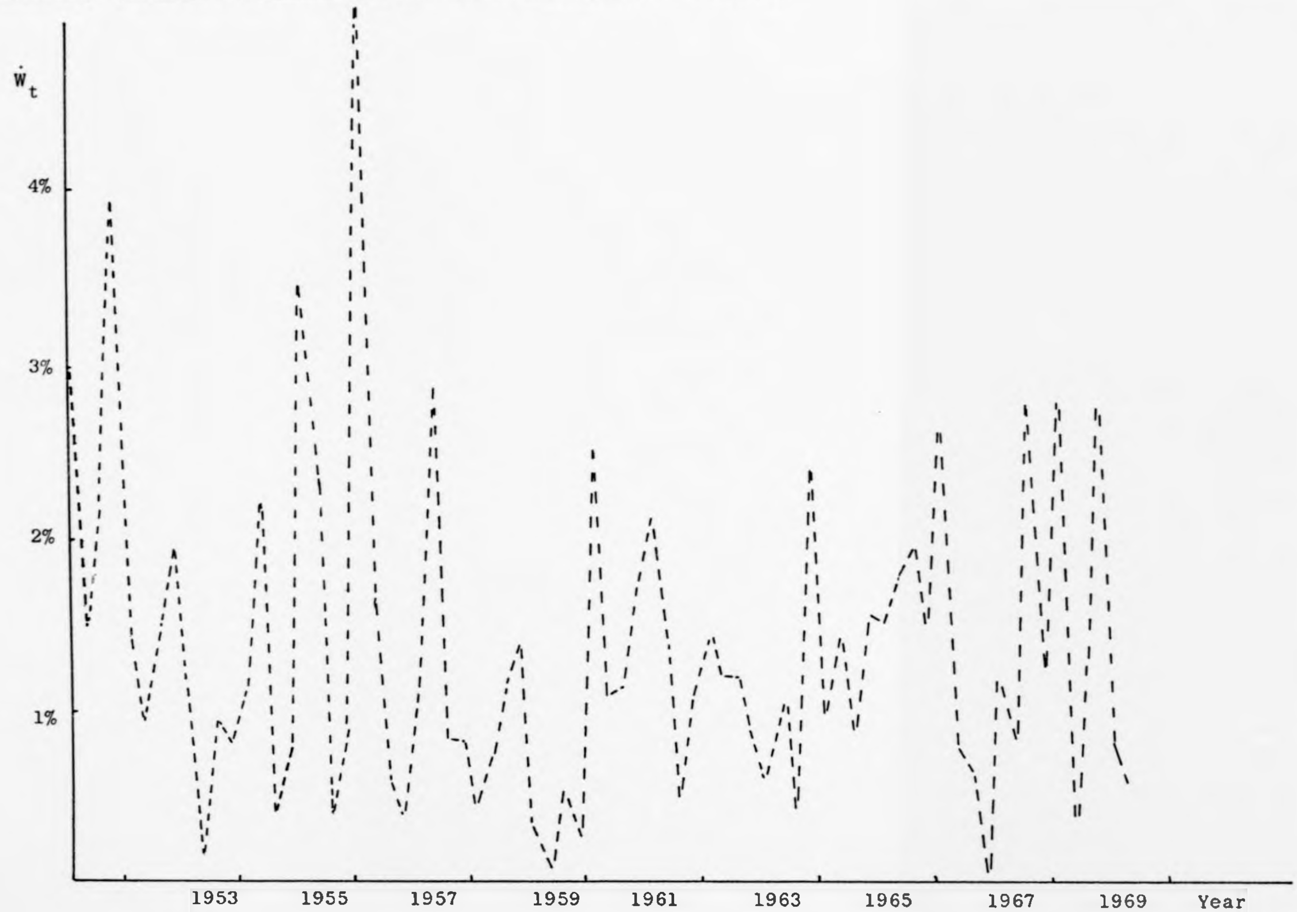
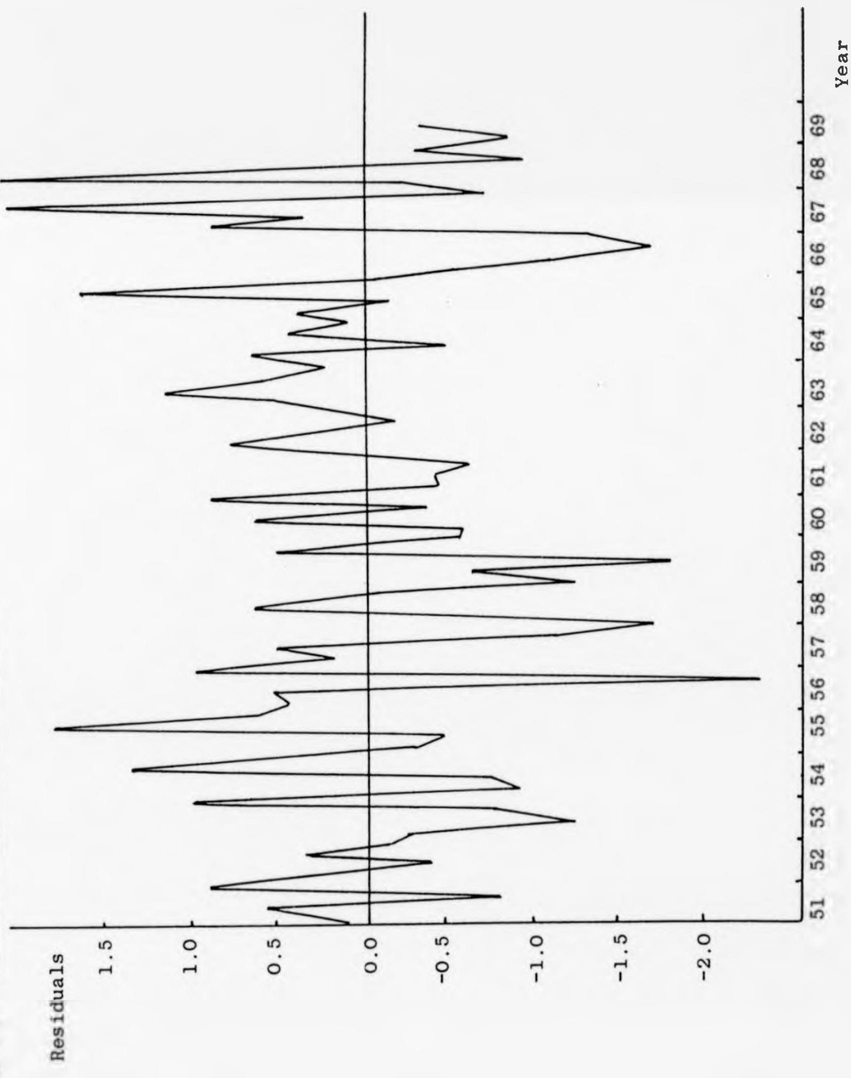


Figure 7.6 Residuals from Equation (7.18)



This implies that there would be a limit to the effect a very high positive disturbance term in one period would have on the disturbance terms in future periods. But this would not effectively be the case for very large negative disturbance terms. The results were not very encouraging and they have not been reported here. With respect to the serial correlation terms, none of the linear terms were significant at the 5% level. Only one was significant at the 10% level, and that had the wrong sign. The squared terms remained significant in general, and there was no marked change in their size.

Consequently the possibility of nonlinear disturbance terms has not been pursued here. Yet the exercise has perhaps been of some interest due to the innovatory nature of the work. Be that as it may it has not provided us with an answer as to why these peaks have been consistently underestimated. A further possibility is that there might be some link with the politico-economic cycle. As the following table shows nearly all the peaks coincided with some major event in that cycle.

Table 7.1 Politico-Economic Events which Coincide with Peaks in the Wage Inflation Series

Peaks	Politico-Economic Events
1951(4)	General Election, October 1951
1955(1)	General Election, May 1955
1956(1)	1956 was classified as an incomes policy year by Lipsey and Parkin
1957(2)	Council on Prices and Incomes estabilshed, August 1957
1960(1)	General Election, October 1959
1963(4)	
1966(2)	General Election, March 1966

(Peaks after 1966 were omitted, as the series became considerably more volatile at this time, with several "peaks" within a very short space of time). The peaks themselves are probably correlated with a large number of settlements, and in this case it is not difficult to guess why they should precede the introduction of incomes policies. But it is not so obvious as to why they should be correlated with general elections. None the less the similarity between the two events is striking, with four of the five general elections in this period occurring near a peak. This is obviously a matter of some interest, but for the moment we shall have to leave it there with the matter somewhat undecided.

In addition to the basic equations various alternative specifications were estimated. Firstly, we argued earlier that we would not expect the coefficient on expectations to be a constant with a value of unity. Rather we would expect it to be a variable, with a value equal to the employer's desired differential. This hypothesis was tested, but the results provided no significant improvement over the basic equation and they have not been reported here. We also experimented with a nonlinear mechanism by which expectations below a certain level did not affect the rate of inflation, but above this critical value they entered with a unit coefficient. Such a mechanism has been suggested by Eckstein and Brinner (1972), and also found favour with Askin and Kraft (1974). However initial results indicated that allowing for such a nonlinear effect produced no significant improvement in our wage equation, and this line of research was not pursued with either.

7.5 The Effects of Incomes Policies

We noted in chapter 1 that there was no general consensus amongst economists as to the effects that incomes policies had had. Thus for the U.K., Parkin, Sumner and Ward (1976) and Tarling and Wilkinson (1977), amongst others, find no effects at all. Others, for example, Burrows and Hitiris (1972) and Sargan (1977) do find a significant role for incomes policies. Whilst Henry and Ormerod (1978) find that they have a temporary effect.

There is even disagreement as to the correct way in which to allow for incomes policies within a wage equation. Many researchers have used a shift dummy variable to capture the effects of incomes policies (e.g. Lipsey and Parkin (1970)). However Oi (1976) has argued that this is invalid as it requires that the slope coefficients on the independent variables be equal during policy off and policy on periods, an assumption he thinks unlikely.

Indeed the use of shift dummy variables seems a particularly inappropriate method of allowing for incomes policies for a number of reasons. In addition to Oi's comments their use supposes that their application will cause a constant "shift" downwards in the inflation rate from what it would have been in the absence of an incomes policy, regardless of what level that inflation rate would have been. Even the use of seperate dummy variables to represent seperate incomes policies only partially overcomes this objection. For although this allows for a seperate effect for each incomes policy, which will presumably depend upon both the nature of the incomes policy and what the inflation rate would have been in the absence of the incomes policy (the greater the inflation rate the greater the potential shift effect). It will not distinguish between the differing effects of each individual incomes policy during different stages of its implementation.

As an alternative to the use of shift dummy variables we could, using nonlinear techniques, quite easily estimate a slope dummy variable operative to the same degree on all the coefficients. This would be the empirical equivalent to the view that the incomes policy operates to reduce inflation by the same proportionate, rather than absolute, amount in each period. It is therefore superior to the use of a single shift dummy variable, but it would still be open to the criticism that it presupposes that an incomes policy will be operated with the same degree of rigour at all stages of its operation.

As a further alternative we could attempt to find some proxy for the effectiveness of incomes policies throughout the entire period of their operation. One such possibility is the use of data on strikes over wages. We shall argue later that if the incomes policy causes wage increases to be below the level the employer wishes to give, then strikes which attempt to force the employer to increase his offer are irrelevant. For in this case the employer is prevented from even implementing the offer which he wishes to make. If we make the assumption that employers' desired wage offers have some distribution with a non-zero variance. Then the greater the distance between the wage increase allowable under the incomes policy and the average employer's desired wage offer, the greater will be the number of employers prevented from implementing the offer they would like to make, and the fewer wage strikes there will be.

But the specification of this proxy and the ensuing empirical work would enlarge the thesis to an undue degree. Therefore this approach has not been pursued. However if one rejects the use of dummy variables, then in practice we are not left with many alternatives with which to isolate the effects of incomes policies. We could,as Lipsey and Parkin also did, estimate the equation for policy off periods, and then compare the predictions made using this equation with actual inflation during policy on periods. Unfortunately, using the criteria adopted by Lipsey and Parkin and Tarling and Wilkinson, out of the 73 observations which form our sample base, 36 can be classified as being policy on periods. This leaves us with much too small a sample base on which to estimate the equations, particularly taking into account the serial correlation structure which would reduce even further the available number of observations.

Thus the only alternative is to estimate the basic equation, whilst not allowing for incomes policies, and then examine the residuals to see if we can detect any evidence of their effects. In doing this we are implicitly making a number of assumptions about the effectiveness of incomes policies. The most important of these is that in the majority of the periods in which they were operating, they had either no effect on the rate of inflation, or alternatively that such effects were relatively small and can be legitimately included as one of the many factors which affect, without dominating, the disturbance term.

In justifying this assumption we should first note that only one of the incomes policies introduced in this period (1951(1) - 1969(2)), can be classified as being "compulsory", all the rest being "voluntary". This was stage 2 of the Labour governments policy, (1966(3) - 1967(2)). In general (a noteable exception would appear to be the second and third stages of the Social Contract), it seems reasonable to suppose that a compulsory policy will be more effective than a voluntary one.

Secondly some justification for the assumption might be found from an examination of the data on wage strikes, as we suggested earlier that the effectiveness of incomes policies might be evaluated by their effects on strikes over wages. This data is shown in figure 8.3, and we can see that since the mid fifties, and prior to 1970, there have only been two brief periods when the number of wage strikes fell below 200. The first such period was from 1962(4) - 1963(1), and the second from 1966(3) - 1967(1). This would seem to confirm the view that throughout the period 1951(1) - 1969(2) incomes policies had a marked dampenning effect on wage inflation in only a few brief periods.

Finally when we come to examine the residuals themselves, neither those from figure 7.4 or figure 7.6 seem to indicate that the equations were consistently overestimating the rate of inflation in the period after 1961, which would have been the case had the almost continuous operation of an incomes policy after this date exerted a consistant dampenning effect on the inflation rate. We can therefore conclude that it seems probable that until 1969 incomes policies were not in general causing the rate of inflation to deviate significantly from what was also compatible with the underlying labour market conditions. However this does not preclude the possibility that some of these incomes policies, during part of their period of implementation, had such effects. An examination of the residuals reveals that there were perhaps two clear periods when the inflation rate was being consistently overestimated by a substantial amount. Using figure 7.4 to date these, as the quarterly rate of inflation is more sensitive to "outliers" than the annual rate, they were, 1959(1) - 1959(4) and 1966(2) - 1967(2). The first of these two periods does not coincide with any suggested period of incomes policy operation, but it may possibly be explained by a reduction in the number of settlements in advance of a general election. The second period does however coincide almost exactly with the implementation of the compulsory incomes policy already noted. That this should have such an effect on the residuals is hardly surprising, in the five month period July - December, 1967, the index moved only one point, from 169.8 to 169.9. Presumably this is explained by an almost total lack of settlements being implemented during this period, and we might expect at the termination of the incomes policy, an above "average" increase in the index caused by their delayed implementation. Whether this is in fact the case or not, we can see that once the period of "severe restraint" ends, there are a number of very large positive residuals.

We can therefore conclude that,during the period under study, incomes policies did not have a significant effect on the inflation rate. But it seems probable that in individual cases there was such an effect. However it also seems likely that, in at least one instance, this was followed by an acceleration in the inflation rate, possibly due to the delayed implementation of a large number of settlements.

But we cannot go on from this to conclude that incomes policies in general cannot have a permanent effect on the inflation rate, merely that in the period under consideration they did not appear to. In order to answer this wider question we also need to consider the forces which may lead to the termination of an incomes policy, and to do this we need to bring trade unions more explicitly into the inflationary process. Both these are tasks which we shall attempt in the following chapter.

7.6 The Period after 1969

We have seen that the basic model is capable of explaining wage inflation until 1969(2). This date was initially chosen as it has been widely argued that it was about then that excess demand based models of inflation begin to break down (Williamson and Wood (1976) and Henry, Sawyer and Smith (1976)). We can illustrate that this is also the case for this model in a number of ways. Firstly we simply extended the sample basis to cover the whole of the period 1951(1) - 1975(4), the results are shown below

$$\begin{aligned}\dot{W}_t = & -2.68 + 11.20\Pi_t + 0.57\,V_t + 0.049\,t\Pi_t + 0.77\,B_t \\ & \;\;(2.00)\;\;\;(1.27)\;\;\;\;\;\;(1.22)\;\;\;\;\;\;(1.27)\;\;\;\;\;\;\;\;(0.78) \\ & + 0.35\,\dot{W}^e_t \\ & \;\;(12.89)\end{aligned}$$

$$\begin{array}{lll} & \rho_1 = -0.20\ (1.91) & \\ R^2 = 0.66 & \rho_2 = -0.39\ (3.63) & \\ DW = 2.01 & \rho_3 = -0.04\ (0.56) & (7.24)\end{array}$$

Compared with (7.21) this equation is clearly less satisfactory in several respects. Firstly only two of the coefficients are now significant at the 10% level, the constant term and expectations. Secondly the coefficient on expectations is much too high, it implies an annual coefficient of about 2.32, as opposed to the theoretical value of unity, and finally the serial correlation coefficients have also been reduced in significance.

Another way of demonstrating the inadequacy of our search theoretic general cannot have a permanent effect on the inflation rate, merely that in the period under consideration they did not appear to. In order to answer this wider question we also need to consider the forces which may lead to the termination of an incomes policy, and to do this we need to bring trade unions more explicitly into the inflationary process. Both these are tasks which we shall attempt in the following chapter.

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$$\dot{W}_t = \underset{(2.00)}{-2.68} + \underset{(1.27)}{11.20\Pi_t} + \underset{(1.22)}{0.57\,V_t} + \underset{(1.27)}{0.049\,t\Pi_t} + \underset{(0.78)}{0.77\,B_t} + \underset{(12.89)}{0.35\,\dot{W}^e_t}$$

$$R^2 = 0.66 \qquad \rho_1 = -0.20\ (1.91)$$
$$\rho_2 = -0.39\ (3.63)$$
$$DW = 2.01 \qquad \rho_3 = -0.04\ (0.56) \qquad (7.24)$$

Compared with (7.21) this equation is clearly less satisfactory in several respects. Firstly only two of the coefficients are now significant at the 10% level, the constant term and expectations. Secondly the coefficient on expectations is much too high, it implies an annual coefficient of about 2.32, as opposed to the theoretical value of unity, and finally the serial correlation coefficients have also been reduced in significance.

Another way of demonstrating the inadequacy of our search theoretic model of inflation in the 1970's is to use the coefficients from equation (7.24), estimated over the earlier period, to predict inflation in the 1970's. The results of these calculations are shown in Table 7.2. The first column shows the predicted inflation rate and the second the actual rate, with the annual figures in brackets. From this we can see that there are two periods in particular, 1969(3) - 1970(4) and 1974(2) - 1975(2), when the predicted series underpredicts the true series. This point is reinforced by an examination of figure 7.7 which shows the predicted and the actual wage rates. As can be seen the two series gradually diverge by an increasing amount, especially in the two periods already referred to.

7.7 Conclusion

In this chapter we have tested the basic search theoretic model of inflation. For the period 1951(1) - 1969(2), it was found to work quite well, with profits, a combined time trend/profits variable, vacancies, the benefit earnings ratio and expectations of wage inflation all proving significant in determining the rate of wage inflation. In addition we suggested, both for annual and quarterly data, the existence of a more complex error structure than has hitherto been used.

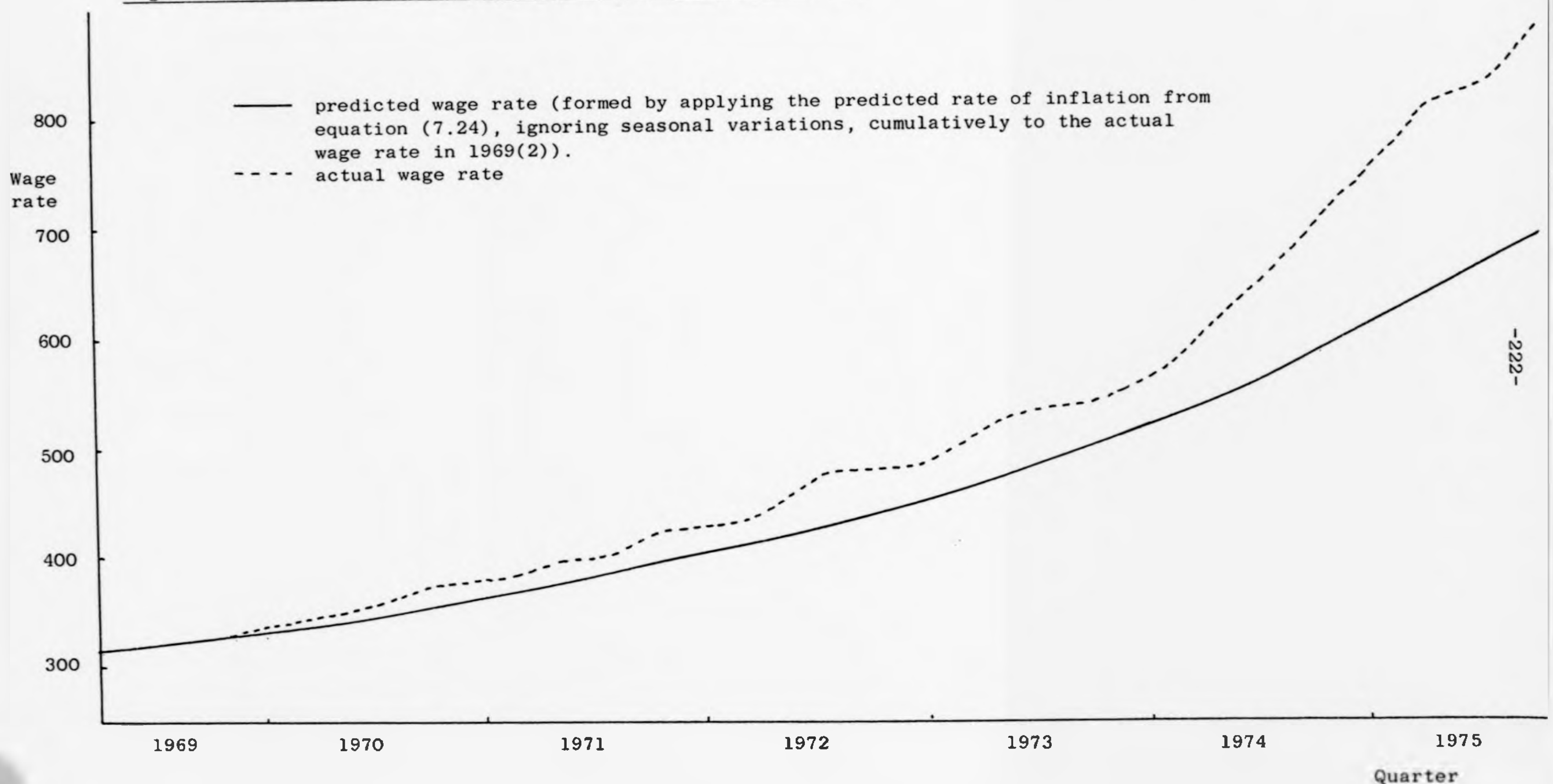
However this same model fails to explain wage inflation after 1969, and it is to this problem that we now turn.

Table 7.2 Comparison of Predicted and Actual Inflation Rates

Time Period	Actual Inflation Rate		Predicted Inflation Rate	
1969(3)	1.43		1.92	
(4)	3.07		1.90	
1970(1)	2.97	(13.17)	2.00	(9.45)
(2)	2.23		2.21	
(3)	2.55		2.58	
(4)	5.42		2.66	
1971(1)	2.06	(12.04)	2.60	(10.43)
(2)	2.94		2.73	
(3)	2.00		2.55	
(4)	5.04		2.55	
1972(1)	1.64	(13.85)	2.37	(11.88)
(2)	3.37		2.85	
(3)	7.34		3.07	
(4)	1.50		3.15	
1973(1)	1.01	(12.06)	3.27	(14.12)
(2)	5.66		3.51	
(3)	3.72		3.73	
(4)	1.67		3.61	
1974(1)	3.69	(26.77)	3.63	(16.35)
(2)	8.22		3.88	
(3)	6.94		4.23	
(4)	7.92		4.60	
1975(1)	6.96	(23.43)	4.42	(16.57)
(2)	8.05		4.24	
(3)	1.86		3.93	
(4)	6.56		3.98	

Note: The figures in brackets represent the sum of the quarterly figures in the corresponding year.

Figure 7.7 Actual and Predicted Wage Rates: 1969(2) - 1975(4)



Data Appendix to Chapter 7[1]

Vacancies[2]: These are adult male and female vacancies reported to the employment exchanges. The quarterly figures are obtained by averaging the monthly figures. Prior to 1962 the figures were amended as described in the text, due to the existence of a seperate register for nurses. Figures in 1000's. Source: British Labour Statistics Yearbook (various issues) and Historical Abstract.

Nurses: Prior to 1962 a seperate register existed for nurses. This was merged at the beginning of 1962, and this is estimated to have added some 19200 to the general register. Source Ministry of Labour Gazette (various issues).

Unemployment[2]: These are adult male and female unemployed workers as reported to the employment exchanges, excluding school leavers and adult students. The quarterly figures are obtained by averaging the monthly figures. Source: British Labour Statistics Yearbook (various issues) and Historical Abstract.

Working Population: The data relates to the end of the quarter. To get a figure nearer to the average in the quarter as a whole, a two period moving average was used. Source· British Labour Statistics Yearbook (various issues) and Historical Abstract.

Profits: Gross trading profits of companies seasonally adjusted. Prior to 1955 the quarterly figures had to be linearly interpolated from the annual figures. Source: Economic Trends Annual Supplement, 1977.

G.D.P.: Gross domestic product measured at factor cost. Prior to 1955 the quarterly figures had to be linearly interpolated from the annual figures. Source: Economic Trends Annual Supplement, 1977.

Unemployment Benefits: These are for a single person. The amount of earnings related supplement has been calculated on the assumption that the average weekly earnings for October in the relevant tax year represent the average for that year. Source: Department of Health and Social Security.

Earnings: Net average weekly earnings of adult male manual workers. From 1963 onwards the estimates were made by the Department of Health and Social Security (and are the same as those used in chapter 3).Prior to this date the data was estimated from biannual gross earnings data, and tax and national insurance rates. Sources: Department of Health and Social Security, British Labour Statistics Historical Abstract and the Annual Abstract of Statistics (various issues).

Wage Rate:The wage rate upon which the measures of inflation are based is the index of basic hourly wage rates for all manual workers in all industries and services. The data relates to the end of the quarter in question. Source: British Labour Statistics Yearbook (various issues) and Historical Abstract.

Wage Inflation Expectations: These were based on the formula

$$\dot{W}^e_t = 0.920\,\dot{W}^e_{t-1} + 0.060\,\dot{W}_t + 0.780\,\dot{W}^{e\prime}_{t-1} - 0.796\,\dot{W}^e_{t-2}$$

where $\dot{W}^{e\prime}_{t-1}$ and $\dot{W}^{e\prime}_{t-2}$ are as defined in the text. The wage rate is that used above. The quarterly figures are an average of the three monthly figures.

Notes (1) All data are seasonally adjusted unless otherwise stated.

(2) Both unemployment and vacancies were expressed as a proportion of the working population. This contrasts with the analysis in chapter 3, where unemployment and vacancies were in absolute terms. The reason for this change reflects the length of the different sample periods. In chapter 3 the potential labour force can properly be assumed constant, with fluctuations in the measured figures being due to cyclical factors, as secondary workers who become unemployed tend not to register. We felt that such fluctuations would bias the proprtionate measures of unemployment. However the present sample period is almost twenty years long, and we feel a more

serious bias would result from neglecting the growth in the labour force, which has in fact been considerable.

Chapter 8

A Switching Regimes Model

8.1 Introduction

We have so far developed a search theoretic model of the inflationary process. We have also tested that model and found that although it provides a satisfactory explanation of wage inflation in the post-war period, until 1969(2), it would appear to break down after that date. Moreover this result is not unique to the theory developed here, but seems symptomatic of most excess demand based theories.

We are therefore faced with a number of problems. Why did it break down? Is it that the inflationary mechanism changed for some reason at this point in time? Or is it that the theory was never valid, merely for a period of time appearing to be so, but when more evidence became available the apparent consistency disappeared. Amongst economists this latter view seems to be growing in popularity. Thus, for example, Henry, Sawyer and Smith (1976) conclude that there is no evidence for any relationship between unemployment and inflation in the post-war period.

The difficulty one has in accepting this conclusion is, as we saw in the introduction to the thesis, that for a long time many, probably a majority, of economists ascribed to the view that there was such a relationship. We believe that before we can conclude that they were in error, we should re-examine the theory, including the assumptions made, particularly if those assumptions are common to all excess demand theories.

With respect to the theory put forward in chapter 2, there were several assumptions made in order to simplify the analysis. However the one, which for present purposes, appears most relevant was that trade unions do not influence the inflationary process, except perhaps to the extent of acting in some manner as a catalyst. This assumption is not unique to the analysis but can be found, explicitly or implicitly, in nearly all excess demand based theories. A good example of this can be found in Friedman (1975)

> "Trade unions play a very important role in determining the position of the natural level of unemployment. They play a more important role in denying opportunities to some classes in the community that are open to others. They play a very important role in the structure of the labour force and in the structure of <u>relative</u> wages. But despite appearences to the contrary, a <u>given</u> amount of trade union power does not play any role in exacerbating inflation. It is true that if relatively weak unions become strong, <u>in the process of going from weak to strong</u> they may exert an interim inflationary influence. They will, in the process drive up the real wages of their members. This will reduce the level of employment in their sector. In so far as the government has a full employment policy and is sensitive to the total level of unemployment, it will adopt expansionary policies and drive up the level of money demand. This is capable of producing a <u>temporary</u> rise in the level of prices. But it does not produce continuing inflation. The strong union will then get its new real wage rate, and there will be a re-alignment of employment in the various industries."

Thus what Friedman appears to be saying here is that the object of union policy is merely to establish some union/non-union differential. If unions become stronger they may attempt to increase this differential. But once this has been established there will be no further effects on the inflationary process, except of course that the natural rate may have increased.

Friedman's view is therefore similar to that of Phelps (1968), Ashenfelter, Johnson and Pencavel (1972) and others who have argued that the establishing of a union/non-union wage differential is a prime objective of union policy. Except that Phelps also has this differential varying with labour market conditions (Phelps argues that this will vary directly with excess demand in the labour market, however the evidence points towards an inverse relationship (Mulvey and Trevithick (1975)).

However, as we stated in the introduction to the thesis we do not feel that this view regarding the unions' role is correct. Instead we believe, for reasons that will be expanded upon later, that the primary aim of unions is to maintain their members' standards of living. It may well be that because workers acting collectively are better able to do this than workers acting alone, there will be some differential between organised and unorganised workers. But this is an outcome of unions actions, not the determining factor.

Therefore it seems to us that excess demand based theories have not adequately incorporated trade unions into the inflationary process, and it seems possible that this might provide a partial explanation of why such theories broke down in the 1970's. Moreover it is also our view that bargaining theories have also, somewhat paradoxically, failed in this respect. Most of them have failed to encompass the view that a union is not a single entity with a common aim, or even a combination of individuals with a common aim. It is rather a collection of individuals with common and specific interests, who feel that those interests can best be furthered by joining together. But in joining together they do not lose those individual interests and supplant them with other collective ones.

Any analysis of trade unions and the bargaining process should therefore be phrased in terms of a coalition and examine how coalitions reach decisions and function. It should also encompass the fact that this structured, formalised type of coalition develops both formal and informal leaders. The latter may be shop stewards or simply workers with some influence over their colleagues. The formal leaders consist basically of full time union officials, including some shop stewards. These formal leaders, although they may begin with the same aims and interests as the other members of the coalition, may well, applying Michel's (1962) "Iron Law of Oligarchy", develop interests of their own, seperate to those of the ordinary membership.

The kernel of such an analysis can be found in an extraordinarily perceptive paper by Ashenfelter and Johnson (1969), who recognise that there are indeed three parties involved in labour-management relationships:

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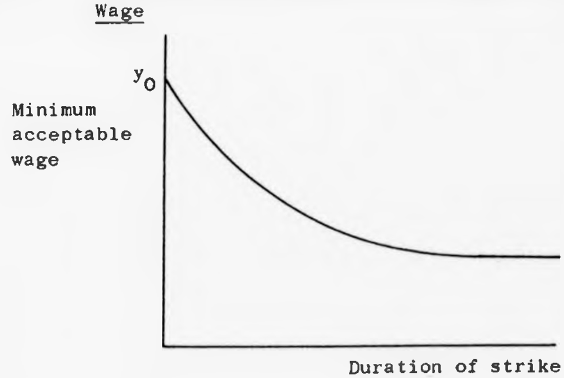
The kernel of such an analysis can be found in an extraordinarily perceptive paper by Ashenfelter and Johnson (1969), who recognise that there are indeed three parties involved in labour-management relationships;

the management, the union leadership and the union membership. Moreover they specify the objectives of the leadership as: (1) the survival and growth of the union as an institution and (2) the personal political survival of the leaders. They then argue that these objectives are accomplished, in most part, by satisfying the aspirations of the membership as well as possible.

With respect to the membership, they argue that there is some minimum wage which is acceptable to them, denoted by y_0, which will depend upon the levels of unemployment and company profits. In addition it will depend directly on the extent to which a moving average of recent wage increases deviates, or falls short of some expected long run increase. They also argue that this minimum acceptable wage will fall with a strike as shown in figure 8.1.

Figure 8.1 The Effect of a Strike on the Worker's Minimum Acceptable Wage



They present the employers problem as one of maximising profits. He then has the choice of agreeing to y_0 and avoiding a strike, or of rejecting y_0 and incurring a strike which will result in a lower wage increase. In effect the firm must weigh the effect on profits of strike costs against the possibly lower wage costs which can be expected to accompany a strike.

We believe that the recognition that there are three parties involved in the wage negotiations is a most important insight. But that not enough attention is given to the determinants of either unions' or employers' actions. Consequently we will present a more detailed analysis than Ashenfelter and Johnson, paying particular attention, on the union side, to the determination of this minimum acceptable wage and the effect on this of the relationship between union leaders and their membership. We will also be looking at the employers' side of the problem, and in particular attempting to make that more compatible with the search theoretic approach presented in the previous chapters. We feel this to be important and would emphasise that we do not regard the employers position, as apparently Ashenfelter and Johnson do, as one of attempting to negotiate as low a wage as possible. Rather he will also be considering the effects of this wage on the ease with which he will be able to attract and retain labour in the contract period, i.e. the period over which the wage is effective.

In the event this turns out to be one of the crucial differences between the analysis presented here and most bargaining theories. Its development will provide the key which will open the way for a synthesis of the wage bargaining and excess demand theories of inflation into what can be regarded as a switching regimes model. A model which will be consistent with both approaches to inflation, and which is capable of explaining the breakdown of excess demand theories after 1969 and their apparent acceptability prior to that.

Thus in the following sections we shall analyse,in turn, the bargaining problem from the unions' and the employers' sides. The analysis concerning the unions will itself be divided into two sections, firstly the problem of what determines the minimum acceptable wage, and secondly the nature of the relationship between union leaders and their membership. Finally in the latter sections of the chapter we shall be concerned with empirically formulating and testing the theory.

8.2 The Individual Worker's Aspiration Wage

By the term "individual worker's aspiration wage" we mean the minimum wage which the worker will accept rather than vote for a strike.[1] Ashenfelter and Johnson argue that this will depend positively upon the difference between the expected long run increase in wages and the currently anticipated increase in wages. (Although this seems a little inconsistent, as if these two terms are equal then the minimum acceptable wage increase is zero). The implication of this in their model is that y_0 is a moving average of previous changes in real wages

$$y_{0t} = \alpha_1 + \alpha_2 \sum_{i=0}^{M} \mu_i \Delta r_{t-i} \qquad (8.1)$$

where $\alpha_1 > 0$ and $\alpha_2 < 0$

Thus implicit in their formulation is the concept of some long run constant increase in real wages, which they justify on the grounds that "workers always want more".

This hypothesis of a long run desired increase in wages can also be found elsewhere. For example Johnston and Timbrell (1973) postulate the existence of a"catch-up" variable, which represents the extent to which annual changes in real net wages fall short of some postulated constant. More recently Henry, Sawyer and Smith take a hypothesis originally developed by Sargan (1964) and conclude that pressure for money wage increases from workers in order to reach some target for growth in take home pay has been a decisive influence in the current inflation. The results of their empirical work tend to provide some support for this hypothesis, and they estimate the desired increase in real earnings to vary between 2 to 2½%, it tending to be higher when more recent observations are used.

However in all this work there is no real justification for why workers should desire an increase in wages (apart from Ashenfelter and

(1) In this chapter we use several different income and wage concepts, to clarify the analysis these are summarised in Tables 8.1 and 8.2 respectively.

Johnson's comment that workers always want more). Still less is there any explanation as to why this desired increase should be constant and the determinants of this constant. This is, after all, a significant departure from previous theories. Keynes claimed that workers attempted to maintain the level of their money wages, later theorists modified this to read real wages. But it is still quite a jump to go from this proposition to one that says workers attempt to increase their real wage by 2½% every year. Have workers always tried to do this, if so why did it elude so many economists for so long? If, on the other hand, such behaviour has recent origins what were they?

We believe that before we can answer these questions we must first ask why workers want wages in the first place. The answer is of course an obvious one, but it leads to conclusions which are not so obvious. Workers want wages in order to be able to purchase the goods they consume. This then suggests the alternative interpretation that workers are not primarily concerned with the wages they receive, but the standard of living this entitles them to. This then further suggests that a workers aspiration wage is such that it will enable him to maintain the standard of living, or consumption pattern, he and his familly currently enjoy. This we suggest will be the minimum wage which will prove acceptable to workers and their famillies.

We can now see how Keynes reached the conclusion he did. In his world people both suffered from some degree of money illusion and related their consumption to present income, in order to mainatin their standard of living therefore they would have to maintain their money wage. If we take away the money illusion assumption then individuals will have to maintain the level of their real wage, which is the conclusion later theorists arrived at. However a great deal of work, both theoretical and empirical, has been done which suggests that people do not base their consumption solely upon income in the present period, whether real or money.

One of the best known alternatives was put forward by Friedman (1957), who suggested that people base their consumption upon a concept he called permanent income. If this is correct, and if it is also correct that individuals attempt to maintain their standard of living, then it follows that the income concept individuals will be concerned with is their permanent income, and it is this which they will attempt to maintain.

Friedman in constructing a variable to measure permanent income suggested the following formula

$$Y^*_p(T) = \beta \int_{-\infty}^{T} e^{(\beta-\alpha)(t-T)} Y^*(t)\,dt \tag{8.2}$$

where β is the adjustment coefficient by which permanent income adjusts to measured income.

$$\frac{d\,Y^*_p}{d\,T} = \beta\,\{Y^*(T) - Y^*_p(T)\} \tag{8.3}$$

and α is the estimated rate of growth of real income. Friedman added this as he thought it more reasonable to estimate permanent income in two parts, firstly a trend value which is taken to grow at a constant percentage rate and secondly a weighted average of adjusted deviations of past values.

However it would seem that this formulation does not really capture the spirit of the permanent income hypothesis, which is that in making consumption decisions people take into account the future. True there is a growth factor present, but it is purely retrospective, it does not extend into the future. The growth factor in (8.2) merely adjusts previous periods incomes to put them on a comparable basis with present income. It in no manner allows for expected income growth in the future. Thus in making their permanent income calculations people perceive that income has been growing in the past, allow for this when calculating permanent income, but apparently believe that all such growth ends in the present period.

If we turn to the text to see if this is consistent with Friedman's view, or if it is that he made an error in presenting this formula, then we are in difficulties. For, apart from the mathematical interpretation of permanent income, an exact economic definition is surprisingly difficult to find. He does not seem to favour the view (page 25) that permanent income is equal to the present value of the individuals present and future earnings plus his non-human capital. Which he rejects on the grounds that it implies an extremely long time horizon and also doubts if units can borrow on the basis of anticipated returns from both human and non-human wealth, at the same rate of interest at which they can lend accumulated non-human wealth. On the other hand, he also rejects the possibility that individuals take no account of future income, on the grounds that this is too short sighted. Instead he seems to favour an intermediate view.

Alternative theories of the consumption function have favoured the first view, although the growth factor has also been misinterpreted in the corresponding empirical work. Thus Ando and Modigliani's (1963) life cycle hypothesis, for example, seems very similar to the hypothesis that people plan their expenditure plans on the discounted present value of their present and future earnings. Indeed if we were to incorporate within this latter approach the restriction that people can only borrow limited amounts on their future income, and also adjust interest rates to reflect myopic time preference tendancies, any differences between the two approaches largely disappear.

However this may be, it is clear that unless one takes the extreme view, which Friedman himself rejects, that no account at all is taken of the future, then (8.2) is not a valid proxy for permanent income. For, although it allows for a retrospective growth factor, it fails to extend this into the future. The growth element in (8.2) merely adjusts previous periods income to comparable terms with present income. An example may make this clearer. Take two different economies A and B. In country A the level of real disposable income per capita is a constant £1000 per annum. In B it is not constant but growing at an annual rate of 5% and in period T it too has reached a level of £1000 per annum. Calculating permanent income with Friedman's formula, and assuming past growth rates have been correctly perceived, would yield values for permanent income of £1000 for both countries, because the role of α is merely to adjust previous periods income to a comparable basis with present income.

Yet does it seem reasonable that the populace of country B, having perceived income growing in the past will not extend this growth into the future? Is it not more realistic to assume that they will expect their income to continue growing into the future, that they will take account of this in formulating their expenditure plans, and that a correct measure of permanent income should reflect this. If one accepts this argument then it becomes obvious that Friedman's empirical measure of permanent income is not the correct measure to use in studies of consumption. For it takes no account of the future, his measurement is merely a filter for extracting temporary deviations from permanent components.

We may, however, build upon the assumption, basic to modern theories of consumption, that individuals in making their consumption plans take account of expected lifetime income. In an undiscounted form this would be

$$Y_L^*(T) = \int_T^{T+K} Y_p^*(T)\, e^{\delta(t-T)}\, dt \qquad (8.4)$$

where K is the time horizon over which the individual discounts, and might be equal to the expected lifetime of the individual. Y_p^* is Friedman's permanent income measure, upon which we put a slightly different interpretation, namely that it represents the income the individual would expect to receive in period T with all temporary fluctuations filtered out. δ is the expected growth rate of income which may or may not be equal to α, the rate at which it has been perceived to have been growing at in the past. One could, for example, imagine a situation where a major event such as the outbreak of war, or in more recent times the oil crisis, can have an independent and direct effect upon expectctaions of future income growth.

In this case, for consumers' spending plans to remain unchanged, and therefore their standard of living to remain constant, the level of income at the end of the following period must be at least equal to

$$Y^d(T+1) = Y^*_p(T)\, e^{\delta} \tag{8.5}$$

where $Y^d(T+1)$ is desired income at period T+1, and desired income growth will be given by

$$\dot{Y}^d(T+1) = \frac{Y^*_p(T)\, e^{\delta} - Y(T)}{Y(T)} \tag{8.6}$$

We have now developed several different concepts of income and several more of income growth. In order to help clarify the analysis these are summarised in Table 8.1.

In this expression for desired income growth, (8.6), the two growth rates, α and δ, play a crucial role, and it is to an examination of these that we now turn. In this Friedman's work is again of little help, he gives scant attention to α, the perceived rate of growth in the past, or its derivation. This was perhaps understandable, the principal burden of the work was to provide an alternative to the simple Keynesian consumption function. However it would seem unlikely that α is in fact constant throughout long periods of time. Friedman's own empirical work is related to the period 1897 - 1949. Thus it implicitly assumes that the expected long term rate of growth in the 1930's, when income in fact grew very little, was the same as in the 1920's when it did grow rapidly. Similar comments apply to the U.K., is it reasonable to assume that α had the same value in the inter-war years, when over a fourteen year period, 1923 - 1937, the average weekly wage rose by less than 7% in real terms, as it had in the

Table 8.1 Summary of Different "Income" Terms

Term	Definition
$Y(T)$	Actual income at the end of period T
$Y_p^*(T)$	Friedman's permanent income
$Y_L^*(T)$	Undiscounted expected lifetime income
$Y^d(T+1)$	Desired income at the end of period T+1
α	The rate at which income has been perceived to have been growing in the past
δ	The rate at which income is expected to grow in the future, which may or may not be equal to α
$\dot{Y}^d(T+1)$	The desired income growth over the next period

Note: all terms referred to here relate to real income, nett of tax.

post-war years when, until recently, personal income growth has been much more marked. Or does it not make more sense to argue that the perceived growth rate will bear some relationship to the actual growth rate in the period in question?

With these comments in mind, we are going to put forward the alternative hypothesis that α is not in fact constant, but is a variable related to present and past actual growth rates in a geometrically declining manner. We shall also assume, initially at least, that in general δ, the rate at which income is expected to grow in the future, is equal to α, the rate at which it has been perceived to have been growing in the past. Inserting this value for δ into (8.5) gives us the desired level of real income, but before this can be translated into a money wage rate allowance must be made for taxes and other deductions, and also any expected inflation.

When this is done the gross desired money wage increase is

$$\dot{Y}_g^d(T+1) = \frac{Y_p^*(T)\, e^{\delta}\, P^e(T+\tfrac{1}{2}) - Y(T)\,P(T)}{Y(T)\,P(T)} \; \frac{(1 - atr)}{(1 - mtr)} \qquad (8.7)$$

The first term on the right hand side in brackets gives the desired proportionate increase in net money wages. The price expectations term refers to the mid point of the contract period. If the expected price level at the end of the period was used to multiply the desired wage this would ensure that at the end of the period wages were at their desired level, but in the intervening period they would have been consistently above that level. The appropriate time horizon on expectations is therefore that which ensures that on average throughout the period desired wages equal actual wages. Thus, if this period is a year, this will imply the expected price level in approximately six months time.

The term in the second set of brackets reflects the possibility that any desired increase in net wages will necessitate a greater increase in gross wages because of the difference between average and marginal tax rates. As noted by Jackson, Turner and Wilkinson (1972) any increase in income will be charged at marginal tax rates, which are in general greater than average tax rates. Hence for desired disposable money income to increase by a given amount, gross income must increase by a greater amount still. For example, in October 1969 net earnings for manual workers were £18.17 per week. An increase of 10% would, in money terms, entail an increase of £1.817. The marginal tax rate, including national insurance, was 0.432, hence gross wages would need to increase by

$$\pounds 1.87 \frac{1}{(1 - 0.432)} = \pounds 3.20$$

Gross wages in October 1969 were £24.83 (giving an average tax rate of 0.268), therefore the desired increase in gross wages was 12.88%.

The effect of this difference in the two tax rates is, as in (8.7), proportional to the ratio of the two tax retention ratios. We can see that the greater the difference between average and marginal tax rates, the greater this effect will be. Thus to some extent the inflationary impact of taxation is not so much related to levels, as to the progressivity of the system. Although it should also be noted that upward changes in taxation rates exert a disequilibrium effect on wages independent of any effect on the progressivity of the system. These are points which we shall be returning to later, in the concluding chapter.

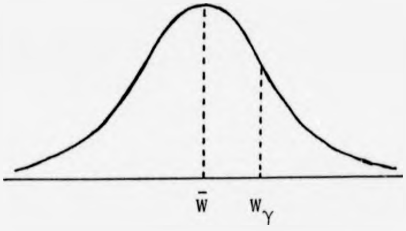
We have, in this section, examined how individual workers form their aspiration wage. However this will not in general be the same for all workers. Therefore we must now turn to examine how the trade union leader translates the varying aspiration wages of his membership into one "target wage" which he seeks to negotiate with the employer.

8.3 The Trade Union Leader's Target Wage

It has already been suggested that one of the trade union leader's principal concerns is to retain his job. To do this he will have to attempt to satisfy some minimum proportion, probably in excess of a half, of his membership, or the section of the membership with which he is concerned. Within the context of a desired money wage increase this means that his target wage needs to be in excess of this minimum proportion, which we denote by γ, of his membership.

Their aspiration wages will differ due to differences in the way individuals derive their permanent income, due to different adjustment coefficients. There will also be differences in expected inflation rates. Hence trade union leaders will be faced with a membership which has a distribution of desired wages which is illustrated in figure 8.2.

Figure 8.2 Distribution of Union Members' Aspiration Wages



This has a mean value of $\bar{W}$, W_γ is the wage which satisfies the aspirations of the proportion γ of his workforce. The greater is γ, the greater is the proportion of the membership he attempts to satisfy, the greater will be the union leader's target wage. In addition, providing γ is greater than 50%, the target wage will also increase with the variance of the distribution in figure 8.2. However at the same time opposition to this target wage will increase from those with aspiration wages in excess of the target wage.

The variance itself will be a function of the component elements which make up the desired money wage, i.e. the desired real wage and expectations of inflation. In chapter 6 we tested and accepted the hypothesis that cross section uncertainty, with respect to expectations of inflation, would be greater when the inflation rate itself was changing rapidly. A similar result might be supposed to apply to the aspiration wage, i.e. when the recent pattern of real wages has been volatile, then permanent income will vary widely from individual to individual. This again being due to the parameters which underlie the formation of permanent income varying across individuals.

Differences in individual uncertainty have no effect on the individual's aspiration wage as we have built the theory around income maximising individuals. If, however, we were to replace this with utility maximising individuals, where the utility function, defined on the real wage, is strictly concave, that is it exhibits diminishing marginal utility with respect to the real wage. Then the standard Von Neumann-Morgenstern (1947) expected utility framework can be employed, with the result that the existence of individual uncertainty about the real wage reduces the utility of the real wage. Therefore in order to maintain his level of utility the individual must increase his desired money wage. Individual uncertainty in this context will again be related to the rate of inflation, uncertainty over this will lead to uncertainty about the real wage over the contract period. We also saw in chapter 6 that individual uncertainty too would increase when the inflation rate was changing rapidly.

If we now place this discussion within the context of the early 1970's in the U.K., and recall that at this time the inflation rate was accelerating to unprecedented levels. Then we can reasonably class this period as a time of high individual and cross section uncertainty. We would then expect to see individual workers aspiring to real wage increases which will overcompensate for any expected price increase. We would also expect to witness trade union leaders attempting to negotiate settlements which will increasingly excede the average aspiration wage of their membership. Yet at the same time, we would expect to observe increased opposition to such settlements by some of the membership whose aspiration wage lies to the right of W_Y. This might lead trade union leaders into attempting to reduce this opposition by securing settlements which will satisfy a greater proportion of their membership. It might also provide a platform upon which aspirants to the leadership, official and unofficial, can build their case, or breakaway movements can be formed.

Such events could easily be interpreted as increasing trade union militancy both by members of trade unions and their leaders, and that this is a direct cause of inflation. Wheras in actual fact this increased "militancy" is a symptom, not a cause of inflation.

8.4 The Employer's Competitive Wage

We have now examined the determinants of the wage the trade union leader attempts to negotiate with the employer. We must now turn to examine the bargaining problem from the employer's side. It was argued earlier that it was not in the employer's interest to attempt to negotiate as small a wage as possible. Instead he will have in mind the effects of this wage on the ease with which he will be able to attract and retain labour in the contract period, i.e. the period during which the negotiated wage is operative. More specifically he will have in mind a wage, which we will call the "competitive wage", which is optimal in relation to these considerations, and this is the wage he will attempt to negotiate with the unions.

As its name implies the competitive wage will be related to the wages he would wish to pay in a competitive labour market, in the absence of a union's presence, the determination of which we have already examined in previous chapters. However, we may expect the analysis which emerges from including trade unions to differ from that made previously for several reasons. Firstly we would expect a tendancy to move towards regular collective bargaining, and out of this arising a concept of a wage rate applicable in some way to all workers, and set for some, probably fixed, time into the future. This differs from the previous analysis in several important respects. Firstly there was previously no limit on the frequency with which wages could be changed. Thus faced with changing labour market conditions the employer could take immediate action, in the form of changing his hiring and quit wages, to retain or increase his labour force. To some extent this flexibility has gone, although it may still be possible for him to pay wage rates above the negotiated rate to certain workers. However it is unlikely that he will be allowed to do the reverse, namely pay lower rates to less productive workers. Hence we get the result that in a downswing, in a firm with a trade union presence, an employee faced with dismissal no longer has the opportunity of offering his services at a lower wage rate.

In the case where no deviation from the negotiated wage is possible, the employer, in deciding his competitive wage, will take into account that the negotiated wage will determine the ease with which he can attract and retain labour in the coming period. We assume, as always, that he will determine the competitive wage by setting it at such a level that the marginal benefit of changing it equals the marginal cost.

The marginal cost is, of course, the increase in the wage rate being contemplated, multiplied by the number of workers it applies to. The marginal benefits relate to the decrease in net revenue foregone as a result of the increased ease of hiring and retaining labour. The reduction in quits the employer could expect will have several effects. Firstly less revenue will be lost whilst searching for replacement workers. In addition however, workers who quit are likely to have higher productivity levels than the average worker, hence there will also be a reduction in the permanent losses due to the retention of these efficient workers. The reduction in search time, whilst looking for replacement workers or to fill new jobs caused by an expansion in the desired labour force, will also cause a reduction in net revenue foregone as a result of unfilled vacancies.

Thus in this case the competitive wage will be a function of the same labour market variables which determined the rate of inflation in the absence of unions.

In the case where the employer is allowed to pay wages above the negotiated rates to certain individual workers there will be no gains to an employer from an increase in the negotiated wage rate. Because if a worker threatens to quit,his wage can be increased immediately and independently of the wages of the rest of the labour force. Similarly if the employer is having difficulties in hiring new workers, then he can offer them more than the negotiated rate. In this case it would appear that the impact of the unions is much less than in the previous case, at least as regards the employer's competitive wage.

However we shall assume that the labour market is divided up into either perfectly competitive sectors, or where there are trade unions they impose a uniform wage rate for all workers. In this case the competitive wage, i.e. the wage the employer wishes to negotiate with the union, will be a function of the same labour market demand variables which determined the rate of inflation in the absence of unions.

8.5 An Analysis of the Wage Bargaining Process

We now have all the elements of the problem and can illustrate how they interact in the actual wage bargaining process. We have suggested that the employer will have in mind an optimal wage he wishes to pay based on the difficulties of attracting and retaining labour, this is the competitive wage. If this is in excess of the trade union leaders target wage then there is no problem, this is the wage that will be "negotiated". If, however, this is not the case then the employer does have a problem. He can incur a strike and hope to reduce the union leader's target wage. However there are costs involved in such action, and if the present discounted value of such costs outweigh the benefits then he will not incur the strike, but agree to pay the union leader's target wage.

The principal expected benefits or gains of incurring a strike relate to the reduction in the negotiated wage which the employer can expect to agree with the union. Ashenfelter and Johnson argue that the outbreak of a strike has the effect of lowering the workers aspirations, as shown in figure 8.1, due to the shock effect of the firm's resistance and the resultant loss of normal income.

Within the context of the model we have developed a reduction in the union leaders target wage might take place for several reasons. Firstly there might be a reduction in the workers' concept of their permanent income. We have suggested that this is formed with reference to past changes in real income, by the permanent income mechanism, but that there may be impact effects from such events as the recent middle east oil crises. In a similar manner strikes might also have such impact effects upon the permanent income calculations. Leading to both a reduction in the workers aspiration wage prior to the strike, and further reductions during the strike, resulting in a decline in the union leader's target wage as shown in figure 8.1. Alternatively it may be that although the permanent income calculations will be unaffected by the strike, workers will be persuaded to settle, in the short term, for a wage below their "permanent income" wage in the expectation that this will be made good in a future negotiation.

Finally it may be that the workers aspiration wage is unaffected, either in the short or long term, by the strike. But that it brings pressure upon the union leaders themselves to reduce γ in figure 8.1, which represents the proportion of their membership whose aspirations regarding wages they attempt to satisfy. Such pressures might be, for example, a reduction in strike funds or increasing pressure from those workers whose wage aspirations are met by the employer's offer, to accept that offer. All of these pressures might be expected to increase with time, but there may be some minimum proportion of the membership below which the trade union leader will be very unwilling to let support for himself fall. Although it should be noted that this may be accompanied by increasing opposition from those whose wages already exceed W_{γ}. Thus we see that a strike is likely to increase tension within the union, possibly leading to splinter groups forming.

This potential gain to the employer will be more important the greater is the share of wages in total costs. Thus in a highly capital intensive industry, where labour costs are a relatively small component of total costs, the gains from incurring a strike will tend to be less than in a labour intensive industry.

When however, the strikers are only a small proportion of the total workforce, but the wage award they get will influence the wage aspirations of the rest of the workforce, then the gains to the employer will be increased. Another case when the costs to the employer may be disproportionate to the strikers numbers, is where they have the potential to halt all production, as for example a small number of skilled men might have. A similar case occurs when the employer has several different firms and plants, and the wage award in any one will set the pattern for the remainder.

The expected losses to the employer of incurring a strike will be the expected difference in profits due to the strike. These will be reduced for several reasons. First there will be the loss in profits due to the fall in sales due to the cessation of supplies. These will, of course, be greater the greater are profits in general, but there are other factors to consider. If stocks are low these losses will be more severe than if stocks are high. We might expect stocks to be highest at sometime in the downswing of the cycle, when employers have produced more goods than they can sell. In such cases the reduction in profits from lost sales may be negligable. Indeed it may even be that this presents the employer with a conveniant way to cut back production and reduce those stocks. Hence both the general profit level and the level of stocks will be important in determining short run costs to the employer of lost sales.

In addition to these short run costs there may be losses even once the strike has ended. These may occur if buyers, either consumers or other firms, are able to find alternative suppliers of the product. The easier this can occur, i.e. the greater is the elasticity of substitution of one supplier for another, then the greater the risk of sales being lost and profits being affected even once the strike has ended. Similarly if the employer has a monopoly of this particular product, but close substitutes are available, then again there might be a more permanent reduction in sales. The Post Office, for example, enjoys a monopoly for which there are no close substitutes, and hence is not likely to suffer a significant lasting reduction in demand as a result of the strike. The car industry, on the other hand, presents almost the exact opposite example. If supplies of one car are not available then competitors models will be bought, and for those who do this, it might set a pattern for furure car purchases.

On a slightly different plane there will be the potential reduction in workers' productivity following a strike. This might serve to introduce a bad industrial relations atmosphere into the firm which may continue after the strike has ended and cause a lasting reduction in profits. In addition there is a possibility that strikers will find alternative full-time employment, in which case when the strike ends the employer will have a reduced labour force and may have to hire more workers than he had previously contemplated.

A further factor is that although the union leader's target wage is in excess of the wage the employer wishes to pay, there are none the less advantages to him in paying this, although these advantages will be outweighed by the losses. These consist of the greater ease with which he can attract and retain labour to his firm. Incurring a strike to reduce the negotiated wage will reduce this benefit.

The time horizon for these costs varies from the length of the strike, for lost output, to an indefinite period for some of the other costs. Of equal interest is the relevant time horizon for the benefits. Ashenfelter and Johnson use an indefinitely long one, implying that the gains last indefinitely. More realistically we recognise that this particular negotiated wage will only last over the contract period, after which a new negotiated wage will be agreed. It therefore seems possible that the expected benefits will last only over the contract period. On the other hand, an employer might feel that a strike will not only reduce the trade union leaders target wage in this period, but in future negotiations as well. This will occur if the parameters of the permanent income calculation are affected by the strike, one possibility is that δ, the expected growth rate of real income in the future, might be reduced. In addition the actual reduction in the real wage secured by a strike in this period, will act on future permanent income calculations to reduce workers aspirations. Thus the employer can quite legitimately expect that the benefits will be spread over more than one contract period, but these benefits will not be the same for all periods, as in the Ashenfelter and Johnson case.

Hence it can be seen that we have a rather unique example of a switching regimes model. The negotiated wage will equal the competitive wage when this exceeds the union leaders target wage. When this is the case in the majority of wage negotiations, inflation will be determined by an excess demand based search theory similar to the one developed earlier. When this is not the case however, when in the majority of wage negotiations the union leaders target wage exceeds the employer's competitive wage, then we are in a more genuine bargaining situation. In this case, provided there is no strike the negotiated wage will equal the union leaders target wage. This will be a function of the proportion of his members he attempts to satisfy, and the distribution of their individual aspiration wages. These in turn will be determined by reference to previous income levels and the expected rate of inflation. If there is a strike the union leaders target wage will tend to exceed the negotiated wage, which will lie somewhere between this and the employer's competitive wage. In this case the negotiated wage will depend upon both the union leaders target wage and the duration of the strike. This, in turn, will depend on profits, stocks, the difference between the union leaders target wage and the employer's competitive wage, and possibly other labour market variables such as unemployment and vacancies.

Thus, when the competitive wage exceeds the union leader's target wage inflation will be determined by an excess demand mechanism. When this is not the case however, when in the majority of negotiations the competitive wage does not exceed the union leaders target wage, then inflation will be determined by the difference between present wages and the union's target wage, and the probability of a strike reducing this difference. In

Table 8.2 Summary of Different Wage Concepts used

Term	Definition
Negotiated wage	The actual wage negotiated between the employer and the union leader. This will equal, either the competitive wage or the bargained wage, whichever is the greater
Competitive wage	The wage the employer wishes to pay, and is based on the ease with which he can retain and attract labour
Bargained Wage	The wage negotiated in a genuine bargaining situation when the union leaders target wage exceeds the competitive wage
Union leader's target wage	The wage the union leader attempts to negotiate with the employer. It is based on the aspiration wages of his membership and the proportion of that membership he attempts to satisfy
Individual's aspiration wage	The minimum wage the worker will accept, and is such that it will enable him to maintain his planned consumption pattern

this case we shall call the wage which gets negotiated the bargained wage. A definition of this and all the different wage concepts used in this chapter can be found in Table 8.2.

Thus we now have a plausible explanation for the apparent breakdown of excess demand based theories of inflation since 1970, when prior to that they had almost been universally accepted. If one accepts the switching regimes model presented here, then it can be argued that prior to 1970, the competitive wage exceeded the union leaders target wage in the great majority of wage negotiations. However it seems possible that after this date this was no longer always the case and that at certain times wage inflation was being determined by a more genuine bargaining process. We are now left with the further problem, which we will turn to in the next section, of testing this hypothesis.

8.6 Empirical Formulation

We have suggested that there are two different inflationary mechanisms at work at different times. In effect, particularly after 1970, it would appear that we have a switching regimes model and some way has to be found of dividing the period into two, into those quarters when wage inflation was generated by a competitive mechanism and those when it was determined by a more genuine bargaining mechanism. Beginning with Quandt (1958) considerable effort has been directed at estimating similar models (Goldfeld and Quandt (1973), Fair and Jaffee (1972), Fair and Kelejian (1974), Maddala and Nelson (1974) and Laffontand Garcia (1977)). There have been two general approaches, the first is based upon maximizing some liklihood function. The second attempts to find some extraneous criteria upon which to divide the sample.

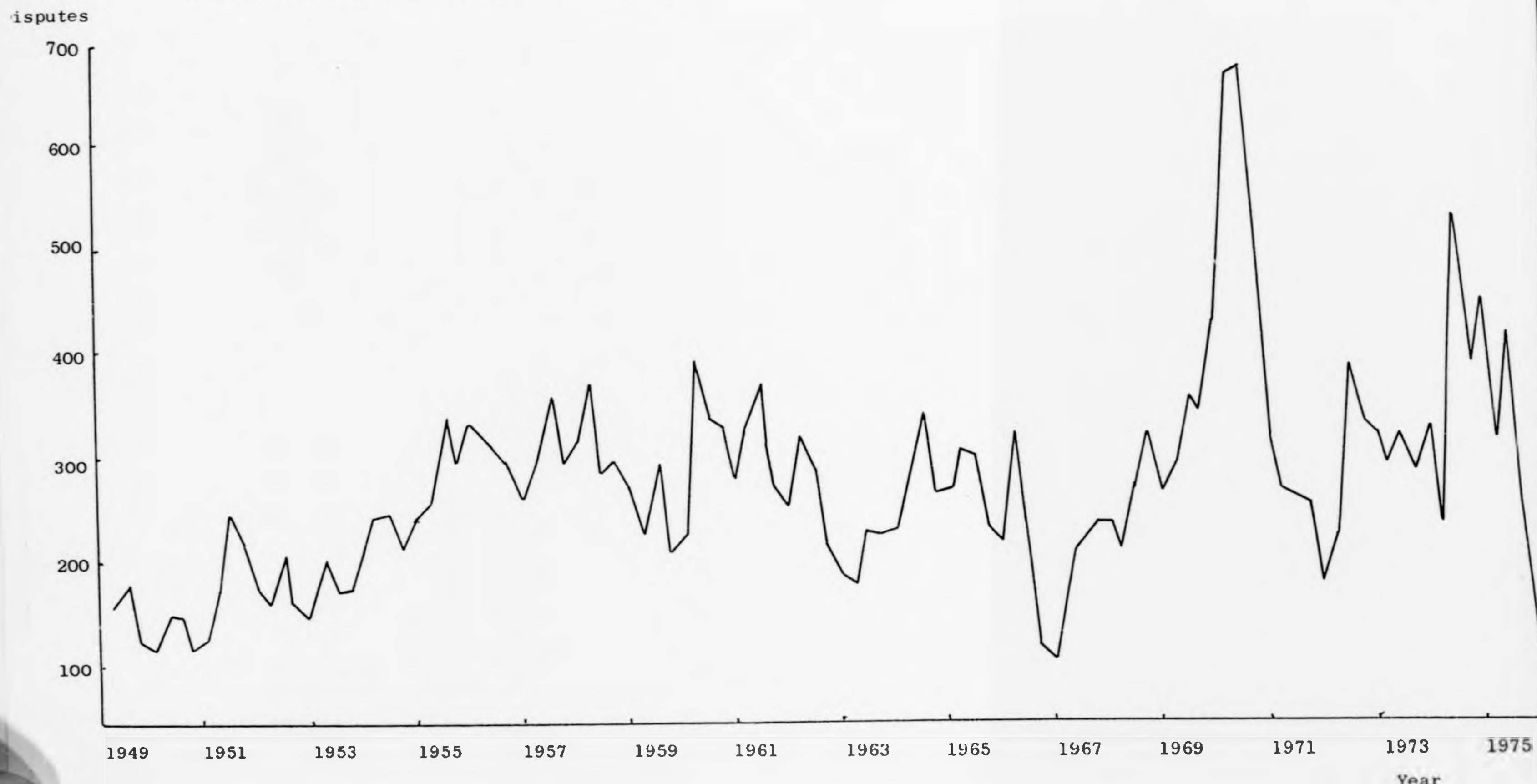
We shall adopt the latter approach, and in doing this we shall ask whether there are likely to be any other ways in which periods when the competitive wage is less than the union leader's target wage can be distinguished from periods when this is not so. The answer is that we should probably witness an increase in strikes over wages.

In what we might call normal periods, i.e. when for the majority of wage negotiations the competitive wage exceeds the union leader's target wage, there will for several reasons still be some wage strikes. Firstly some industries will be in decline, and employers in those industries will have a lower competitive wage than the average employer. Similarly some industries may have been experiencing periods of very high prosperity which would lead workers to have higher than average expectations of income growth. When this prosperity declines to a more normal level the employer will be unwilling to meet these expectations. Also not all employers are rational, and some unions may be undergoing some internal leadership struggle which will increase W_Y in figure 8.2. We might also expect the number of wage strikes to vary with the business cycle due to either, similar variations in the competitive wage or union strategy.

However when the competitive wage is less than the union leader's target wage in the average industry, not just ones which have been declining for example, then wage bargaining will take on a much more genuine character. This will not always result in a strike for, as we argued earlier, in deciding whether or not to accede to the unions demands, the employer will balance the likely costs and benefits of a strike.But we would expect that, ceteris paribus, the greater the gap between the wage the unions are demanding and the wage the employer wants to pay, the less likely the average employer will be to accede to the unions demands and the greater the probability of a strike. Hence we can see that when strikes are above some critical value we can assume that period to be one where on average the union's target wage is greater than the competitive wage. In addition the more strikes there are above this critical value, then the greater is the probable gap between the two sides.

Figure 8.3 shows the number of disputes over wages commencing in the relevant quarter, as published in the Department of Employment Gazette. These were published monthly, but do not represent all such strikes commencing in a given period as some were reported after publication. However these amended figures were not published. Fortunately this does not seem too serious for our purposes as it is unlikely to impart any bias to the analysis. The figures themselves represent the combination of two sets of strike categories, those relating to demands over wage advances, and those relating to other wage questions. Over the period there has been a shift in the relative importance of these two components, with strikes over wage advances becoming relatively more important. However this may represent the increasing frequency with which wage rates are revised collectively (see Elliot (1976)). The argument being that if wages are revised relatively infrequently, pressure for wage increases from workers will have to find outlets other than the obvious one of upward revision of the wage rate.

Figure 8.3 Disputes over Wages: 1949 - 75

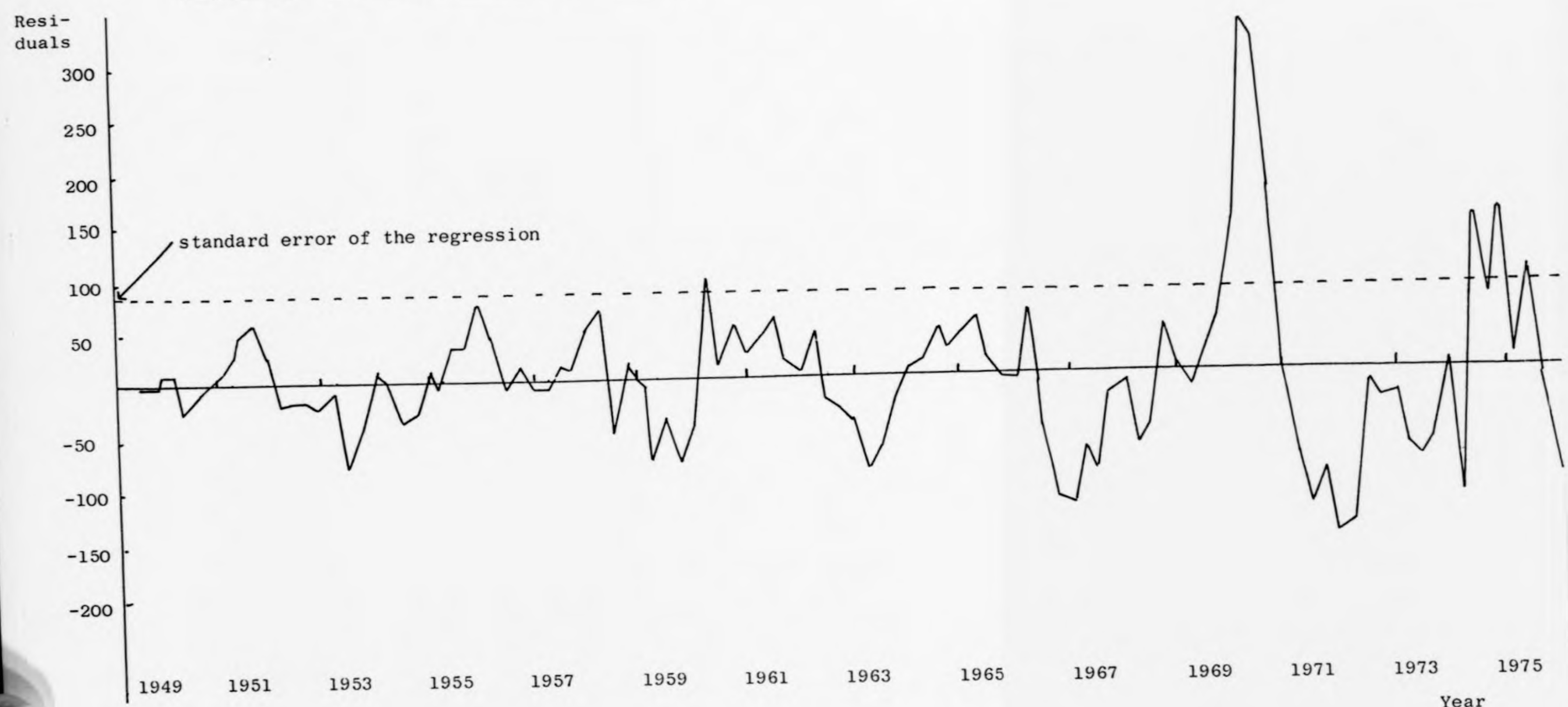


However it remains a fact that strikes over these two categories combined showed no marked and sustained trend, either upwards or downwards, over the period as a whole. Instead, what seems to have happenned is some increase in the number of strikes in the early post-war years, reaching some form of plateau in 1955/6, from which the only deviations appear temporary. These deviations appear to be of two kinds, steep troughs, as in 1963, and very sharp peaks, as in 1969/70. It seems possible, as we suggested in the previous chapter, that we might identify the troughs with incomes policies. For such policies, although they do nothing to meet the workers' aspiration wages, reduce the immediate relevance of conflict between employers and trade union leaders. As for the relatively low level of strike activity in the early 1950's, this might be linked with the relative prosperity of that period, when relatively few industries were declining.

In order to identify those periods with excessive strike activity, and hence those periods which could be identified with genuine bargaining conflicts, a polynomial trend was fitted to strikes over the period as a whole. Observations which then fell significantly above the trend value were used to define the periods we are trying to identify. The alternative to this procedure would appear to be some lengthy analysis of strike activity which would be lengthy and out of place here.

We chose a fifth order polynomial which in general provided a relatively good fit to the data (It should be noted that higher order polynomials would possibly have been significant, but these would pull the trend towards those extreme values which we are trying to identify). The polynomial when fitted resulted in the following equation, (8.8). The residuals are shown in figure 8.4, and as can be seen in general they fall within one standard deviation of their actual values. There are however several periods when this was not so. For the purpose of this study we are only concerned

Figure 8.4 The Residuals from Equation (8.8)



$$S_t = 151.2 - 4.35\,t + 0.91\,t^2 - 0.03\,t^3 + 0.00035\,t^4$$
$$\quad (2.95) \quad (0.48) \quad (1.79) \quad (2.48) \quad (2.89)$$
$$- 0.0000014\,t^5 + \text{Seasonal Dummy Variables}$$
$$(3.15)$$
$$R^2 = 0.41$$
$$DW = 0.74 \qquad (8.8)$$

with those periods which showed significant positive deviations from their trend value, i.e. when strikes were significantly greater than we would expect them to be. There were two such periods, 1969(4) - 1970(3) when all four observations were more than one standard deviation in excess of their predicted values, and 1974(2) - 1975(2), when three of the five observations were more than one standard deviation above their predicted values.

To test whether these two periods really were significantly different from the rest of the sample, we repeated the regression with two dummy variables,SD1 and SD2, operative for the respective two periods. The results were

$$S_t = 159.8 - 6.15\,t + 1.00\,t^2 - 0.030\,t^3 + 0.00036\,t^4$$
$$\quad (4.78) \quad (1.04) \quad (3.00) \quad (3.96) \quad (4.47)$$
$$- 0.0000014\,t^5 + 283\ 39\,SD1 + 161.60\,SD2 + \text{Seasonal Dummy Variables}$$
$$(4.75) \qquad (10.23) \qquad (5.27)$$
$$R^2 = 0.75$$
$$DW = 1.57 \qquad (8.9)$$

As can be seen the dummy variables are both significant at the 5% level, and therefore we can accept the hypothesis that these two periods, as a whole, sufferred unusually large strike activity over wages.

In the work which follows we are going to identify these nine quarters as periods when inflation was determined, not by the competitive wage, but by a more genuine bargaining process. In particular, we constructed a dummy variable, operative for these nine periods, and which acted multiplicatively on the whole equation, i.e.

$$\dot{W}_t = f(X_t)\,(1 + \xi \text{STDUM}) + \text{serial correlation terms} + \text{seasonal dummy variables}$$

where STDUM = Number of wage strikes in period t, for t = 1969(4) - 1970(3) and 1974(2) - 1975(2)

= 0 for all other periods.

and X_t = the basic explanatory variables, as for example specified in equation (7.21).

We set STDUM equal to the number of strikes when operative, rather than simply equal to one, because the more strikes there are above the critical value, the greater will be the distance between the competitive wage and the union leader's target wage. Thus the equation may be interpreted as implying that in normal periods, when the dummy variable is not operative, wage inflation will be determined by the basic excess demand mechanism. But in abnormal periods, when the dummy variable is operative, inflation will be greater than the rate which would result from this mechanism, and the proportional difference will be proportional to the amount of strike activity. This is why (1 + ξSTDUM) acts in a multiplicative, rather than an additive, manner, i.e. to maintain the proportional relationship between the two. Finally we chose $\dot{W}_t$, as the explanatory variable, in preference to $\hat{W}_t$ for reasons described on page 192, the high noise to signal ratio having been resolved by correct specification of the error term.

In the regression ξ was given an initial starting value of zero, the other coefficients had the same starting values as before. The regression itself was based upon the period 1951(1) - 1975(4), the results were

$$\begin{aligned} \dot{W}_t = (&\underset{(3.76)}{-3.47} + \underset{(3.17)}{19.61\Pi_t} + \underset{(0.66)}{0.21\,V_t} + \underset{(2.32)}{0.061\,t\Pi_t} + \underset{(0.57)}{0.36\,B_t} \\ &+ \underset{(15.13)}{0.29\,\dot{W}^e_t})\,(1 + \underset{(5.32)}{0.00102\,\text{STDUM}}) \end{aligned}$$

$$\begin{aligned} &R^2 = 0.76 \qquad && \rho_1 = -0.38\ (3.55) \\ &DW = 2.00 && \rho_2 = -0.52\ (5.08) \\ & && \rho_3 = -0.14\ (1.27) \qquad (8.10) \end{aligned}$$

This represents a considerable improvement over equation (7.24), which regressed the basic equation over the whole period. The strike dummy also very significant and clearly its inclusion greatly improves the equation. Of the three serial correlation coeficients, the third order one is still insignificant at the 10% level, though only marginally so. It is possible that this might be due to an increasing tendancy to revise wage contracts at more frequent intervals, though for this to be a completely satisfactory explanation it would require that wages were being revised at least once a year.

As further tests of the validity of the strike dummy variable, we did two further regressions, one with a dummy variable, D69, taking a value of one after the third quarter of 1969 and zero before that. In other words testing the hypothesis that there was a simple multiplicative shift in the excess demand equation after 1969. The second regression replaced STDUM with S_t, which is simply the number of strikes in period t. The results of these two regressions were

$$\dot{W}_t = \underset{(1.47)}{(-1.99} + \underset{(1.07)}{8\ 66\,\Pi_t} + \underset{(1.62)}{0.69\,V_t} + \underset{(0.59)}{0.024\,t\Pi_t} + \underset{(0.71)}{0.68\,B_t}$$

$$+ \underset{(4.26)}{0.29\,\dot{W}^e_t})(1 + \underset{(0.90)}{0.18\,D69})$$

$$\begin{array}{ll} & \rho_1 = -0.21\ (2.00) \\ R^2 = 0.67 & \rho_2 = -0.40\ (3.64) \\ DW = 2.00 & \rho_3 = -0.07\ (0.55) \end{array} \qquad (8.11)$$

and

$$\dot{W}_t = \underset{(2.30)}{(-1.49} + \underset{(2.09)}{8.41\,\Pi_t} + \underset{(0.50)}{0.11\,V_t} + \underset{(0.58)}{0.011\,t\Pi_t} + \underset{(0.67)}{0.30\,B_t}$$

$$+ 0.19\,\dot{W}^e_t) (1 + 0.0028\,S_t)$$

$$\begin{array}{ll} & \rho_1 = -0.32\ (3.00) \\ R^2 = 0.72 & \rho_2 = -0.50\ (4.63) \\ DW = 1.99 & \rho_3 = -0.06\ (0.52) \end{array} \qquad (8.12)$$

Claerly neither of these results are as good as the previous ones, the R^2's are not as high, neither in general, are the t statistics as significant. Therefore these results, together with those of equation (8.10), imply[1] that the use of a selective strikes dummy variable gives better results than the untransformed strikes variable, and again support the hypothesis that the periods we have identified as abnormal are in fact fundamentally different from the other periods.

A further implication of this hypothesis is that the basic search theoretic model should also work in those periods which we have not identified as abnormal, just as it did prior to 1969. Indeed it has already been noted in the previous chapter that the predictions from this model were not unreasonable outside the periods which we have since identified as being abnormal. We therefore re-estimated equation (7.21) over a sample base extended to include those periods after 1969(2) which we have not defined as being abnormal. The results were

$$\begin{aligned} \dot{W}_t = {} & \underset{(3.74)}{-3.37} + \underset{(3.54)}{20.59\,\Pi_t} + \underset{(0.21)}{0.06\,V_t} + \underset{(1.63)}{0.039\,t\Pi_t} + \underset{(1.68)}{1.10\,B_t} \\ & + \underset{(11.09)}{0.29\,\dot{W}^e_t} \end{aligned}$$

$$\begin{array}{llr} & \rho_1 = -0.42\ (3.70) & \\ R^2 = 0.58 & \rho_2 = -0.60\ (5.59) & \\ DW = 1.94 & \rho_3 = -0.18\ (1.55) & (8.13) \end{array}$$

These results are quite good, although they cannot be directly compared with (7.24) due to their being defined on different periods. However some of the coefficients, e.g. that on expectations, are more theoretically acceptable than before and what is equally important very similar to those obtained from the earlier sample period upon which (7.21) was defined.

Consequently we can conclude that their is substantial indirect evidence which supports the hypothesis, i.e. the switching regimes model, we have been advocating.

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1. Although it should be noted that as we have not conducted a more rigorous statistical test, e.g. a nested F test, this cannot be regarded as firm proof.

8.7 The Link Between the Worker's Aspiration Wage and Permanent Income

The chief difficulty in testing the existence of a link between permanent income and the aspiration wage is the lack of data. According to our strikes criteria there are only nine periods which we can classify as being abnormal, and hence being periods when the negotiated wage can be linked with the union leaders target wage. Yet this itself is linked with individual's aspiration wages in a variable manner. And these in turn are formed by the rather complex interaction of real disposable income lagged over a number of periods, expectations of inflation, the degree of certainty with which these expectations are held, the difference between average and marginal tax rates, and the expected and perceived growth rates in real disposable income. Hence it does not seem a feasible task to formulate and test all of these interconnected relationships in full. But we can at least make a beginning and test for the existence of a relationship between the aspirations wage and a lagged distribution of real wages, using a permanent income type formula, where in the aggregate the real aspiration wage is given by

$$\frac{W_1}{P}{}_t^a = \sum_{i=1}^{n} \lambda(1-\lambda)^{(i-1)} \frac{W_{t-4i}}{P_{t-4(i-1)-2}} \alpha^{(i-1)} \delta \qquad (8.14)$$

λ is the same type of adjustment parameter as appears in Friedman's permanent income formula, the first two terms result from the expansion of the adaptive expectations machanism implicit in that formula. The term inside the brackets represents the wage rate lagged four periods and is there to represent the workers previous wage in a number of previous years. This term is divided by a price term, relating to the mid point of each of those years. α is a growth term, there to update previous observations onto a comparable basis with present observations. δ is also a growth term, representing the rate at which income is expected to grow at in the future.

To convert the real aspiration wage into money terms we must multiply (8.14) by the present price level plus some fraction χ of the expected price increase over the following twelve months. We might expect χ to take a value of about 0.005, which would on average maintain the real wage at its desired level over the coming tweleve months (However we should bear in mind that both individual and cross section uncertainty about expectations, can cause union leaders to overcompensate for price expectations.). Hence the aspiration wage, in money terms can be expressed in the following functional form

$$W_t^a = \sum_{i=1}^{n} \lambda(1-\lambda)^{(i-1)} \frac{W_{t-4i}}{P_{t-4(i-1)-2}} \alpha^{(i-1)} \delta \; (P_t + P_t(\chi \dot{P}_t^e)) \qquad (8.15)$$

In Friedman's original work n was set equal to 16, however this would use up too much data and comparisons of the aspiration wage with the competitive wage could only begin in the mid 1960's. Consequently we restricted n to equal 11, which means that we will be underestimating the effects of lagged income. This underestimation will be relatively small, for example with $\lambda = 0.25$, $\sum_{i=1}^{n} \lambda(1-\lambda)^{(i-1)} = 0.958$ (It should equal 1.0). To the extent that this underestimation exists, it will bias χ upwards, as the only other coefficient to be estimated. Finally to further simplify matters δ, the rate at which income is expected to grow at in the future was set equal to the rate at which it had been perceived growing at in the past. This in turn was set equal to the actual growth rate over the previous ten year period, corrected to represent an annual growth rate, i.e.

$$\alpha_t = \sqrt[10]{\left[\frac{W_{t-4}}{P_{t-2}} - \frac{W_{t-44}}{P_{t-42}}\right] \Big/ \frac{W_{t-44}}{P_{t-42}} + 1.0} \qquad (8.16)$$

Bearing in mind all the qualifications we proceeded to estimate (8.15), using nonlinear least squares, on the nine abnormal periods already defined.

(The price expectations term was derived using a similar formula to that used when calculating wage inflation expectations, see note in data appendix at the end of the thesis). The initial starting values for the coefficients were, $\lambda = 0.4$, and $\chi = 0.01$. The results were

$$\lambda = 0.25\ (6.33) \qquad R^2 = 0.997$$
$$\chi = 0.016\ (6.27) \qquad DW = 2.43 \qquad (8.17)$$

Again, the results are reasonably good, the coefficient λ is somewhat less than Friedman's estimate, but of a reasonable value. The estimate for χ is very high, but we have seen that it will be sensitive to many extraneous influences besides that of price expectations. The value for R^2 is very high, but this is to be expected in a split sample with wide variations between the two sample periods. In addition, however, both t statistics are significant at the 5% level. Thus we can see that a permanent income type formation is capable of explaining the trend in wages during this abnormal period.

We are now in a position to make another, rather stringent test of the switching regimes hypothesis. For if this is correct, the aspiration wage should be less than the competitive wage in all periods, except those which have been defined as being abnormal. To test this we calculated the aspiration wage, using the parameters estimated in equation (8.17), for the period 1960(2) to 1975(4). We then also calculated the competitive wage over the same period. This was done by multiplying W_{t-1} by the predicted rate of inflation, derived from equation (7.21), to obtain the predicted increase in the wage rate. We then added this to W_{t-1} to obtain the competitive wage, W_t^c, i.e.

$$W_t^c = W_{t-1} + W_{t-1}\dot{W}_{t-1}^p \qquad (8.18)$$

where $\dot{W}_t^p$ represents the predicted rate of inflation. The results of these calculations are shown in Table 8.3.

Table 8.3 A Comparison of the Competitive and Aspiration Wages; 1960(2) - 1975(4)

Date	Competitive Wage	Aspiration Wage
1960(2)	195.7	175.1
(3)	198.1	176.0
(4)	200.6	177.0
1961(1)	203.7	181.9
(2)	208.1	194.6
(3)	211.3	197.3
(4)	211.9	202.4
1962(1)	213.7	208.2
(2)	216.2	213.5
(3)	219.0	217.5
(4)	221.8	215.9
1963(1)	223.5	217.8
(2)	223.9	225.3*
(3)	227.2	223.5
(4)	228.5	221.6
1964(1)	234.5	225.5
(2)	236.7	233.3
(3)	240.6	238.6
(4)	242.7	240.6
1965(1)	246.2	244.7
(2)	250.5	251.2*
(3)	255.2	255.3*
(4)	260.0	259.2
1966(1)	263.8	259.3
(2)	271.4	263.8
(3)	273.2	269.8
(4)	274.4	271.2
1967(1)	274.1	270.0
(2)	276.5	272.3
(3)	279.5	277.8
(4)	287.0	278.8
1968(1)	292.2	282.5
(2)	300.3	290.4
(3)	301.6	299.3
(4)	305.6	303.1
1969(1)	313.9	310.7
(2)	316.2	318.1*
(3)	318.7	324.4*
(4)	323.1	326.4*
1970(1)	333.0	334.5*
(2)	343.2	342.9
(3)	351.6	351 9*
(4)	361.8	361 7
1971(1)	381.8	372.5
(2)	389.4	387.7
(3)	401.3	401.7*
(4)	408.7	406.8
1972(1)	429.3	405 7
(2)	435.5	416.2
(3)	452.3	427.4
(4)	486.5	446.3
1973(1)	494.2	454.5
(2)	499 8	474.1
(3)	529.3	502 1
(4)	550.2	531.2
1974(1)	558.7	558.9*
(2)	579.4	602.0*
(3)	629.6	663.2*
(4)	674.5	689.0*
1975(1)	730.5	728.6
(2)	780.0	820.9*
(3)	841.3	925.2*
(4)	854.4	930.8*

An * denotes a quarter when the aspiration wage exceeded the competitive wage.

They provide remarkable support for our hypothesis, and also for the existence of a link between the aspiration wage and permanent income. For, apart from the nine quarters which we have designated as abnormal, the competitive wage is almost always in excess of the aspiration wage. Whilst in the nine periods we have designated as abnormal, the aspiration wage is greater than the competitive wage no less than seven times.

8.8 Conclusion

In many respects this is the most important chapter in the thesis. In it we have developed a switching regimes model which is consistent with both the breakdown of excess demand based theories after 1969, and their apparent success prior to that date. This theory has taken the form of a synthesis between wage bargaining and excess demand based theories, which we see as being complementary, rather than competitive.

Thus the theory suggests that the negotiated wage will be equal to the competitive wage, formed by an excess demand type mechanism, when this is greater than the union leader's target wage. However when this is not the case, wage inflation will be the outcome of a bargaining process. We have suggested that prior to 1969, the competitive wage was in general in excess of the union leader's target wage. Hence the success of excess demand based theories in explaining wage inflation prior to that date. But after this it would appear that there were at least two periods, both lasting approximately a year, when this was not the case, hence the apparent breakdown of excess demand theories after that date.

In attempting to provide some empirical support for the theory we have pointed to several peices of evidence. Firstly we noted that there were only two periods of strike activity which could be identified as excessive, 1969(4) - 1970(3) and 1974(2) - 1975(2). Both of these occurred after 1969, and both seemed incompatible with the general trend in strikes prior to that. Which is exactly what we would expect if the above hypotheses were valid. Secondly when a regression with a strikes dummy variable, operative in these nine periods, and acting multiplicatively on the wage equation was estimated the results were superior to any alternative specification which was tried. Thirdly when the search theoretic model was estimated for the whole period until 1975(4), omitting only those periods which were designated abnormal, the results were reasonably satisfactory. Finally when a model of the worker's aspiration wage was used to formulate a series representing the union leader's target wage, this target wage was almost always less than the competitive wage, except in the nine periods mentioned above. We regard these four seperate pieces of evidence as providing, collectively, an impressive case in support of the theory.

In addition to the basic synthesis, several other points of interest have emerged from this chapter. We shall be turning to these, as well as to the policy implications of the theory and comparisons with other theories, in the following chapter. Which will conclude the thesis.

Chapter 9

Conclusion

9.1 A Restatement of the Central Theme

The central task with which this thesis has been concerned has been to reconcile the apparentsuccess of excess demand theories in explaining inflation prior to the 1970's with their apparent failure since then. In the event this reconciliation took the form of a synthesis between such theories and wage bargaining ones. It is this thesis which represents what we feel to be the most important contribution of the thesis.

Hitherto these two approaches to wage inflation have been regarded as being mutually exclusive. The acceptance of one precluding the acceptance of the other. However it seems to us that both contain essential elements of the truth which the other ignores. Therefore, by combining these two theories we get a more complete analysis of the inflationary process.

Excess demand theories of inflation emphasise the employer's role, whereby he reacts to demand conditions in the labour market by varying the wages he pays. However to a large extent they ignore, or at best give only a cursory analysis to, the role of trade unions. Thus, for example, both Friedman (1968) and Phelps (1968) make the assumption that the principle motivation of unions is to maintain some differential over non-union workers. Therefore all wages, union and non-union, are linked to demand conditions in the competitive sector of the economy. Thus they ignore, what is an important part of many wage bargaining theories, that trade unions are in part motivated by concern over their members living standards.

In comparison wage bargaining theories emphasise the trade unions role but largely ignore the employers'. Almost all, explicitly or implicitly, make the assumption that his principal motivation in the wage bargaining process is to attempt to negotiate as lowa wage as possible. Thus ignoring the point, emphasised by excess demand theories, that employers will bear in mind the effect of the negotiated wage on the ease with which he can attract and retain labour during the contract period.

Combining these two theories together we arrive at the position that the employer will enter the wage negotiations with a wage that he wishes to pay, which we call the "competitive wage". Similarly the trade union leader enters with a minimum wage he wishes to see negotiated, his "target wage". If the competitive wage exceeds the union leader's target wage, then this will be the wage which is negotiated. If, however, this is not the case then we are in a more genuine bargaining situation. If there is a strike then the negotiated wage will probably be less than the union leaders target wage, and it will fall with the duration of the strike. If there is no strike then the employer will have to pay the union leader's target wage.

9.2 Subsidiary Themes and Conclusions

In developing this synthesis, several subsidiary conclusions emerged which we also feel to be of some interest. We began by developing an excess demand based theory of inflation along the lines of Phelps, Holt, Mortenson and others. The theory developed however differed from others in several respects. In method it stressed the interactive roles of job searcher and employer in the hiring process to a degree which has not been done before. In conclusions reached, it emphasised the role of profits within an excess demand framework, and the possibility of a non-unit variable coefficient on expectations.

Hitherto profits have largely been ignored within an excess demand framework, although they have received some emphasis in bargaining models. This lack of interest may in part be due to the influence of an early paper by Lipsey and Steur (1961) who found only a weak association between wage changes and a profits variable. However it should be noted that they used the level of profits, corrected for price changes, but not for real secular growth in the economy. This is important, for we do not feel that an increase in profits due, e.g., to an increase in output resulting from an expansion of the labour force, is likely to have any effect on wage inflation.

The possibility of a non-unit coefficient on expectations arises because a unit coefficient will, using Phelps' terminology, only serve to maintain an absolute differential,in money terms, over the wages an employer expects other employers to be paying. To maintain a relative differential, the coefficient on expectations must vary with labour market conditions. Somewhat surpisingly, to us at least, this was one of the few implications which did not receive some support from the empirical work. However we do find the theoretical arguments persuasive, and would suggest that it continues to be perservered with in empirical work, until we have more evidence on which to judge it.

Another variable which was to prove insignificant, when testing the wage equation, was unemployment. This may well be because of multicollinearity problems, however the possibility also exists that it is not a significant factor in the inflationary process. In the theory its importance stems from the assumption that only full time search is possible. More realistically we might recognise that workers can also engage in search whilst still in employment. If this was done it might well be that the role of unemployment in the inflationary process disappears. However it should also be borne in mind that unemployment was significant when testing the implications of the search theory for labour market flows.

Expectations of inflation play an important role in this, as in most other theories of inflation, and it is to these that we turned in chapters 4 - 6. Chapter 4 contained a review of some of the theoretical and empirical literature on expectations. It seemed to us that, in general, these two strands of the literature had been developed seperately, which seemed unsatisfactory for the one should support the other. It was for this reason that we attempted to develop links between them. As for the optimal method of expectation formation, we argued that this would be likely to vary with the inflation rate itself. In particular, in times when the inflation rate was changing rapidly, individuals were likely to employ a more complex method of expectation formation than when the inflation rate was relatively stable. Important in this context is the concept of a cost function, hitherto the only costs which have been considered are those of being in error, which the individual would attempt to minimize. In addition to this however we suggested that the individual would also take into consideration the costs of the method itself.

This was one of the principal theoretical reasons for rejecting, within the context of inflation, a pure rational expectations hypothesis of expectation formation, in favour of some rational-adaptive hypothesis. In combination with the empirical work of chapter 5, the conclusion that emerged was that expectations were probably formed in a mixed rational-adaptive manner, the exact structure of which would vary with the economic conditions. Thus when inflation was changing rapidly, in possible periods of perceived structural change, a more complex "adaptive" mechanism would be employed than when inflation was relatively stable. The rational element takes the form of cognisance of events, such as the introduction of an incomes policy, which provide information about the economic system.

Another interesting possibility which was to emerge from this chapter was that individuals might not fully perceive the rate of inflation. The most suggestive evidence in favour of such a hypothesis came from figure 5.1, where expectations almost continually underestimate the rate of inflation. However no more substantial proof was to emerge and the possibility remains a matter of conjecture. But if it could be established it would, for example, have important implications, independent of the rest of the thesis, for the natural rate of unemployment hypothesis as expounded by others. The principal difficulty in testing this possibility lies in the absence of any data on perceptions, and we urge that the Central Statistical Office, or some other official body, should conduct a regular sample survey, to obtain reliable data on peoples expectations and perceptions, on this and other matters. However in the absence of more tangible evidence we were forced to assume, almost throughout the thesis, that inflation was fully perceived.

There was, however, one exception to this, that the specification of a mechansim to generate expectations would result, even in the long run, in expectations being equal to only 0.75 of the actual inflation rate. In the empirical work this seemed to be acceptable, with coefficients on expectations being in general insignificantly different from one, except in equation (8.13), which extended the sample base to include those periods after 1969(2) which were designated as "normal", i.e. when the competitive wage exceeded the union leaders' target wage. In this regression the coefficient on expectations was significantly greater than one, and this might indicate that inflation is more fully perceived at higher levels as, for example, after 1969(2), than at lower levels.

It was noted in the introduction that one might reasonably identify the common theme of the present economic era as being the more complete integration of expectations into economic theory. But we believe, in common with Laidler and Parkin (1975), that before such integration can proceed much further, considerations of uncertainty must be introduced into the analysis. In this thesis we have made a start, in chapter 6 we analyse the degree of certainty with which expectations are held. We identified two types of uncertainty, cross section uncertainty, or the extent to which individuals hold differing expectations, and individual uncertainty, which reflects the confidence with which individuals hold those expectations. We also suggested suitable proxies for both these concepts, and the empirical work tended to confirm the theoretical conclusion that both types of uncertainty would increase during times when the inflation rate was changing rapidly. We also noted that both kinds of uncertainty were sensitive to external events which provide information about the economic system, such as the introduction of incomes policies.

Turning from the determinants of uncertainty to their actual incorporation into the theory, we can see that this work was not developed so fully. The search theory was based on the assumptions of income maximizing individuals and profit maximizing employers. To introduce concepts of uncertainty, it would be necessary to rephrase the theory in terms of utility maximizing individuals and, e.g., risk averse employers, which in principle at least does not seem too difficult a task. However elements of uncertainty were incorporated into the theory surrounding the determination of the union leader's target wage, and in this case an increase in either individual or cross section uncertainty would tend to increase the target wage. Thus in situations where this exceeds the competitive wage, this will tend to increase any inflationary pressures.

In chapter 7 we attempted to determine whether the search theory developed in chapter 2 was capable of explaining inflation. In the event it proved acceptable until 1969(2), but appeared to break down after that date. In doing this empirical work particular attention was paid to the specification of the error term. Thus it would appear that equations with either the annual or quarterly rates of inflation have a more complex error structure than has hitherto been supposed. This was particularly important with respect to quarterly rates of inflation where the correct specification of the error term significantly increased the signal to noise ratio.

As we have already noted the results of this chapter were, prior to 1969, consistent with the search theoretic model of inflation developed in chapter 2. But, as was emphasised earlier, this cannot be taken as unambiguous proof for the validity of that theory. For nearly all of the variables which the search theory indicated as being significant, were also consistent with other, e.g. wage bargaining, theories of inflation. Because of this it was highly desirable that we should carry out an alternative test of the theory in an area where these other theories had no relevance.

The area we chose was labour market flows, i.e. quits hires and fires, and such a testhad already been carried out in chapter 3, with again largely favourable results to the search theory. This then gives us more confidence in interpreting the empirical results in chapter 7 in the way we have. However this chapter had further implications, particularly with respect to the U-V curve. We devised a method of estimating the U-V curve, and established its existence, in the sense of there being a semi-equilibrium relationship between unemployment and vacancies. We also established that the position of this curve in the unemployment vacancy plane would depend upon the values of certain other variables, such as profits and unemployment benefits, in much the same way as inflation does. Other interesting concepts to emerge included the possibility of a backlog of quits as the economy moves out of a recession.

In chapter 8 we developed the switching regimes model of inflation, by combining together the excess demand and wage bargaining theories. Again the empirical work provided considerable support for this model. This empirical work involved dividing the sample into two, into those periods when the competitive wage exceeded the union's target wage, and into those periods when the reverse was the case. The criteria on which this division took place was based on identifying periods of excessive wage strike activity. This empirical work then provided some confirmation for our assumption that prior to 1969 the competitive wage was nearly always in excess of the union's target wage, but that after that date there were two periods, each about a year, when this was not so. This is then the reason we believe that excess demand theories worked well until 1969, but appeared to break down after that date.

In this chapter we also spent a considerable amount of time in analysing the trade union's role in the inflationary process. Building on a theoretical base originally developed by Ashenfelter and Johnson (1969), we analysed the interactions between the union leader and his membership. We suggested that the principal aim of the union leader was to retain his job, and that he could best do this by satisfying some minimum proportion of his membership. They in turn base their "aspiration wage" on a desire to maintain their standard of living, or planned consumption pattern. We then linked this to Friedman's permanent income hypothesis, with the result that the individuals aspiration wage is that which will leave his permanent income unchanged.

In pursuing this we found that it appears that Friedman mis-specified permanent income for two reasons. Firstly the growth element used in updating previous periods income to compare with the present was constant, when it seems more likely to be a lagged function of actual changes in income. Secondly this growth factor was purely retrospective, it did not extend into the future. Thus the permanent income hypothesis, which in part stems from the hypothesis that individuals in deciding on their consumption take into account expected future income, does not in its formulation take any explicit account of the future.

We believe that these criticisms, if accepted, have extremely important and obvious implications for the consumption function. In particular they may help explain why this also appeared to change in the 1970's (see, for example, Davidson et al (1978)).

9.3 Comparisons With Other Theories

In this section we shall not primarily be concerned with comparisons with other wage bargaining or excess demand theories, for in most cases these comparisons are obvious. To summarise, wage bargaining theories have omitted to take due consideration of both the employers' position and the inter-relationship between the trade union leader and his membership. Whilst excess demand theories have omitted to take full account of the union's role.

Instead we shall be more concerned with "reinterpreting" some of these other theories in what we hope is a more plausible manner. We shall begin this with those studies which have attempted to explain recent inflation in terms of trade union militancy. The most obvious example of such a study is of course Hines'(1964) work, where he argued that increasing trade union militancy would be manifested in areas other than the actual wage bargain. In particular he argued that a necessary prerequisite for the success of a "militant wage demand" would be a recruiting drive to acquire more members. Hence the degree of militancy can be proxied by the increase in the percentage of the labour force which is unionised. We also examined in chapter 1 the arguments which have been registered against this hypothesis, as well as making clear our own objections to this interpretation of "militancy".

However it would appear that in the light of the theory developed here, Hines' militancy proxy was in a sense valid, though not for the reasons he argued. Thus when the aspirations wage exceeds the competitive wage we would expect excess demand based theories to break down. Yet, at the same time we would also expect unorganised workers to join or form unions, to be better able to achieve a wage which will maintain their standard of living, which their employer is reluctant to pay. But Hines mistook the direction of causality, unions do not go seeking members at such times, workers go seeking unions.

Similar explanations explain the apparent success of other militancy variables, e.g. strikes in Taylor's (1970) paper. Again it is precisely when the aspirations wage exceeds the competitive wage that we would expect both excess demand theories to break down and strikes to increase. Hence the significance of strikes in the wage equation, particularly an excess demand based one.

In comparison with Hines, several theories have argued that unions are concerned with maintaining some constant rate of growth in their memberships net real incomes. Thus in spirit these theories are related to ours, although there are important differences. We shall examine these with reference to one of the most recent of these theories, that of Henry, Sawyer and Smith (1976). They argue that unions desire to maintain a constant increase in their members net real income and that deviations from this target growth rate, for example due to incomes policies, will lead to pressure building up to secure the desired wage level. Thus, e.g., on the removal of an incomes policy we can expect very large wage demands.

Some justification for this hypothesis can be found in the thesis, which links, via the permanent income hypothesis, the desired increase in real wages to past increases. However there are important differences between the two theories. Most obviously they suggest that this is largely a complete explanation of inflation in the post-war years, whereas in the theory developed here it is only part of an explanation within a switching regimes model. Also their desired increase in real net earnings is a constant wheras in our theory it varies in accordance with recent experience.

We also mentioned in the introduction that several non-economic theories were gaining some degree of acceptance even amongst economists. A typical example of this is the argument that unions in particular and society in general have become more aggressive in recent years, and that this is manifested by increasingly militent wage claims. Thus Williamson and Wood (1976) note that there has been in the 1970's an increased willingness on the part of trade unions to inflict harm on others in pursuit of their own advantage.

However we believe that this is not a cause of inflation, but a symptom. We have argued that during periods when the union leader's target wage exceeds the competitive wage we can expect to witness, as well as wage claims and settlements above the competitive wage, an increase in the number of strikes coupled with increased opposition to any settlement reached by those union members whose aspiration wages lie below the negotited wage. Such events can easilly be interpreted in the way Williamson and Wood,and others have done. But the evidence in this case is misleading and we do not believe that any analysis on inflation based on what we see as a misinterpretation of the evidence can yield any usefull conclusions. This is why we rejected from the beginning these alternative non-economic approaches.

Finally we return to the point at which the thesis began, the paper by Phillips (1958). He argued that it is only when the cost of living rises more rapidly than money wages, that price increases become operative. Where money wages are rising more rapidly than the cost of living then "...employers will merely be giving under the name of cost of living adjustments part of the wage increases which they would in any case have given as a result of their competitive bidding for labour." As we saw in the introduction to the thesis this argument has been largely dismissed, but we believe that this quite clearly is hinting at the switching regimes model contained here. For it contains most of the essential elements, that workers are interested in a wage which will maintain their standard of living, that employers have in mind a wage they wish to pay in the light of demand conditions in the labour market. And that if this wage is not sufficient to maintain the workers standard of living then a different mechanism comes into operation.

It is of course very easy to put too much emphasis on a few lines, written several years ago, when economic ideas and conditions were very different from those which prevail today. But if we are correct in this interpretation of Phillips' work, then it can only increase ones admiration for a paper which has already been hailed a classic.

9.4 Policy Implications

An examination of the policy implications is obviously an important part of any theory. Nonetheless we feel a little reticent in doing this for several reasons. Firstly the thesis has been primarily concerned with analysing and explaining inflation, rather then with setting out a set of policies to reduce inflation. In order to properly analyse the policy implications we would need to carry out a number of simulations with various policy prescriptions, based on the theoretical model developed. In addition one needs to consider how these policies would affect other areas of the economy, and any feedback from those areas to inflation itself. Such a task is a further thesis in itself.

Secondly it has become apparent as we reviewed the literature how quickly accepted theories become discarded and policy conclusions reversed. This is important for governments do base their policies on economic theories and on the advice of economists, even if the link is sometimes tenuous. The wrong policy advice can have very harmfull effects on an economy and cause a great deal of needless suffering. Thus, although it may seem a long way from the pages of an academic journal to social disorder and distress, the economist cannot differentiate himself from the implications which might follow from some government basing their policies on his theories.

Finally the theory itself is a first attempt to formulate this synthesis between excess demand and bargaining theories, and no doubt it is capable of considerable development, modification and indeed correction. Thus for all these reasons the following discussion is tentative.

The discussion itself will be placed within the context of the U.K. economy, where it seems likely to us that the problems associated with the union leaders' target wage exceeding the competitive wage are relatively new. They did not exist prior to 1945 because people had not perceived incomes growing in the past, as we have remarked before, the rate of income growth in the inter-war years was comparatively low, and thus expectations of future income growth had no foundation. There was thus no continuous pressure for increases in the real wage, in recession as well as the upswing of the cycle, as we argue there is today. After 1945 income growth became more apparent, but the problems with inflation that this was to lead to were not immediately obvious. For over twenty years the competitive wage, the wage the employer wished to pay was sufficient to satisfy workers' aspirations. This was due to several factors, the almost continual prosperity of this period, coupled with the lag between income growing continuously over time and this being perceived and feeding through fully into expectations, and a slightly accelerating growth rate throughout much of the period.

These factors could not continue forever, the turning point would appear to be in 1966 when an almost continuous recession was enough to ensure that three years later the average worker's aspiration wage exceeded both his actual wage and the wage the employer wished to pay. This resulted in an increase in industrial unrest coupled with a rate of inflation which seemed incompatible with the underlying labour market conditions. Since then there has been a further period of expansion which, starting from already high levels of inflation and expectations of inflation, was to lead to a further expansion in the inflation rate. This was followed by a further and prolonged recession, which has again resulted in increased industrial unrest and a continuing high rate of inflation, broken only by the temporary success of the Social Contract. Therefore paradoxically it would appear that the very deflationary policies which were aimed at reducing inflation, only served to further aggravate the problem.

Thus the basic problem with which we are faced with now is that during a recession inflation is not falling, but at least remaining on a plateau from which it can increase to even higher levels during the next expansionary phase of the cycle. However there is also the possibility that inflation, during periods when the union's target wage exceeds the competitive wage, will not merely remain on a plateau, but will actually accelerate to even higher levels. In this case there is no obvious upper bound on the inflation rate. This latter possibility arises for two reasons. Firstly union leaders' will probably attempt to satisfy more than 50% of their membership. Secondly union members themselves, if uncertain about the expected rate of inflation, may seek to secure wage increases which will overcompensate for any expected price increase.

Thus one conclusion at least is clear, to minimize the risk of the problems we have described arising the government should attempt to maintain as constant a growth rate as possible. Unfortunately for the U.K. at present this policy prescription is of little relevance, the problem is not how do we prevent this problem from arising, but how do we solve it once it has arisen.

In examining this problem we shall first turn to the two policies which have been most widely advocated, that is the reduction of demand within the labour market and the use of incomes policies. Policies aimed at reducing the level of excess demand within the economy will reduce the competitive wage, i.e. the wage the employer wishes to pay, and if the competitive wage exceeds the union's target wage, this will then reduce wage inflation. However if this is not the case, if the union leader's target wage exceeds the competitive wage, then the analysis is more complex. Firstly there seems no reason to suppose that, ordinarily, this will reduce the individual worker's aspiration wage. Nor does there seem any compelling reason why it should affect the manner in which the trade union leader responds to his memberships aspirations. Hence we would not, in general, expect the union's target wage to be reduced by, e.g., increasing unemployment. There may however be some impact on the bargaining process itself. The widening gap between the wage the employer wishes to pay and the union leader's target wage may well increase the liklihood of a strike which will reduce the union's target wage in the manner discussed in the previous chapter. This is especially likely as profits are also likely to be low, and thus the costs of a strike will also be low in relative terms. But it is problematical as to how much the strike will serve to reduce the union's target wage.

Against this possibility there are others which will tend to work in the opposite direction. Most obvious is that with the reduction in demand will go a reduction in overtime working which will reduce workers' net incomes. They may attempt to compensate for this by an increase in their wage rates, thus in effect their aspiration wage will vary with the amount of overtime worked. Related to this is a factor which stems from the possibility that consumption plans will be based, not on individual income, but on household income. Increasing unemployment is liable to affect secondary workers in particular, thus, for example, if the wifes income is lost her husband may partially attempt to compensate for this by increasing his own income, via an increase in the wage rate.

There is one further possibility to consider and this is the existence of a level of unemployment so high as to have a direct effect on the workers' aspiration wages, due to fears of becoming and staying unemployed. However there is no evidence to suggest how high a level of unemployment this would need to be, if indeed it exists at all. Overall therefore we do not feel that reducing excess demand will necessarily reduce inflation. If inflation is being generated by a genuine bargaining mechanism, then its effects are problematical. This, coupled with the other harmfull effects that unemployment certainly does have, leads us to advise against the use of such policies.

This rejection also extends to monetarist policies, for it is through excess demand that changes in the money supply affect wage inflation. Thus we argue that control of the money supply in a situation where the competitive wage is less than the unions' target wage, is unlikely to bring about a significant reduction in the inflation rate. What it will do is to increase unemployment, increase bancruptcies and reduce living standards. It may even have adverse effects on inflation. Thus we reject the views that inflation is always and everywhere a monetary phenomenon, and that only the government can create inflation by printing money. For the failure to do so will not reduce inflation, but lead to increasing unemployment. The quantity equation will still hold, but with P rising faster than M and V constant, T, the number of transactions has to fall. This cannot go on for ever and there are grave dangers in the pursuit of such policies.

However if we reject such policies, then we are equally sceptical about the use of incomes policies. Again the problems arise when the union leaders target wage exceeds the competitive wage. In this case for inflation to be reduced permanently by the incomes policy, it will have to reduce workers' aspiration wages. There may indeed be some favourable effects in that any reduction in income in one period will reduce the aspiration wage in future periods. But such a process will be slow, and several years of income restraint will probably be necessary before there has been a significant enough reduction in the worker's aspiration wage. However we do not believe that any incomes policy can successfully restrain incomes for a lengthy period. If the policy is voluntary then pressure will build up against the union leaders who agreed to such a policy and we do not believe that they can successfully withstand such pressure. Even if they try to, we can expect support to increase for rivals to the leadership, both formal and informal. Faced with this threat to their positions, trade union leaders must respond to their memberships wishes, or be replaced by leaders who will.

Neither can a compulsory policy be successfull, for a modern economy is highly dependent on certain key sectors, such as power, and the workers in these industries have the ability to overcome any incomes policy. This is not to deny that certain incomes policies have met with some temporary success, but in general this has also generated opposition to the policy which has led to its termination. After which inflation once more accelerates as workers attempt to restore their standard of living. However we do not totally reject the use of incomes policies, but their role is a more minor one within a general strategy, and it is to this that we now turn.

We noted earlier that there may be a tendancy for inflation to accelerate even in the absence of demand pressures. The reason being that union leaders may tend to overcompensate for expected price inflation, due to both individual uncertainty about those expectations, and their need to satisfy the aspirations of more than half of their membership. The individual uncertainty aspect is relevant as it causes union members to be uncertain about the real wage over the contract period. This could be overcome to some extent, by offering union leaders the opportunity to link the negotiated wage to an index of prices. Unions would then have the opportunity of bargaining for a real wage increase and workers could be certain that this increase would remain constant over the contract period.

To counteract the tendancy of union leaders' to overcompensate for expected inflation, and their memberships aspiration wage, secret ballots could be introduced on whether to strike and whether to end a strike in the light of the employers latest offer. This would tend to result in a negotiated wage which would satisfy about 50% of the membership, rather than a proportion in excess of that. The principal problem with this suggestion is that unions tend to be very sensitive to outside interference in their affairs and the imposition upon them of secret ballots could worsen industrial relations. However this is the only suggestion for trade union "reform" which we make, and by itself might not prove unacceptable.

The second set of policy suggestions are related to the problem of reducing the rate of inflation, as opposed to merely stopping it from accelerating. In very simple terms the basic problem arose because workers aspired to a standard of living which was incompatible with the rate of productivity growth. To reduce inflation therefore we must either reduce those aspirations, or increase the productive capacity of the economy. We shall deal with the former possibility first.

The individual forms his real aspiration wage on the basis of past trends in income and income growth which he expects to continue into the future. We have suggested that this is done using a permanent income type mechanism. Therefore to reduce the aspiration wage this mechanism needs to be bypassed, or alternatively altered so that the rate at which income is expected to grow at in the future is no longer equal to the rate at which it has been perceived to have been growing at in the past. But this entails a reduction in the individuals standard of living and in their planned consumption patterns, and it is not easy to see how this can be achieved. The government could mount a concerted campaign in an attempt to convince people of this. However we remain sceptical about the extent to which this can be achieved.

Alternatively the government could attempt more drastic action still and impose a change on those consumption patterns. This could be done by, for example, rationing or in some other way controlling the consumption of certain widely consumed goods such as petrol, cigarettes and alcohol. This would certainly have an impact on the public conciousness, but whether it would be politically feasible and whether it would have the desired effects on workers' aspiration wages are open to doubt. In particular it is possible that individuals in attempting to maintain their standard of living might merely change their consumption plans and substitute unrationed goods for rationed ones.

There are two further alternatives both linked with taxes and both of which have to an extent already been implemented. Firstly the government could reduce taxes, either direct or indirect, the individual would then experience an increase in real disposable income and there would be a reduction in the gross money income required for the individual to maintain his standard of living. In a sense this would be a temporary effect only, but to the extent that it would lead to reduction in the rate of price inflation which would feed through to expectations of price inflation the effects would be more permanent.

This suggestion has been made elsewhere, for example Jackson, Turner and Wilkinson (1972) and Henry, Sawyer and Smith (1976). But there is one important qualification we would add to their conclusions. This policy will only have a dampening effect on the inflation rate when the unions' target wage exceeds the competitive wage. When this is not the case the negotiated wage will in any case be in excess of the workers' aspiration wage. In this case a reduction in taxes will have no effects on inflation in that period. Instead it will only serve to increase real net income still further, and this will in turn tend to increase permanent income in future periods. Thus leading to increased inflationary pressures during future periods when the union leaders' target wage exceeds the competitive wage.

Secondly, as we noted in the previous chapter, the greater the difference between the average and marginal tax retention ratios, the greater will be the inflationary pressure as increases in income are taxed at higher than average rates. To overcome this personal tax allowances could be linked to a price index, a suggestion which has fact already been implemented.

We now turn to the second part of the suggested "strategy", that of increasing the rate of productivity growth. We have argued that if this can be done then the productive potential of the economy can be brought nearer to the sum of individual aspirations which have to be met from that economy. Again we are aware that there are wider economic and political considerations to be taken into account when arguing for increased productivity growth. We are also aware that many economists now believe that the era of continual growth has passed, and that faced with dwindling resources the nations of the world must come to terms with stagnant, or even declining economies. We make no comment on these wider issues. The arguments we are putting forward are based on considerations of their effects on inflation and unemployment alone.

The argument is then, that the U.K. should attempt to increase productivity growth by a slow and steady expansion of the economy at a rate which it is hoped will be maintainable indefinitely. Thus at first this would come about through firms making increased use of resources which are at present not fully employed. However it is to be hoped that by the time these resources are fully employed, employers will be encouraged, by the steady expansion of the economy to invest in uptodate machinery, thus enabling the rate of growth to be maintained indefinitely. In addition the government should take all possible steps to encourage investment. However a too rapid expansion of the economy is likely, as in the early 1970's, to lead to the competitive wage exceeding the union leader's target wage, thus exacerbating the problem, not only in that period but in the future as well. It may also be that here too incomes policies can play a role, not in holding down the wage level below the worker's aspiration wage, but in preventing it from exceeding that wage, as employers' attempt to attract labour.

These then are the policies we suggest should be followed in attempting to reduce inflation, we are not certain that they will work, it may be that the economy cannot attain a sufficiently high rate of productivity growth. We do believe, however, that they stand a greater chance than any alternatives. Indeed we believe that many of the suggested alternatives are in part responsible for the difficult nature of the problem. Thus reducing the level of demand in the economy has, in our view, only exacerbated inflation, whilst causing unecessarily high levels of unemployment.

Table Al Data Used in Chapter 3

Date		Vacancies	Unemployment	Benefits	Earnings
1967	Feb.	91473	414519	10.25	16.25
	March	94153	406454	10.25	16.34
	April	95839	402374	10.25	16.40
	May	96871	384261	10.40	16.42
	June	98047	365285	10.55	16.52
	July	95423	365622	10.55	16.71
	Aug.	90877	376813	10.55	16.68
	Sept.	89989	394446	10.55	16.82
	Oct.	90823	408751	10.55	16.82
	Nov.	85887	433549	10.95	17.04
	Dec.	85331	446238	11.35	16.94
1968	Jan.	79868	481817	11.35	17.24
	Feb.	81683	481013	11.35	17.41
	March	87431	463560	11.35	17.45
	April	90386	456793	11.35	17.42
	May	94226	435633	11.55	17.55
	June	97652	417023	11.75	17.54
	July	98243	409488	11.75	17.64
	Aug.	94616	412203	11.75	17.76
	Sept.	95205	411126	11.75	17.82
	Oct.	93947	432286	11.75	17.88
	Nov.	97993	442630	11.75	18.05
	Dec.	100257	444040	11.75	18.18
1969	Jan.	89657	481498	11.75	18.22
	Feb.	93838	476369	11.75	18.14
	March	98225	470626	11.75	18.29
	April	102888	451569	11.75	18.50
	May	106864	421480	12.00	18.39
	June	110570	402350	12.25	18.67
	July	108228	398249	12.25	18.73
	Aug.	107739	407587	12.25	18.79
	Sept.	108238	412678	12.25	18.97
	Oct.	104481	436000	12.25	19.12
	Nov.	101212	448881	12.65	18.97
	Dec.	102123	467056	13.05	19.20
1970	Jan.	95576	508059	13.05	19.26
	Feb.	97076	503069	13.05	19.57
	March	99086	500693	13.05	19.73
	April	103895	488302	13.05	20.01
	May	105363	457278	13.40	20.20
	June	107784	435525	13.75	20.43
	July	107742	432809	13.75	20.51
	Aug.	103219	439982	13.75	20.83
	Sept.	104207	442666	13.75	20.90
	Oct.	101676	459489	13.75	21.09
	Nov.	93818	474038	13.75	21.32
	Dec.	89484	493268	13.75	21.52

Table A1 (cont.)

Date		Profits	G.D.P.
1967	Feb.	1152	8561
	March	1155	8601
	April	1151	8638
	May	1146	8675
	June	1142	8712
	July	1154	8732
	Aug.	1166	8753
	Sept.	1178	8773
	Oct.	1190	8831
	Nov.	1203	8888
	Dec.	1215	8946
1968	Jan.	1234	8990
	Feb.	1253	9033
	March	1272	9077
	April	1285	9150
	May	1298	9223
	June	1311	9296
	July	1315	9336
	Aug.	1320	9375
	Sept.	1324	9415
	Oct.	1320	9465
	Nov.	1317	9515
	Dec.	1313	9565
1969	Jan.	1308	9592
	Feb.	1304	9620
	March	1299	9647
	April	1296	9681
	May	1293	9714
	June	1290	9748
	July	1295	9805
	Aug.	1300	9861
	Sept.	1305	9918
	Oct.	1306	9980
	Nov.	1308	10041
	Dec.	1309	10103
1970	Jan.	1311	10194
	Feb.	1313	10285
	March	1315	10376
	April	1321	10460
	May	1326	10545
	June	1332	10629
	July	1346	10750
	Aug.	1361	10870
	Sept.	1375	10991
	Oct.	1390	11073
	Nov.	1404	11154
	Dec.	1419	11236

Table A1 (cont.)

Date		Vacancies	Unemployment	Benefits	Earnings
1971	Jan.	78029	552415	13.75	21.71
	Feb.	76069	556258	13.75	21.75
	March	72233	568219	13.75	21.94
	April	70018	580422	13.75	22.33
	May	71016	583497	14.30	22.62
	June	73764	565489	14.85	22.65
	July	66848	580742	14.85	22.91
	Aug.	68158	601875	14.85	23.14
	Sept.	65992	616834	14.85	23.06
	Oct.	64537	644399	15.65	23.22
	Nov.	62124	678156	16.45	23.26
	Dec.	59745	699544	16.45	23.42
1972	Jan.	54452	748302	16.45	23.64
	Feb.	61700	748323	16.45	23.97

Table A1 (cont.)

Date		Profits	G.D.P.
1971	Jan.	1441	11353
	Feb.	1463	11471
	March	1485	11588
	April	1494	11721
	May	1502	11855
	June	1511	11988
	July	1521	12141
	Aug.	1532	12294
	Sept.	1542	12448
	Oct.	1538	12569
	Nov.	1534	12690
	Dec.	1530	12811
1972	Jan.	1548	12915
	Feb.	1566	13019

Note: For details about this data, see the appendix at the end of chapter 3.

Table A2 Data Used in Chapter 5

Date		Wage Index	Expectations of Wage Inflation	M L	Retail Price Index
1961	March	128.6			112.7
	April	129.0			113.3
	May	129.7			113.6
	June	130.4			114.6
	July	130.5			114.6
	Aug.	130.7			115.7
	Sept.	131.0			115.5
	Oct.	132.3			115.7
	Nov.	132.3			116.9
	Dec.	132.4			117.1
1962	Jan.	133.2			100.0
	Feb.	133.6			100.1
	March	134.2			100.5
	April	135.3			101.9
	May	135.7			102.2
	June	135.9			102.9
	July	137.0			102.5
	Aug.	137.4			101.6
	Sept.	137.6			101.5
	Oct.	137.7			101.4
	Nov.	138.5			101.8
	Dec.	138.8			102.3
1963	Jan.	139.1			102.7
	Feb.	139.4			103.6
	March	139.7			103.7
	April	140.6			104.0
	May	140.9			103.9
	June	141.9			103.9
	July	141.4			103.3
	Aug.	141.5			103.0
	Sept.	141.7			103.3
	Oct.	141.8			103.7
	Nov.	143.1			104.0
	Dec.	145.1			104.2
1964	Jan.	145.7			104.7
	Feb.	146.0			104.8
	March	146.5			105.2
	April	147.0			106.5
	May	147.7			107.0
	June	148.6			107.4
	July	149.2			107.4
	Aug.	149.5			107.8
	Sept.	149.9			107.8
	Oct.	150.0			107.9
	Nov.	150.8			108.8
	Dec.	152.2			109.2

Table A2 (cont.)

Date		Wage Index	Expectations of Wage Inflation	M L	Retail Price Index
1965	Jan.	153.4			104.7
	Feb.	153.6			104.8
	March	154.5			109.9
	April	155.3			112.0
	May	156.0			112.4
	June	157.2			112.7
	July	159.5			112.7
	Aug.	159.9			112.9
	Sept.	160.2			113.0
	Oct.	161.1			113.1
	Nov.	162.1			113.6
	Dec.	162.6			114.1
1966	Jan.	165.1			114.3
	Feb.	165.6			114.4
	March	167.7			114.6
	April	167.7			116.0
	May	167.8			116.8
	June	168.7			117.1
	July	169.7			116.6
	Aug.	169.8			117.3
	Sept.	169.8			117.1
	Oct.	169.9			117.4
	Nov.	169.9			118.1
	Dec.	169.9			118.3
1967	Jan.	171.0			118.5
	Feb.	171.3	3.57	2	118.6
	March	171.9	3.44	1	118.6
	April	172.1	3.71	1	119.5
	May	173.1	4.03	2	119.4
	June	173.3	4.24	1	119.9
	July	176.7	4.47	1	119.2
	Aug.	177.2	4.35	3	118.9
	Sept.	178.1	4.23	2	118.8
	Oct.	179.0	3.94	4	119.7
	Nov.	179.8	4.02	3	120.4
	Dec.	180.3	3.98	4	121.2
1968	Jan.	184.3	4.08	3	121.6
	Feb.	184.9	4.18	6	122.2
	March	185.3	4.30	8	122.6
	April	185.6	4.28	10	124.8
	May	185.8	3.82	13	124.9
	June	186.0	3.91	19	125.4
	July	187.1	4.02	10	125.5
	Aug.	187.6	3.88	7	125.7
	Sept.	188.3	4.20	6	125.8
	Oct.	188.8	4.16	8	126.4
	Nov.	190.7	4.09	8	126.7
	Dec.	193.5	4.24	10	128.4

Table A2 (cont.)

Date		Wage Index	Expectations of Wage Inflation	M L	Retail Price Index
1969	Jan.	194.2	4.28	12	129.1
	Feb.	194.7	4.17	11	129.8
	March	195.0	4.27	8	130.3
	April	195.2	4.32	6	131.7
	May	195.5	4.68	8	131.5
	June	196.1	4.69	5	132.1
	July	197.0	4.87	11	132.1
	Aug.	197.5	4.82	18	131.8
	Sept.	198.9	4.82	18	132.2
	Oct.	199.1	5.22	24	133.2
	Nov.	200.8	5.43	19	133.5
	Dec.	205.0	5.73	23	134.4
1970	Jan.	206.5	..	..	135.5
	Feb.	209.4	..	..	136.2
	March	211.1	..	..	137.0
	April	211.8	..	..	139.1
	May	214.3	..	..	139.5
	June	215.8	..	..	139.9
	July	217.5	..	..	140.9
	Aug.	219.7	..	..	140.8
	Sept.	221.3	..	..	141.5
	Oct.	222.7	..	..	143.0
	Nov.	228.8	..	..	144.0
	Dec.	233.3	..	..	145.0
1971	Jan.	237.1	..	..	147.0
	Feb.	237.4	10.57	9	147.8
	March	238.1	11.03	9	149.0
	April	239.3	11.22	4	152.2
	May	242.8	11.06	1	153.2
	June	245.1	11.01	0	154.3
	July	247.1	10.07	0	155.2
	Aug.	248.6	9.69	0	155.3
	Sept.	250.0	8.97	0	155.5
	Oct.	250.7	8.82	0	156.4
	Nov.	257.8	8.84	0	157.3
	Dec.	262.6	8.50	1	158.1
1972	Jan.	265.2	8.53	1	159.0
	Feb.	265.6	8.88	2	159.8
	March	266.9	8.92	2	160.3
	April	268.6	9.51	1	161.8
	May	271.7	9.84	2	162.6
	June	275.9	9.74	0	163.7
	July	100.0	10.33	1	164.2
	Aug.	103.5	10.51	1	165.5
	Sept.	106.8	10.54	3	166.4
	Oct.	107.6	10.89	3	168.7
	Nov.	108.2	10.45	4	169.3
	Dec.	108.4	9.18	5	170.2

Table A2 (cont.)

Date		Wage Index	Expectations of Wage Inflation	M L	Retail Price Index
1973	Jan.	108.4	8.77	6	171.3
	Feb.	108.9	8.03	7	172.4
	March	109.5	7.53	11	173.4
	April	112.3	7.81	21	176.7
	May	113.3	8.21	19	178.0
	June	115.7	8.44	25	178.9
	July	116.0	8.79	27	179.7
	Aug.	119.7	9.70	29	180.2
	Sept.	120.0	10.08	36	181.8
	Oct.	120.3	10.10	46	185.4
	Nov.	121.0	10.21	49	186.8
	Dec.	122.0	10.22	45	188.2
1974	Jan.	123.7	10.14	38	191.8
	Feb.	124.7	10.27	27	101.7
	March	126.5	10.90	18	102.6
	April	128.0	11.71	19	106.1
	May	132.1	12.68	26	107.6
	June	136.9	14.51	26	108.7
	July	139.9	15.37	29	109.7
	Aug.	145.6	16.92	31	109.8
	Sept.	146.4	17.16	27	111.0
	Oct.	148.7	16.88	34	113.2
	Nov.	153.9	18.33	30	115.2
	Dec.	158.0	18.94	24	116.9
1975	Jan.	159.8	..	..	119.9
	Feb.	162.0	..	..	121.9
	March	169.0	..	..	124.3
	April	170.1	..	..	129.1
	May	176.4	..	..	134.5
	June	182.6	..	..	137.1
	July	184.8	17.29	6	138.5
	Aug.	185.6	15.65	6	139.3
	Sept.	186.0	14.30	4	140.5
	Oct.	187.5	14.17	0	142.5
	Nov.	195.6	14.29	0	144.2
	Dec.	198.2	14.61	0	146.0
1976	Jan.	202.1	14.57	0	147.9
	Feb.	206.4	14.02	2	149.8
	March	207.9	12.62	2	150.6
	April	210.1	10.62	2	153.5
	May	211.7	9.82	5	155.2
	June	216.6	8.28	3	156.0
	July	219.0	8.32	3	156.3
	Aug.	219.1	8.38	3	158.5
	Sept.	219.2	8.46	3	160.6
	Oct.	219.5	8.99	4	163.5
	Nov.	220.7	8.94	5	165.8
	Dec.	221.5	9.67	5	168.0

Table A2 (cont.)

Date		Wage Index	Expectations of Wage Inflation	M L	Retail Price Index
1977	Jan.	223.8			172.4
	Feb.	224.8			174.1
	March	225.2			175.8
	April	226.0			180.3
	May	226.8			181.7
	June	228.7			183.6
	July	229.5			..

Note: The two indices have, where appropriate, been multipled by an appropriate conversion factor when the base year is revised.

Sources: Wage Index and Retail Price Index, British Labour Statistics Yearbook (various issues) and Historical Abstract.

Expectations of Wage Inflation and M L, The Financial Times Survey of Business Opinion.

Table A3 Data Used in Chapter 6

Date		Expectations	Standard Deviation	N A
1967	June	4.7	1.79	27
	Aug.	4.8	1.44	7
	Oct.	4.0	1.19	5
	Dec.	6.8	1.53	6
1968	Feb.	4.9	1.67	0
	April	5.0	1.74	9
	June	4.4	1.14	0
	Aug.	6.3	1.62	1
	Oct.	4.0	0.75	0
	Dec.	4.6	1.32	0
1969	Feb.	4.7	1.41	2
	April	6.4	1.69	0
	June	4.6	1.73	4
	Aug.	5.8	1.75	0
	Oct.	4.4	1.59	0
		. . . .	. . . .	.
		. . . .	. . . .	.
1971	Dec.	8.3	2.05	1
1972	Feb.	7.8	1.22	16
	April	10.3	2.49	2
	June	10.5	2.47	0
	Aug.	9.1	2.32	0
	Oct.	9.5	2.43	20
	Dec.	9.3	2.39	41
1973	Feb.	7.7	4.10	6
	April	6.0	2.28	12
	June	8.0	1.95	7
	Aug.	9.2	2.35	12
	Oct.	9.7	2.49	3
	Dec.	10.1	3.35	0
1974	Feb.	11.5	2.02	17
	April	12.8	4.42	4
	June	16.8	4.86	19
	Aug.	17.7	3.70	0
	Oct.	18.8	4.04	0
	Dec.	19.5	2.50	17
		. . . .	. . . .	.
		. . . .	. . . .	.
1975	Aug.	12.06	4.90	32
	Oct.	12.50	1.48	8
	Dec.	11.03	3.10	0
1976	Feb.	12.30	2.45	1
	April	4.51	3.30	28
	June	8.05	1.75	18
	Aug.	9.90	6.19	0
	Oct.	8.15	3.85	0
	Dec.	11.55	5.95	0

Source: Financial Times Survey of Business Opinion.

Table A4 Data Used in Chapters 7 and 8

Date	Wage Index	Vacancies	Unemployment	Expectations of Wage Inflation
1949(2)	110.6	289.1	283.9	2.200
(3)	111.0	294.3	244.3	1.950
(4)	111.4	238.1	309.2	1.510
1950(1)	112.0	241.1	351.4	1.020
(2)	112.2	254.5	293.9	0.870
(3)	112.5	253.1	262.5	1.350
(4)	116.0	233.5	293.8	2.950
1951(1)	119.4	264.4	291.2	4.375
(2)	121.2	326.2	211.1	6.197
(3)	123.8	321.0	183.1	7.360
(4)	128.7	228.2	247.6	7.457
1952(1)	130.6	201.4	318.6	6.957
(2)	131.8	225.7	308.6	6.097
(3)	133.7	202.7	302.4	4.747
(4)	136.3	159.1	359.9	3.933
1953(1)	137.8	169.1	381.2	3.273
(2)	138.0	199.6	308.0	3.317
(3)	139.3	210.3	261.2	3.123
(4)	140.4	184.0	304.4	3.043
1954(1)	142.0	187.7	343.5	3.187
(2)	145.1	241.2	263.4	3.263
(3)	145.7	252.0	211.6	3.360
(4)	146.9	226.9	245.3	3.700
1955(1)	152.0	245.2	261.8	4.077
(2)	155.5	302.3	198.4	4.377
(3)	156.1	310.2	169.3	4.590
(4)	157.3	261.9	206.3	4.903
1956(1)	103.7	257.3	242.0	5.167
(2)	105.4	266.6	206.3	5.377
(3)	106.0	242.4	203.6	5.360
(4)	106.4	198.4	251.7	4.593
1957(1)	107.6	168.5	341.4	3.980
(2)	110.7	197.4	282.7	4.010
(3)	111.6	204.1	239.2	4.067
(4)	112.5	169.5	294.1	3.900
1958(1)	113.0	147.1	382.8	3.260
(2)	113.8	147.6	382.1	2.997
(3)	115.1	136.1	376.0	2.930
(4)	116.7	114.8	466.7	2.760
1959(1)	117.1	117.5	522.5	2.443
(2)	117.2	154.1	430.9	1.830
(3)	117.8	183.5	370.9	1.310
(4)	118.1	172.6	406.9	1.563
1960(1)	121.1	180.2	418.9	2.083
(2)	122.4	223.3	330.5	2.713
(3)	123.8	236.7	280.9	3.557
(4)	125.9	207.4	318.5	3.890

Table A4 (cont.)

Date	Earnings	Benefits	Profits	G.D.P.
1949(2)	5.90	1.3	458	2696
(3)	5.95	1.3	461	2736
(4)	5.99	1.3	479	2763
1950(1)	6.11	1.3	496	2791
(2)	6.22	1.3	514	2818
(3)	6.34	1.3	532	2845
(4)	6.45	1.3	554	2926
1951(1)	6.64	1.3	576	3007
(2)	6.73	1.3	599	3088
(3)	6.85	1.3	621	3168
(4)	6.96	1.3	602	3240
1952(1)	7.10	1.3	583	3313
(2)	7.44	1.3	564	3385
(3)	7.54	1.625	545	3457
(4)	7.64	1.625	553	3525
1953(1)	7.82	1.625	562	3592
(2)	8.05	1.625	570	3660
(3)	8.11	1.625	578	3727
(4)	8.17	1.625	595	3780
1954(1)	8.33	1.625	611	3833
(2)	8.47	1.625	628	3885
(3)	8.60	1.625	644	3938
(4)	8.73	1.625	664	4009
1955(1)	8.97	1.625	720	4119
(2)	9.17	2.0	706	4069
(3)	9.27	2.0	730	4311
(4)	9.38	2.0	730	4395
1956(1)	9.60	2.0	743	4482
(2)	9.83	2.0	727	4520
(3)	9.88	2.0	715	4569
(4)	9.93	2.0	743	4718
1957(1)	9.98	2.0	747	4729
(2)	10.02	2.0	770	4794
(3)	10.25	2.0	789	4885
(4)	10.40	2.0	769	4982
1958(1)	10.42	2.5	741	5057
(2)	10.37	2.5	718	4973
(3)	10.42	2.5	741	5086
(4)	10.47	2.5	783	5088
1959(1)	10.56	2.5	727	5087
(2)	10.86	2.5	819	5288
(3)	11.00	2.5	849	5331
(4)	11.14	2.5	922	5530
1960(1)	11.35	2.5	961	5563
(2)	11.55	2.5	932	5557
(3)	11.69	2.5	926	5653
(4)	11.82	2.5	911	5842

Table A4 (cont.)

Date	Nurses	Working Population	Strikes
1949(1)	..	22982	..
(2)	26431	22982	179
(3)	25784	22982	129
(4)	24490	22982	120
1950(1)	23036	22982	155
(2)	22049	22982	151
(3)	21490	23057	125
(4)	20913	23075	130
1951(1)	20600	23188	177
(2)	20448	23239	249
(3)	20225	23329	217
(4)	19678	23325	167
1952(1)	18835	23389	166
(2)	18630	23357	210
(3)	18623	23355	167
(4)	18478	23324	152
1953(1)	18264	23353	207
(2)	18041	23444	173
(3)	18129	23531	172
(4)	17944	23602	215
1954(1)	17597	23669	242
(2)	17824	23720	248
(3)	18144	23825	210
(4)	18077	23873	245
1955(1)	18123	23914	258
(2)	18519	23932	341
(3)	18746	24073	292
(4)	19145	24114	332
1956(1)	19721	24115	327
(2)	19821	24156	313
(3)	19562	24274	291
(4)	19084	24224	259
1957(1)	18875	24204	293
(2)	19183	24246	352
(3)	19464	24220	294
(4)	19299	24184	318
1958(1)	18960	24078	373
(2)	18577	24117	285
(3)	18386	24115	299
(4)	18209	24131	271
1959(1)	17883	24187	225
(2)	17750	24196	300
(3)	17562	24364	202
(4)	17362	24390	219
1960(1)	17355	24524	386
(2)	17580	24526	338
(3)	17867	24620	323
(4)	18152	24761	279

Table A4 (cont.)

Date	Retail Price Index	Expectations of Price Inflation
1949(2)	108.9	2.38
(3)	111.1	2.42
(4)	111.7	2.53
1950(1)	112.6	2.37
(2)	113.5	2.15
(3)	113.6	2.15
(4)	113.9	2.56
1951(1)	116.2	4.02
(2)	119.2	5.81
(3)	124.5	6.55
(4)	127.9	7.04
1952(1)	130.2	7.00
(2)	133.3	6.21
(3)	137.7	5.22
(4)	136.5	4.65
1953(1)	138.5	4.12
(2)	139.7	3.61
(3)	141.2	3.04
(4)	140.1	2.52
1954(1)	139.9	2.17
(2)	141.2	2.11
(3)	142.2	2.21
(4)	143.4	2.33
1955(1)	145.5	2.51
(2)	146.0	2.75
(3)	149.6	3.08
(4)	150.0	3.45
1956(1)	154.0	3.61
(2)	155.4	3.52
(3)	157.1	3.33
(4)	156.6	3.08
1957(1)	158.6	2.93
(2)	159.7	2.97
(3)	162.1	3.00
(4)	162.8	3.01
1958(1)	166.0	2.92
(2)	166.3	2.61
(3)	169.0	2.37
(4)	166.3	2.06
1959(1)	169.0	1.43
(2)	169.2	1.16
(3)	167.7	0.89
(4)	166.7	0.69
1960(1)	169.0	0.76
(2)	168.3	0.86
(3)	170.1	1.00
(4)	169.5	1.20

Table A4 (cont.)

Date	Wage Index	Vacancies	Unemployment	Expectations of Wage Inflation
1961(1)	128.6	201.0	336.8	4.073
(2)	130.4	241.2	282.1	4.200
(3)	131.0	236.3	261.8	4.127
(4)	132.4	174.8	338.9	3.947
1962(1)	134.2	150.2	407.6	3.843
(2)	135.9	171.8	386.7	3.793
(3)	137.6	156.1	390.0	3.713
(4)	138.8	119.6	491.0	3.483
1963(1)	139.7	113.3	626.7	2.893
(2)	141.1	147.2	504.2	2.210
(3)	141.7	157.1	428.0	2.343
(4)	145.1	157.5	450.3	2.613
1964(1)	146.5	182.1	445.1	2.913
(2)	148.6	230.1	355.4	3.270
(3)	149.9	242.4	310.4	3.413
(4)	152.2	228.6	336.0	3.563
1965(1)	154.5	233.2	353.3	3.790
(2)	157.2	287.8	292.6	4.130
(3)	160.2	284.5	276.6	4.433
(4)	162.6	255.0	311.1	4.780
1966(1)	167.4	260.0	322.6	4.880
(2)	168.7	295.0	271.1	4.510
(3)	169.8	272.3	277.7	3.630
(4)	169.9	192.1	422.5	2.520
1967(1)	171.9	168.5	527.0	2.067
(2)	173.3	181.5	491.4	2.470
(3)	178.1	177.9	478.8	3.293
(4)	180.3	168.2	542.2	4.140
1968(1)	185.3	166.8	586.2	4.430
(2)	186.0	194.2	531.3	4.297
(3)	188.3	197.8	499.3	4.350
(4)	193.5	193.2	536.7	4.197
1969(1)	195.0	187.6	572.7	4.123
(2)	196.1	211.6	509.5	4.117
(3)	198.9	208.6	492.1	4.203
(4)	205.0	190.4	548.6	4.627
1970(1)	211.1	181.5	603.5	5.473
(2)	215.8	197.5	552.3	6.670
(3)	221.3	194.0	532.2	7.853
(4)	233.3	170.3	583.2	8.390
1971(1)	238.1	137.4	681.7	8.740
(2)	245.1	136.9	699.1	8.943
(3)	250.0	128.3	734.5	9.010
(4)	262.6	113.4	832.5	9.083

Table A4 (cont.)

Date	Earnings	Benefits	Profits	G.D.P.
1961(1)	11.92	2.5	934	5970
(2)	12.02	2.875	920	5929
(3)	12.09	2.875	911	6230
(4)	12.18	2.875	874	6069
1962(1)	12.27	2.875	855	6158
(2)	12.36	2.875	886	6329
(3)	12.45	2.875	921	6345
(4)	12.54	2.875	933	6420
1963(1)	12.65	2.875	833	6373
(2)	12.86	3.375	1038	6721
(3)	13.02	3.375	1075	6778
(4)	13.15	3.375	1157	6991
1964(1)	13.44	3.375	1110	7008
(2)	13.72	3.375	1149	7625
(3)	13.90	3.375	1142	7359
(4)	14.03	3.375	1143	7550
1965(1)	14.33	4.0	1200	7609
(2)	14.36	4.0	1182	7691
(3)	14.51	4.0	1178	7908
(4)	14.82	4.0	1181	8004
1966(1)	14.97	4.0	1154	8108
(2)	15.27	4.0	1131	8223
(3)	15.30	4.0	1158	8348
(4)	15.25	7.75	1149	8404
1967(1)	15.22	7.75	1111	8621
(2)	15.45	8.05	1181	8708
(3)	15.76	8.05	1093	8823
(4)	15.87	8.55	1240	8725
1968(1)	16.28	8.55	1280	9171
(2)	16.47	8.95	1273	9175
(3)	16.69	8.95	1349	9500
(4)	16.93	8.95	1352	9544
1969(1)	17.27	8.95	1357	9616
(2)	17.54	9.45	1432	9719
(3)	17.77	9.45	1447	9909
(4)	18.17	9.95	1432	10094
1970(1)	18.31	9.95	1429	10311
(2)	18.90	10.65	1436	10751
(3)	19.40	10.65	1462	10492
(4)	19.98	10.65	1603	11364
1971(1)	20.60	10.65	1604	11544
(2)	21.29	11.75	1690	12023
(3)	21.87	11.75	1691	12658
(4)	22.18	12.75	1710	12926

Table A4 (cont.)

Date	Nurses	Working Population	Strikes
1961(1)	18708	24835	328
(2)	19368	24773	371
(3)	19499	24916	277
(4)	19262	24849	252
1962(1)	19200	25002	318
(2)	..	25046	285
(3)	..	25153	217
(4)	..	25097	189
1963(1)		25060	175
(2)		25138	230
(3)		25207	226
(4)		25275	230
1964(1)		25189	273
(2)		25268	338
(3)		25440	260
(4)		25471	264
1965(1)		25410	308
(2)		25463	303
(3)		25553	235
(4)		25636	217
1966(1)		25532	326
(2)		25584	237
(3)		25698	125
(4)		25554	106
1967(1)		25343	199
(2)		25402	211
(3)		25538	238
(4)		25400	237
1968(1)		25238	209
(2)		25253	273
(3)		25349	326
(4)		25314	265
1969(1)		24220	287
(2)		25236	357
(3)		25312	347
(4)		25243	428
1970(1)		25181	656
(2)		25082	675
(3)		25141	487
(4)		25091	312
1971(1)		24828	267
(2)		24874	262
(3)		24896	253
(4)		24935	175

Table A4 (cont.)

Date	Retail Price Index	Expectations of Price Inflation
1961(1)	172.1	1.49
(2)	172.9	1.87
(3)	175.8	2.20
(4)	177.2	2.60
1962(1)	179.6	2.92
(2)	181.1	2.82
(3)	185.5	2.65
(4)	182.9	2.52
1963(1)	184.4	1.99
(2)	186.9	1.81
(3)	187.3	1.72
(4)	186.2	1.63
1964(1)	187.8	1.82
(2)	189.6	2.14
(3)	193.6	2.43
(4)	194.3	2.69
1965(1)	196.8	2.92
(2)	198.1	3.07
(3)	203.1	3.13
(4)	203.7	3.12
1966(1)	205.7	3.06
(2)	206.6	3.00
(3)	211.1	2.96
(4)	211.1	2.72
1967(1)	213.2	2.25
(2)	213.8	1.92
(3)	216.1	1.90
(4)	214.3	2.67
1968(1)	218.5	2.39
(2)	221.0	2.80
(3)	226.0	3.15
(4)	226.7	3.49
1969(1)	231.4	3.59
(2)	234.9	3.65
(3)	238.1	3.67
(4)	238.3	3.74
1970(1)	242.2	3.94
(2)	246.9	4.26
(3)	252.2	4.74
(4)	255.0	5.35
1971(1)	261.4	5.99
(2)	268.6	6.29
(3)	278.1	6.24
(4)	280.3	5.62

Table A4 (cont.)

Date	Wage Index	Vacancies	Unemployment	Expectations of Wage Inflation
1972(1)	266.9	111.1	917.0	9.177
(2)	275.9	141.8	824.8	9.977
(3)	106.8	154.8	769.8	10.257
(4)	108.4	173.2	752.3	10.313
1973(1)	109.5	216.3	716.3	10.683
(2)	115.7	299.0	590.9	10.443
(3)	120.0	341.6	523.9	10.173
(4)	122.0	358.7	491.8	10.087
1974(1)	126.5	272.9	592.4	10.583
(2)	136.9	319.3	538.0	12.160
(3)	146.4	313.4	561.7	14.857
(4)	158.0	285.0	605.1	17.703
1975(1)	169.0	179.3	747.1	19.470
(2)	182.6	165.5	799.1	19.550
(3)	186.0	139.8	937.3	19.050
(4)	198.2	114.6	1077.8	18.827

Table A4 (cont.)

Date	Earnings	Benefits	Profits	G.D.P.
1972(1)	22.60	12.75	1632	13180
(2)	24.47	13.00	1830	13509
(3)	25.05	13.00	1954	13815
(4)	26.31	13.75	2053	14454
1973(1)	26.81	13.75	2203	15795
(2)	27.70	13.75	2226	15451
(3)	28.86	13.75	2426	15900
(4)	29.67	14.35	2378	16346
1974(1)	29.06	15.10	2457	16530
(2)	29.90	15.18	2460	17541
(3)	32.24	16.35	2551	19511
(4)	33.63	16.35	2494	20070
1975(1)	35.68	17.15	2401	21697
(2)	36.70	18.35	2335	22733
(3)	38.91	18.35	2314	23656
(4)	39.98	18.35	2627	24992

Table A4 (cont.)

Date	Nurses	Working Population	Strikes
1972(1)		25075	224
(2)		25003	389
(3)		25209	326
(4)		25272	320
1973(1)		25416	298
(2)		25359	320
(3)		25421	286
(4)		25386	328
1974(1)		25332	237
(2)		25409	523
(3)		25662	386
(4)		25662	443
1975(1)		25494	314
(2)		25633	417
(3)		25917	245
(4)		25893	113

Table A4 (cont.)

Date	Retail Price Index	Expectations of Price Inflation
1972(1)	285.0	4.66
(2)	288.9	4.70
(3)	295.1	4.94
(4)	299.9	5.22
1973(1)	306.8	5.58
(2)	312.5	5.92
(3)	322.5	6.48
(4)	327.7	7.60
1974(1)	339.2	9.20
(2)	354.7	10.10
(3)	375.8	11.09
(4)	383.7	12.19
1975(1)	404.1	14.06
(2)	429.7	15.55
(3)	474.0	16.13
(4)	485.7	15.43

Note: The two indices have, where appropriate,been multiplied by a conversion factor when the base year is revised.

For further details on this data see the appendix at the end of chapter 7.

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