The Causes of Employment Changes in British Industries and their Health Consequences, 1960-1990.

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Abstract

Since the second world war, there have been enormous changes in Britain's production and employment patterns. Two possible explanations for this phenomenon are technical progress and demand shifts. We set out an industry model with imperfect competition to assess their roles.

In many ways, the effects of technical progress and demand shifts are intertwined. Technical changes which lead to new products or higher quality of output will obviously increase demand and employment. On the other hand, technical progress in the form of productivity gains have an ambiguous effect in employment terms. This is one of the questions we address.

In our model, we demonstrate that the impact of productivity gains on employment depend chiefly on the demand elasticity and the extent to which higher productive efficiency is passed on in lower prices. This implies that an understanding of "insider" power in wage setting is essential for evaluating these effects. In the long run, however, competition ensures that these "insider" effects are washed out and the long term effect of technical change depends chiefly on the demand elasticity. Under plausible assumptions and empirical estimates, we find these effects to be positive.

On the role of demand shifts, we note that these influences depend on the demand elasticity and the slope of the industry supply curve. Empirical estimates are obtained for these factors. Ultimately, the overall effects depend on the size of the demand shifts themselves which we suspect to be substantial. We distinguish between secular changes in demand and its cyclical counterpart. Cyclical demand could have been adversely affected by persistently large deviations from purchasing power parity and the differential pace of product improvement and development relative to competing

countries. Secular demand could have fallen due to a lower world income elasticity of demand for British industrial products.

Given the huge rise of unemployment in the last two decades, we assess its impact on the health of workers. After controlling for age, sex, duration of unemployment, regional characteristics, macro-economic and secular factors, we find that unemployment shocks have significant impacts on mortality rates. The pattern of such impacts is rather complex and may explain why contrasting results have been obtained by different investigators.

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Enclosure : published copy of chapter 4. Inside Back cover.

Declaration

Some of this thesis contains work done in conjunction with Professor Stephen Nickell.

In particular, chapter 4 is joint published work with Prof. S. Nickell. Chapters 2 and 3 are based on work which was done jointly with Prof. S. Nickell. My contribution to the published piece and the work on which chapters 2 and 3 are based is 50 percent.

S. J. Nickell

Supervisor's signature.

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All remaining errors are my own.

CHAPTER 1. INTRODUCTION.

In the period since the second world war, there have been enormous changes in Britain's production and employment patterns. Back in 1960, manufacturing used to employ 37% of the labour force accounting for 37% of British Gross Domestic Product. In 1991, this has fallen to 22% representing 23% of GDP.[1] This drop was particularly severe in the past decade. With the fall in industrial employment, there was also an alarming rise in unemployment, to a level which is sometimes comparable to that in the great depression. In this thesis, we attempt to shed some light on the causes of the employment changes in British industry and to study the health consequences of the rise in unemployment.

There are, of course, natural reasons why the share of industry output and employment might fall over time. For a start, the world is now much richer. Higher savings have led to a vast pool of financial resources that needs managing. Thus the financial sector has grown in importance and has absorbed manpower and resources from manufacturing. Better off individuals go on more holidays and entertain themselves with artistic and leisure activities creating a large leisure industry. The development and expansion of the service sector has led to it gradually overtaking the industry sector partly mirroring the way that manufacturing overtook the agricultural sector in the industrial revolution.

Internationally, some less developed countries have become richer in their capital stock, thus giving them a comparative advantage that hitherto did not exist. Moreover, as these LDC's mature, some have become so efficient in manufacturing that they

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[1]Various issues of Department of Employment Gazette and National Accounts. Due to changes in definition, these comparisons are not exact.

have replaced part of the manufacturing capacity of the developed world. And, as the world economy develops, the income elasticities of demand for manufacturing goods fall since more people will be able to spend their extra income on holidays and such like.

Insofar as the substitution away from manufacturing industries is a natural consequence of global development, the decline in industrial employment and output need not pose any economic problems, much less imply a decline of the national economy. However, there are some phenomena which cause concern. First, there is the emergence of persistently high levels of unemployment suggesting that industries have been shedding jobs faster than the service sector was capable of absorbing them. Second, comparisons of British industrial employment and output with those in other industrialised countries reveal that the decline in Britain was much more severe. The growth of German and Japanese industries has, of course, been legendary. But even U.S. or French industrial performance compares very favourably to the British. Between 1960 and 1990, industrial production almost trebled in France, and U.S. industrial output grew by 150%. By contrast, British industry only managed a 50% growth. Over the same period, manufacturing employment in Britain fell by 40%, much more than that in France (down 16%), or the U.S. (virtually unchanged).[2] Thus, there is a significant part of the change in British manufacturing employment that requires further investigation.

There exist a number of conjectures about the causes of industrial decline in Britain. Kaldor (1966) postulates that the growth rate of labour productivity is determined by the growth rate of manufacturing output, and that the comparatively poor performance of British industries is to be explained by inability to recruit sufficient labour to

[2]United Nations Monthly Digest of Statistics.

manufacturing.[3] However, Rowthorn (1975) demonstrates empirically that labour productivity gains and the growth of the manufacturing employment are mutually independent. Bacon and Eltis (1976) suggest that the growth of the public sector had wrested labour and resources from manufacturing, creating structural imbalance and reducing industrial growth. Here too, Gomulka (1979) works out that, even if we accepted all their arguments, these would only explain 10% of the relative decline of British industrial output (relative to Germany or Japan) from 1961-74.

The weakness of these theories is that they are set in an environment of full employment, and their persuasiveness is seriously undermined by high levels of unemployment. It appears that the modelling of industrial performance must allow for, and hopefully explain, the presence of unemployment. In this regard, Layard and Nickell (1985,1986) provide a neoclassical model which explains the changes in British employment and unemployment. The possible causes they examined include wage push variables such as benefits and unions, import prices, cyclical demand factors, and technical progress.

We adopt this approach and extend it into the present analysis. In particular, we are concerned about the drastic decline of manufacturing employment relative to the domestic economy, and also relative to international competitors. Were there factors specific to British industries which caused them to decline, or have British industries been less able to adapt to general economic, technological or price developments? And how do we measure the effects of these factors?

Our framework is one where industries compete in an imperfectly competitive market with other domestic industries as well as foreign producers. The main causes we would like to explore are technical progress and shifts in the demand function. In

[3]Kaldor (1975) later recanted this latter view, and thought that the lack of international competitiveness was probably more important.

order to give us a frame of reference, let us begin with a consideration of a set of possible explanations.

There are those who believe that raw material or import prices are important causes for the decline in industrial employment. Material costs can influence the manufacturing sector in two ways. First, they enter the production process, possibly affecting factor allocation efficiency, and definitely making final goods more expensive to produce. If the production function is separable in materials, then factor utilization is unaffected, and material price changes impact on industry demand via differential material contents in different industries. Keeping in mind that we are trying to understand inter-country or inter-sector differences, this effect is important only if British industries have higher material input than their competitors. If so, then we would expect a drop off in demand for British industrial goods as input price rises.[4]

Another way material or import prices can affect industry is through their impact on the wage setting process, since it will exacerbate the wedge between the real product wage and the real consumption wage. Higher import prices will drive up the aggregate wage level, generating higher prices. Relative domestic prices are unchanged, but for the traded sector competitiveness will deteriorate causing a loss of demand (assuming that other countries do not suffer from the same problem). Of course, all these are relevant only if raw material or import prices have changed significantly. Here, the evidence is mixed. Commodity prices (including oil) have seen substantial rises in the seventies and early eighties, falling back significantly in the late 1980s.[5] Real import prices, on the other hand, had shown no clear trend.[6]

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[4]While there are plenty of casual evidence that the Japanese, for example, are moving into high value added activities, the extent of this development in Britain is unclear.

[5]See Figure 4 in Layard and Nickell (1991), "Unemployment", p400.

[6]See Layard and Nickell (1986), "The Rise in Unemployment", p128-129.

A second set of possible explanations are wage push variables. Initially, variations in general wage push factors such as benefits or taxes would be expected to have a fairly uniform impact, changing aggregate wages but not affecting relative wages. However, if there are no abnormal profits, prices will have to rise to compensate, competitiveness will fall in the traded sector once again affecting demand. Industry specific wage push factors will obviously have more selective impact. Some, like union power, affects the sharing out of economic rents. As such, their influence is essentially short term, and of a duration that depends on the source of such rents and the competitive processes that will eliminate them. (We shall return to this point latter.) Empirically, the change in the general factors are well documented. For example, Layard and Nickell (1985) pointed out that taxes had risen steadily for the most part of the last three decades. Real benefits, on the other hand, are unlikely to offer a lot of explanatory power.

Overall then, the predominant way these factors influence industry employment is via their effect on industrial demand. Now this type of demand change is chiefly short term and cyclical. Theoretically, differences in competitiveness will be gradually removed by a combination of exchange rate depreciation and the elimination of temporary rents that are accruing to wages or profit margins. And that part of industrial demand that is pro-cyclical or anti-cyclical will also revert to its normal state. As such, they do not offer a satisfactory explanation of secular changes in employment.[7] In practice, some types of cyclical demand can take a long time to recover. Exchange rates, for example, are driven mainly by financial flows rather than trade flows, and can deviate from purchasing power parity significantly for prolonged periods. Thus, producers may well have to treat them as secular changes. More

[7]This is especially true in the presence of adjustment costs, which will tend to make short term changes uneconomical.

common types of secular demand factors are things like consumer tastes, and the world income elasticity of demand for British industrial goods. Here, we would expect producers to take full account of demand changes in planning their investment and labour requirements.[8]

Someone looking at industrial production statistics may well wonder why we need to worry about demand at all. Given that industrial output had increased over this period, albeit at an anaemic rate, and that employment had fallen, one might feel that, whatever happened to demand, it was technical progress which led to the contraction in employment. This simplistic view is incorrect because technical progress is intrinsically intertwined with industry demand.

Technical progress can occur in a number of ways. Most obviously, improvements in the methods of production mean that labour, machinery and material inputs are used more efficiently to produce the same product. In this sense, the impact on employment is ambiguous. Less manpower is now required to produce the same amount of output. On the other hand, reductions in the cost of production allow a lower price and generate more demand for this output.

Technical progress can also occur in other substantial ways. It can change the nature of products, for example make them more reliable. Consider the modern television set. It seldom goes wrong and when it does, repairing it is straightforward. Or consider the use of new materials. New alloys for the engine blocks in motorcars allow them to run at much higher temperatures. This greatly improves fuel efficiency and lowers running costs. Thus when we buy a television set or a motor car, we purchase a product that is intrinsically superior to items made a decade or so ago.

Technical progress can also change and increase the mix of goods available.

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[8]In this respect, note that Thirwall(1978) presents evidence that British industries have lower world income elasticities of demand when compared to other industrialised countries.

Through a combination of better production technique, use of new materials etc., new products come on the market. Look at the large arrays of computers and computer software. While these changes are difficult to quantify, intuitively it is easy to see that these developments tend to increase the demand for industry products. That is, they shift the demand curve outward. What is more, international considerations exacerbate the sensitivity of these effects, further emphasizing the desirability of technical progress. Indeed, there is a view that British industries suffer from disadvantages in the development of technical innovations.[9]

Nonetheless, new technologies tend to divide employers and employees. For however good new products are, they tend to be made by new workers in new working arrangements. Very often, this does not generate any great advantage to the existing workforce. Of particular interest is the role of technical innovations in production efficiency. There is considerable resistance to the implementation of new technologies because of a fear that they will cost jobs. However, as we argued before, technological lags can cause serious losses in demand in the long term. It is thus important to clarify the arguments.

The balance between lower employment due to labour efficiency and higher employment due to increased demand depends on two things. First, the elasticity of demand. Second, the extent to which higher production efficiency is passed on in the form of lower prices. As production techniques improve the cost of production falls, generating the possibility of higher profit margin and wages and, to the extent that these have not exhausted the technical gain, lower prices attract larger demand. Of course, such progress spreads out to other producers sooner or later and profit margins will need to come back into line. Similarly wages which may be held higher

[9] see Gomulka, S. (1979), "Increasing Inefficiency versus Slow Rate of Technological Change".

for a time through union action, for example, will have to reckon with competitive forces eventually. Therefore, in the short run, rent seeking behaviour in wage and price setting have important implications for industrial adjustments to technology and demand changes. In the long run, the employment consequences of technical progress in production depend mainly on the demand elasticity.

Given the pivotal roles that industry demand and technical progress play in the determination of employment, we need to address several questions. First, how sensitive are employment and output to different kinds of demand shocks? And, what are the employment consequences of technical progress in production?

To answer these questions, we set out in chapter 2 an industry model with imperfect competition which determines industry wages, prices, employment and output. We then discuss the impact of technology and demand shocks in our model. In chapter 3, we derive and estimate an empirical version of our model using 3-digit level industry data. This provides parameter values on an industry by industry basis to allow us to assess the significance of our analytical results. Along the way of the theoretical developments, we look into the behaviour of rent seeking in wage setting which affects the short run response of industry to technological or demand shocks. In particular, we employ the idea of "insider" effects in wage determination. In chapter 4, we provide a more rigorous derivation of these "insider" effects in wage setting. We then proceed to estimate these "insider" effects on 2-digit level industry data and attempt to explain them in terms of industry characteristics, such as union power.

Having thus explored the causes of employment decline in British industries, in chapter 5 we turn our attention to the health effects of the consequent rise in unemployment. The particular question we address concerns the relationship between mortality and unemployment. Despite a long list of literature on this subject stretching back to the 1930s, there is no strong consensus on the existence of the mortality effects of unemployment. Essentially, there are two problems which trouble investigators. One is the association between incidence of unemployment, mortality and chronic poverty, confusing the issue of causation. The second relates to a debate concerning whether material or psychological channels are more important. In a comparison of different British standard regions, we try to resolve these questions by exploring the different aspects of unemployment and how they may or may not be associated with mortality. One would expect that different characteristics of unemployment, such as its duration or its age specificity, will have differential effects on the unemployed. By exploiting these differences, we may be able to explain why conflicting results have been found in the literature, and to help resolve the debate over the manner in which these effects work.

The results from the various parts of the thesis are summarised in our conclusion, chapter 6. After which we present a list of references.

There are several themes which run through this thesis. One is, of course, the investigation of employment and unemployment. Another is our methodology. We are able to employ pooled cross section-time series throughout most of our analysis. This has the advantage of controlling for time invariant characteristics of the cross section unit, as well as macro factors which have a uniform impact. The implication in chapter 5, for example, is that we need not worry about modelling the secular decline in mortality when we seek to explain cyclical effects like unemployment. In the earlier chapters too, we are able to control for industry characteristics and business cycle effects which would make estimations of demand elasticities and such like very difficult. The only point when we did not used this methodology is in the main part of chapter 4. This is decided mainly on technical grounds. Since we were interested only in the identification of the "insider" effects, the data requirements are somewhat different. Furthermore, some wage push variables are only available at the 2-digit level. Using this in our estimation means that we cannot used pooled time series-cross section method, but are however able to use a longer run of data. As an interesting exercise, at the end of chapter 4, we present an alternative empirical route comparing estimates obtained using the 2-digit data set and the 3-digit data set. Reassuringly, these are remarkably similar.

CHAPTER 2. THE DETERMINATION OF WAGES, PRICES, EMPLOYMENT AND OUTPUT IN BRITISH INDUSTRY: A MODEL WITH IMPERFECT COMPETITION.

I. Introduction.

In this chapter, we provide a theoretical analysis of the impact of technical progress and demand shifts on British manufacturing employment. Our aim is to explain the secular changes in employment in this sector, particularly the sharp decline since the early 1970s.

There is a long history of research into the causes of slow industrial growth in Britain. This includes the papers by Kaldor (1966,1975), Bacon and Eltis (1976), and Eltis(1979). In the main, these arguments are based on growth theories with the implicit assumption of full employment. Their relevance has thus been weakened by the rise of unemployment. An attempt to model industrial performance must allow for the presence of unemployment. For this, we turn to the approach developed in Layard and Nickell (1986,1991), in which they set out a neoclassical model to explain the rise in British unemployment. The array of possible causes they examined include wage push variables such as benefits and unions, import prices, cyclical demand factors, and technical progress.

We extend this approach into the present analysis. Of particular concern to us is the fact that, though overall employment growth has been anaemic and aggregate unemployment has been rising, the fall in manufacturing employment has been especially severe. Furthermore, there is also a relative decline of British manufacturing when compared to those of other industrialised nations. Hence, there is a part in the movement of manufacturing employment that deserves further examination. The methodology and data we employ here allow us to utilise and investigate the difference in the inter-industry pattem of employment and output. The framework we use is a model of an imperfectly competitive industry in the presence of general wage setting behaviour. The general idea in this model is that as productivity or demand rises, both wages and profits rise in the short run, with the presence of "insider" forces in wage setting generating further complications. Over the longer term, however, competitive forces drive down the price of output relative to costs and eventually wages are forced back into line.

This analysis allows us to address a number of important issues. There are those who resist the implementation of new technologies on the ground that such technologies will reduce employment. If we observe the histories of past innovations, this does not appear to be the case. More significantly, delay and refusal to accept new technologies, either in new products or new processes, can cause a serious loss of competitiveness and hence, demand. It is very desirable to resolve this question on an industry by industry basis and also to assess their demand elasticities. There are also some evidence that the world income elasticities for British products are relatively low because British manufacturing is concentrated in the older industries, and that this may explain the reduction in Britain's share of world trade.[1] We attempt to capture this by calibrating a demand variable so that it has a trended part as well as a cyclical element.

In terms of a full explanation of the changes in manufacturing employment, there are of course other possibilities apart from technical progress and demand. Some have argued that import or raw material prices could be an explanation. While there is no clear evidence that real import prices have significantly increased,[2] commodity prices

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[1]For example, see the NEDO studies by Panic (1975).

[2]See Layard and Nickell (1986), pp128-9.

have been more erratic.[3] However, any rise in raw material prices would also affect other industrialised countries, such as Germany or Japan, and is therefore unlikely to explain international differences unless British industries have particularly high material contents. Variations in wage push variables such as benefits and taxes would also be expected to have a fairly uniform impact and unlikely to explain inter-sectoral differences. On the other hand, wage push effects which raise the general wage level may cause a more detrimental loss of competitiveness in a traded sector like manufacturing. These effects are captured as part of our demand variables. Hence, technology and demand shocks have pivotal roles in the determination of industry employment.

Following the developments in this chapter, we shall investigate empirically the impact of demand shifts and technical progress in the next chapter. In chapter 4, we return to the issue of "insider" forces in wage setting as this is of fundamental importance in understanding the labour market.

Our model of industry behaviour and wage determination is presented below. Section III contains a discussion of some long run comparative static results arising from the theory. In particular, we shall concentrate on the long run impact of demand shifts and productivity gains. Section IV presents our conclusions.

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[3]see Layard and Nickell (1991), figure 4, p400.

II. A Model of Industry Behaviour.

In this section we discuss the behaviour of firms in an imperfectly competitive industry and go on to present a rather general model of wage setting. We then put the pieces together and study how the industry responds to exogenous changes in the long run.

The Behaviour of Firms.

Suppose that each industry, i, consists of price setting firms (indexed j). In order to analyze their pricing and employment decisions, we must specify the demand conditions which they face and their technology. Starting with the latter, the firms have a common, constant returns, technology described by

$$Y_{ij} = \bar{F}(A_i N_{ij} / K_{ij})\, K_{ij} \tag{1}$$

where Y is value-added output, N is employment, K is capital and A is labour augmenting technical progress.

Next consider the demand curve facing the industry. First we define real aggregate demand in the whole economy as $e^{\sigma_1}\bar{Y}$ where $\bar{Y}$ is the potential output of the economy when resources are fully utilised and σ_1 is a measure of aggregate demand relative to potential output. The share of real demand falling to the i^{th} industry depends on a taste factor, e^{ω_i}, and demand factors specific to the industry, $e^{\sigma_{1i}}$. The output of industry i competes in two specific markets, first the domestic market for all goods (price index P) and second the world market for all goods (price index P^* in domestic currency). The output of industry i also competes against the foreign output of the same industry and the price used here is the relevant import price, P_i^*. So the demand curve facing industry i can be written as

$$Y_i^d = (P_i/P)^{-\theta_1} (P_i/P^*)^{-\theta_2} (P_i/P_i^*)^{-\theta_3} e^{\omega_i} e^{\sigma_{1i}} e^{\sigma_1} \bar{Y} \tag{2}$$

or

$$Y_i^d = e^{\omega_i} (P_i/P)^{-\theta} e^{\sigma_i} \bar{Y} \tag{3}$$

where $\theta = \theta_1 + \theta_2 + \theta_3$ and σ_i is defined by

$$\sigma_i = \sigma_1 + \sigma_{1i} + \theta_2 \log(P^*/P) + \theta_3 \log(P_i^*/P) \tag{4}$$

Having set the scene, we now discuss industry pricing behaviour. We suppose that prices are set before demand, σ_i, aggregate price, P, and wages W_i, are revealed. Once prices have been set, output is produced in order to satisfy demand and labour is employed to produce the output.

Concerning price setting, we suppose that the industry output price which emerges is systematically related to the monopoly price which would rule if there was complete collusion between all the firms. The details of this relationship are discussed later. The final price is uniform across all firms in the industry and demand, and hence output, is distributed across firms according to size as measured by the (predetermined) capital stock. So the output-capital ratio is the same for all firms. Thus if Y_i, K_i, N_i are industry aggregates,

$$Y_i : K_i : N_i = Y_{ij} : K_{ij} : N_{ij}$$

So we can write an industry aggregate production function

$$Y_i = F(A_i N_i / K_i)\, K_i \tag{5}$$

In order to derive the monopoly price, we may define the cost function corresponding to (5) as

$$C = C(W_i/A_i, Y_i/K_i)\, K_i \tag{6}$$

and given that the industry demand elasticity is θ, the monopoly price $P_{m,i}$ is given by

$$P_{m,i} = \frac{\theta}{\theta - 1}\, C_2(W_i/A_i, Y_i/K_i) \tag{7}$$

Note that both C and marginal cost, C_2, are homogenous of degree one in prices and that the elasticity of demand, θ, must exceed unity.

The fundamental question is the determination of the relationship between $P_{m,i}$ and the actual price which is set. In a Cournot-Nash industry, the actual price is a fixed proportion of the monopoly price. This follows from the fact that in such an industry, price is set as a fixed mark-up on marginal cost, the mark-up depending on the Herfindahl index of concentration. However, other theories indicate that deviations of industry prices from the joint monopoly level are sensitive to the cycle. Stiglitz (1984) provides a long list of possible theories which generate the result that industry prices will tend to fall further below the joint monopoly price as demand expands. Thus, for example, the flow of potential entrants tends to be higher in booms than in slumps so the limit price required for entry deterrence is higher in the latter period. This is related to the result that in industries with free entry and exit, only average cost pricing can limit the threat of entry (see Mirman, Tauman and Zang 1986, for example).

In the context of oligopolistic industries Rotemberg and Saloner (1986) provide both a theoretical foundation and some empirical evidence for the view that collusion is more difficult when demand is high. The idea here is simply that the benefits of deviating from collusive behaviour are more likely to outweigh the costs when demand is high. Again this implies that the mark-up on <u>marginal</u> cost moves counter-cyclically.

This discussion implies that we must allow for the possibility that there is a cyclical relationship between the actual price, P_i, and the monopoly price $P_{m,i}$ with the discrepancy being bigger when demand is higher.[4] This would imply that we have

$$P_i = f(\sigma_i^e)\, P_{m,i}\,,\ f \leq 1,\ f^1 \leq 0 \tag{8}$$

σ_i^e being the expected demand index.

Since prices are fixed in advance, they must be set on the basis of expected marginal costs and so, using (7) and (8) we have

$$P_i = \frac{\theta f(\sigma_i^e)}{\theta - 1}\, C_2(W_i^e / A_i,\ Y_i^e / K_i) \tag{9}$$

To make our model comparable with standard models of price behaviour it is convenient to separate out trend productivity effects and demand effects and this we do by defining trend industry output $\overline{Y}_i$ by

$$\overline{Y}_i = e^{\omega_i} (P_i / P^e)^{-\theta}\, e^{\overline{\sigma}_i}\, \overline{Y} \tag{10}$$

where $\overline{\sigma}_i$ is the average demand index.

Now expected output, Y_i^e, is equal to expected demand at price P_i, that is (from 3)

$$Y_i^e = e^{\omega_i} (P_i / P^e)^{-\theta}\, e^{\sigma_i^e}\, \overline{Y}$$

Therefore,

[4]Ultimately, this is an empirical matter and the discussion below does not depend on the particular cyclical behaviour of margins.

$$Y_i^e / \overline{Y}_i = e^{(\sigma_i^e - \overline{\sigma}_i)} \tag{11}$$

Hence, marginal cost, C_2, may be expressed in terms of trend industry output as

$$MC_i = C_2\left(W_i^e / A_i, \overline{Y}_i / K_i \cdot e^{(\sigma_i^e - \overline{\sigma}_i)}\right) \tag{12}$$

Instead of using trend capital productivity, it is more instructive to use trend labour productivity. This we do by relating trend industry output, $\overline{Y}_i$, to trend employment, $\overline{N}_i$, through the production relation

$$\overline{Y}_i / K_i = F(A\overline{N}_i / K_i) \tag{13}$$

Thus,

$$MC_i = C_3\left(W_i^e, \overline{Y}_i / \overline{N}_i, A_i, e^{(\sigma_i^e - \overline{\sigma}_i)}\right)$$

This is then incorporated in the price equation (9). Note that we are assuming here that $\overline{Y}$, A_i, K_i and ω_i are all known in advance.

It is convenient to present the relevant equations in log-linear form in order to provide a foundation for the empirical work and this we may do as follows.

<u>Production function</u>

$$y_i - k_i = \gamma_o + \gamma_1 (n_i + a_i - k_i) \tag{5a}$$

<u>Industry demand</u>

$$y_i - \bar{y} = \omega_i - \theta (p_i - p) + \sigma_i \tag{3a}$$

<u>Price-setting equation</u>

$$p_i = \beta_o - \beta_3 (\sigma_i^e - \overline{\sigma}_i) + mc_i \tag{9a}$$

where the marginal cost is

$$mc_i = w_i^e - a_i + \beta_2 (y_i^e - k_i)\,, \tag{12a}$$

The marginal cost term can then be expressed in terms of trend labour productivity

and demand effects by noting that $y_i^e - \bar{y}_i = \sigma_i^e - \overline{\sigma}_i$, so

$$mc_i = w_i^e - a_i + \beta_2 (\bar{y}_i - k_i) + \beta_2 (\sigma_i^e - \overline{\sigma}_i)$$

Furthermore

$$\bar{y}_i - k_i = \gamma_o + \gamma_1 (\bar{n}_i + a_i - k_i) \tag{13a}$$

which gives

$$\bar{y}_i - k_i = \frac{\gamma_o}{1-\gamma_1} - \frac{\gamma_1}{1-\gamma_1} (\bar{y}_i - \bar{n}_i) + \frac{\gamma_1}{1-\gamma_1} a_i$$

Thus the marginal cost is re-written as:

$$mc_I = b_{o1} + w_I^e - b_1(\bar{y}_I - \bar{n}_I) - (1 - b_1)a_I + \beta_2(\sigma_I^e - \bar{\sigma}_I) \tag{12b}$$

$$b_{o1} = \beta_2 \gamma_o/(1 - \gamma_1), \; b_1 = \beta_2 \gamma_1/(1 - \gamma_1)$$

Therefore, the corresponding version of the price setting equation is:

$$p_I - w_I^e = b_o - b_1(\bar{y}_I - \bar{n}_I) - (1 - b_1)a_I + b_2(\sigma_I^e - \bar{\sigma}_I) \tag{9b}$$

$$b_o = \beta_o + b_{o1}, \quad b_2 = \beta_2 - \beta_3$$

This completes the discussion of firms' behaviour and we must next move on to wage determination in the industry.

The Determination of Industry Wages.

We shall devote chapter 4 to study the complexity of the wage determination issue. In the following, we limit ourselves to a sketch of the basic features in our wage model that is relevant to the current analysis. Our model of wage determination is kept deliberately general because, in reality, wages may be determined by a variety of different methods even within the same industry. Here we see industry wages as being influenced by two sets of factors. The first group we call "insider" factors and these reflect productivity within the industry and the well-being of the existing workforce. The second group reflect "outsider" influences which affect the firms' ability to retain and motivate workers, and include wages paid elsewhere and the general state of the labour market.

In order to make these notions more precise, we begin by deriving the relationship between product wages, employment and productivity within the industry. This relationship is based on the marginal revenue product condition which is an alternative form of the pricing equation (9). It is a well known fact that marginal cost is equal to the wage divided by the marginal product of labour, so we have

$$MC_i = W_i^* / A_i F_1 (A_i N_i^* / K_i) \tag{14}$$

Using this and rearranging (9), we obtain the marginal revenue product condition

$$W_i^* = \frac{\theta - 1}{\theta f(\sigma_i^*)} P_i A_i F_1 (A_i N_i^* / K_i) \tag{15}$$

which is really an alternative way of writing the pricing rule. Under competition, of course, $\theta \rightarrow \infty$ and (15) then simply represents the employment decision of the competitive firm with P_i now being exogenous. The log-linear version of (15) is obtained by using the production function (5a) to eliminate expected output y_i^e in (9a) and (12a). This yields, after some re-arrangement

$$p_i - w_i^* = \beta_o + \beta_2 \gamma_o - \beta_3(\sigma_i - \overline{\sigma}_i) + \beta_2 \gamma_1 (n_i^* - k_i) - (1 - \beta_2 \gamma_1) a_i \tag{16}$$

In order to specify the "insider" wage, we first ask the question, what would the wage have to be in order to generate a level of employment for all the workers considered "insiders", n_i^I, if demand remains at the average level $\overline{\sigma}_i$? The answer is given by

(16), replacing n_i^e by n_i^I dropping the σ terms. Insider wage setting, in its purest form, is concerned with maximising wages while guaranteeing the jobs of the existing workforce (see, Blanchard and Summers 1986, for example). Thus n_i^I would be set at $n_{i-1}(1-\delta)$ where δ is the proportion who leave voluntarily. The argument here is that unions are the primary force in wage bargaining and their sole concern is with existing jobs. There are, however, further possibilities. For example, the union might also attach some weight to the recently unemployed workers from the i^{th} industry. We would then have

$$N_i^I = N_{i-1}(1-\delta)+(1-\omega_1)U_{i-1},\ 0\leq\omega_1\leq 1$$

where U_i refers to those unemployed who recently worked in industry i. So if L_i is the labour force "attached" to firm i, defined as

$$\begin{aligned} L_i &= N_i + U_i \\ \textit{then } N_i^I &= L_{i,-1} - \delta N_{i,-1} - \omega_1 U_{i,-1} \\ &= L_{i,-1}[1-\omega_1 u_{i,-1} - \delta(1-u_{i,-1})] \end{aligned}$$

where $u_i = U_i/L_i$ is the industry unemployment rate. So, in logs, we have

$$n_i^I = l_{i,-1} - (\omega_1-\delta)u_{i,-1} - \delta \tag{17}$$

In addition, there are a number of further factors which could be included in the "insider" category. Insiders may resist wage adjustments associated with changes in the wedge between product wages and consumption wages (post-tax wages deflated by retail prices). In other words, if tax changes, for example, raise product wages relative to consumption wages, workers may resist the reduction in the consumption wage necessary to stabilise employment. Other factors tending to raise the "insider" wage may include the power of the union in industry i, for example, and in general we simply include all these exogenous forces in a vector $\mathbf{z}_{1i}$.

So we are now in a position to specify the "insiders" wage, w_i^I, as that which will ensure the long run employment of n_i^I workers defined in (17), modified by some further exogenous factors $\mathbf{z}_{1i}$. So we have, using (16),(17)

$$\begin{aligned} w_i^I = & -(\beta_o+\beta_2\gamma_o+\beta_2\gamma_1\delta)+p_i-\beta_2\gamma_1(l_{i,-1}-k_i) \\ & +(1-\beta_2\gamma_1)a_i+\beta_2\gamma_1(\omega_1-\delta)u_{i,-1}+z_{1i} \end{aligned} \tag{18}$$

It is most unlikely, however, that firms are immune from outside forces and the "outsider" wage reflects this fact. This wage, w_i^o, captures the payment required to retain and motivate workers. This clearly depends on the wages that are expected to rule elsewhere, $\overline{w}$, modified by the chances of obtaining employment and the financial and other penalties associated with unemployment. We suppose that the former depends inversely on the general level of unemployment, u, and the latter on a series of factors, such as the level of unemployment benefits, which we label $\mathbf{z}_{2i}$. The outsider wage may, therefore, be specified as

$$w_i^o = \delta_{oi}+\overline{w}-c_1 u+z_{2i} \tag{19}$$

where, for the moment, we suppose the unemployment term to enter linearly.

Now we assume that the actual wage set in industry **i** is a weighted sum of the "insider" and "outsider" wages where the weights are λ, $1-\lambda$ respectively. Thus we have

$$\begin{aligned} w_i = & \lambda w_i^I+(1-\lambda)w_i^o+\lambda_o \\ & -\lambda_o-\lambda(\beta_o+\beta_2\gamma_o+\beta_2\gamma_1\delta)+(1-\lambda)\delta_{oi}+\lambda(p_i+\beta_2\gamma_1(k_i-l_{i,-1}) \\ & -\beta_2\gamma_1(\omega_1-\delta)u_{i,-1})+(1-\beta_2\gamma_1)a_i)+z_{1i} \\ & +(1-\lambda)(\overline{w}-c_1u+z_{2i}) \end{aligned} \tag{20}$$

In order to tie this up with our pricing model we shall suppose that L_i is proportional to the trend level of employment in the industry thus yielding[5]

$$l_{i-1} = \bar{n}_i + \alpha \qquad (21)$$

This implies

$$k_i - l_{i-1} = (k_i - \bar{n}_i) - \alpha$$

$$\text{or} \quad k_i - l_{i-1} = \frac{1}{(1-\gamma_1)}(\bar{y}_i - \bar{n}_i) - \frac{\gamma_o}{1-\gamma_1} - \frac{\gamma_1 a_1}{1-\gamma} - \alpha$$

making use of the trend production function (13a).

Substituting this into (20) now gives, after some manipulation, our final wage equation

$$\begin{aligned} w_i = {} & c_o + \lambda(p_i + b_1(\bar{y}_i - \bar{n}_i) + (1-b_1)a_i) \\ & + (1-\lambda)(\bar{w} - c_1 u + z_w) + \lambda\beta_2\gamma_1(\omega_1 - \delta)u_{i-1} \\ c_o = {} & \lambda_o + \lambda(\beta_o + \beta_2\gamma_o + \beta_2\gamma_1\delta) + (1-\lambda)\delta_{oi} - \beta_2\gamma_1\alpha - b_1\gamma_o\lambda \end{aligned} \qquad (22)$$

We can give some interpretation to (22) by re-arranging it as a relative wage equation,

$$\begin{aligned} w_i - \bar{w} = {} & c_o + \lambda(b_1(\bar{y}_i - \bar{n}_i) + (1-b_1)a_i - (\bar{w} - p_i)) \\ & + (1-\lambda)(c_1 u + z_w) + \lambda\beta_2\gamma_1(\omega_i - \delta)u_{i,-1} \end{aligned}$$

This indicates that wages in industry i rise relative to outside wages for four possible reasons. First, if inside "trend" marginal productivity,

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[5]In order to justify our comparative static results, we need only suppose that this holds in the long run but it makes for a cleaner exposition if we assume it remains true throughout.

$$\beta_2\gamma_1\,[(k_i - l_{i,-1}) + (\alpha_1 - 1)a_i]$$

rises relative to outside wages normalised on industry product prices, $(\bar{w}-p_i)$. Second, if the general level of unemployment, **u**, is lower. Third, if the industry unemployment rate, u_i, has been higher and fourth, if autonomous wage pressure inside the industry, z_i, increases. The third of these effects may appear somewhat strange, at first sight, but it is really quite straightforward. If unemployment inside the industry has been rising, this implies that employment is now at quite a low level. The "insiders" can now negotiate a higher wage, without fear of job loss, than they would have been able to do had employment been previously maintained.

Three parameters are particularly important in understanding wage setting in a particular industry. The parameter λ measures the extent to which wage setting is influenced, in the short run, by "inside" forces such as own productivity. This is clearly related both to the absence of competition in the product market and to the power of unions in the labour market. The size of the (positive) coefficient on lagged unemployment reflects the extent to which the existing employees are concerned only with their own welfare and the extent to which they can impose this concern on management. In a sense, therefore, a high coefficient on lagged unemployment reflects both selfishness and power. This forms the basis of the hysteresis effect. The third parameter is that associated with aggregate unemployment. This captures the impact of outside labour market on wage setting. The higher it is, the more "competitive" is wage setting behaviour.

III. The Industry Model in the Long Run

One of the main purposes of setting up an industry model is to see how the industry will adjust in the long run to a variety of exogenous shifts. In particular we are interested in how wages, prices, output and employment adjust to technological improvements (rises in $\mathbf{a}_i$) and demand shifts (ω_i, σ_i). In order to undertake such an investigation we propose a specific operating context. First, we assume perfect foresight since we shall not be concerned here with the impact of surprises. Second, we shall not endogenise capital accumulation but simply investigate its consequences, while noting the situations in which capital accumulation is likely to occur, for example, when more capacity is clearly required. However, we must allow "trend" marginal productivity to change because this will influence "insider" wages. Our model allows trend productivity to evolve through equations (13) and (10). Recall that

$$\overline{Y}_i / K_i = F(A\overline{N}_i / K_i) \tag{13}$$

$$\overline{Y}_i = e^{\omega_i}(P_i / P^e)^{-\theta} e^{\overline{\sigma}_i}\, \overline{Y} \tag{10}$$

These ensure that when aggregate demand is operating at the full utilization level in the economy as a whole, then it will be enough to ensure that industry *i* will be operating at this same level. So, in the long run, the industry will operate at full utilization output when $\sigma_i = 0$.

Before looking at some comparative statics, one final point is worth remarking and this refers to the determination of employment. Since, in reality, there are employment adjustment costs, employment will adjust only slowly to exogenous shocks. The production function in (9a) should, therefore, be thought of as holding when employment has adjusted fully and when hours of work and capital utilization (shift work) have reverted to their normal levels. The true, short run, production function would, of course, include these other factors but is surplus to our requirements so long as we are mainly interested in the full long run employment responses. (Note that employment only enters in this equation and is thus completely separable from the rest of the model.) Similar arguments relate to the price and wage equations where adjustment terms in the model allow short-term rent seeking behaviour.

IIIA. The Impact of Productivity Gains and Technical Progress.

In order to see how the model operates it is convenient at the outset, to set down its key equations. These are

Production:(eq 5a) $$y_i-k_i=\gamma_o+\gamma_1(n_i+a_i-k_i) \qquad (23)$$

Demand:(eq3a) $$y_i-\bar{y}=\omega_i-\theta(p_i-p)+\sigma_i \qquad (24)$$

Pricing:(eq9b) $$p_i-w_i=b_o-b_1(\bar{y}_i-\bar{n}_i)-(1-b_1)a_i+b_2(\sigma_i-\bar{\sigma}_i) \qquad (25)$$

Wages:(eq22)

$$w_i=c_o+\lambda(p_i+b_1(\bar{y}_i-\bar{n}_i)+(1-b_1)a_i)+(1-\lambda)(w-c_1u+z_w)+\lambda\beta_2\gamma_1u_{i-1} \qquad (26)$$

Key parameter: $$b_1=\gamma_1\beta_2/(1-\gamma_1)$$

where β_2 measures the rate at which marginal costs increase with output, and γ_1 is the elasticity of output with respect to employment in production.

In the short run, this model determines wages, w_i, prices, p_i, output, y_i, and employment, n_i, given a_i, k_i, p, w, u, z_w, u_{i-1}, σ_i, $\bar{\sigma}_i$, $\bar{y}_i-\bar{n}_i$, $\bar{y}$. In the long run, however, we may suppose that $y_i=\bar{y}_i$, $n_i=\bar{n}_i$. Therefore, in the long run, trend productivity is also determined within the model.

The next step is to determine the impact of technology, a_i, k_i, on wages, prices, output and particularly employment. Our main objective is to explain secular changes in employment and output. Before that, we begin with a description of short-run behaviour which is interesting on its own and also gives some insight into this model.

Improvements in production efficiency benefits the consumers through lower prices. This is given in (25) which relates the price mark-up on marginal cost to cyclical demand only, and is independent of the level of marginal cost itself. The rationale behind this is that in an imperfectly competitive industry setting, profit margins must stay within a certain range to deter new entrants. Now equation (25) is in a static form. In the short run, prices take time to respond to changes in demand and marginal costs. This amounts to the presence of adjustment terms which we include as[6]

$$p_t - w_t = b_o + \rho(p_{t-1} - w_{t-1}) - (1-\rho)[b_1(\overline{y}_t - \overline{n}_t) + (1-b_1)a_t + b_2(\sigma_t - \overline{\sigma}_t)] \qquad (25a)$$

Initially, only a part, **(1-ρ)**, of the improvement will show up as lower prices. The remainder becomes a source of economic rent to the firm and its workers. The sharing of this spoil depends on the power of the "insiders" to seize the new rent that has arisen. To see this more clearly, let us look into the structures of the price and wage equations. Assume for the moment that $1-\mathbf{b}_1 > 0$. Note also that w_t is the wage which concerns the workers, and $w_t - a_t$ is the wage paid per unit of efficient labour unit, $n_t + a_t$, which is the important wage for the firm. The firm's mark-up on marginal cost is $[p_t - (w_t - a_t) - b1(yi - n_t - a_t)]$. When there is a technical shock so that $\mathbf{d}a_t > 0$, the wage per efficient unit of labour drops and the mark-up rises. This rise is partly offset by diminishing marginal productivity of labour as the output to efficient labour ratio is raised. The extent of deterioration in the marginal cost, $\mathbf{b}_1$, is inversely proportional to the elasticity of substitution between capital and labour, σ. Hence, the overall initial benefit to the firm is $(1-\mathbf{b}_1)\mathbf{d}a_t$. A portion, **(1-ρ)**, of this is given up due to competition considerations. The firm is then left looking at a rent of $\rho(1-\mathbf{b}_1)\mathbf{d}a_t$.

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[6]There are, of course, a lot of reasons for the presence of adjustment terms in price equations. A common explanation is menu costs.

This supposes that the wage w_l stays the same. So we turn to (26) to examine this. Here, we note that when there is an increase in economic rent, wages will respond. In this case, the rise in w_l is $\lambda\rho(1\text{-}b_1)da_l$. In the extreme case that workers have no power to capture any gains from technical shocks, $\lambda=0$ and w_l indeed stays the same. At the other extreme, $\lambda=1$ and w_l rises by $\rho(1\text{-}b_1)da_l$. Since prices cannot rise, workers have captured the entire amount of productivity gain and profit margins are unchanged.

If ρ is large, demand and output are stimulated by only a small reduction in the price, and employment is likely to fall via (23). This state of affairs is temporary. Progress in production technology will spread and the firm then faces price competition as well as the threat of new entrants.[7] Notice that this applies whether the rent was accruing to producers or workers. What is more important, foreign producers are also competing and could provide an even more substantial levelling effect. In fact, the majority of the technical advances of this type are probably innovated by foreign competitors and diffuse into domestic industries and so the possibility of enjoying the rent does not arise.[8]

This brings us to considerations of the long run, which is perhaps the more important part of this analysis. For it is this that may tell us whether technical progress has contributed to any secular decline in British manufacturing employment.

To begin with, we have set out some important long run comparative static results in table 1A.

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[7]In the set-up of our model, we have assumed identical firms. In reality, there may well be a sequence in which new technology is diffused through the industry. Nonetheless, it is difficult to envisage a prolonged advantage in the production process of an existing product.

[8]Gomulka(1979) presented evidence that the amount of technical innovations in Germany and Japan had overtaken that of Britain some time in the early 1960s. The U.S. has been and remains the leader in this area.

TABLE 1A

Long Run Comparative Static Results[9]

Partial derivatives

		w_i	p_i	y_i	n_i
Aggregate Wage,	$\frac{\partial}{\partial w}$	1	$1/\Delta$	$-\theta/\Delta$	$-\theta/\gamma_1\Delta$
Aggregate Price,	$\frac{\partial}{\partial p}$	0	$\theta\beta_2/\Delta$	θ/Δ	$\theta/\gamma_1\Delta$
Capital,	$\frac{\partial}{\partial k_i}$	0	$-\beta_2/\Delta$	$\theta\beta_2/\Delta$	$1-1/\gamma_1\Delta$
Technical Progress,	$\frac{\partial}{\partial a_i}$	0	$-1/\Delta$	θ/Δ	$(\theta/\gamma_1\Delta)-1$

$\Delta = 1+\theta\beta_2$

A number of features of these results are of considerable interest. As we have stated before, the forces of competition ensure that when productivity gains are made, industry prices fall and workers are unable to capture any of these gains once prices and output are adjusted fully. In the light of this, it is not surprising that in the long run, industry wages are not sensitive to technology. The interesting results concern industry employment and here there are three important factors. First, industry employment is decreasing in the aggregate real wage, (***w-p***), *ceteris paribus*. The

[9] The derivation of these results is given in the appendix.

coefficient here is $\theta/\gamma_1(1+\beta_2\theta)$ which is increasing in the demand elasticity θ. As aggregate real wages rise, this drives up real product wages (note $\delta(w_i-p_i)=\frac{\theta\beta_2}{\Delta}\delta(w-p)$) and hence reduces employment. This is, of course, only a *ceteris paribus* result and rising aggregate real wages will generally be associated with increases in aggregate demand which will offset this effect.

Turning to the role of the capital accumulation, there are, as might be expected, two offsetting effects here. A *ceteris paribus* rise in the capital stock will reduce prices and hence raise demand. On the other hand it will cause substitution away from labour. In the light of this, it will come as no surprise that the upward impact on employment is increasing in the demand elasticity and, one would expect, decreasing in the elasticity of substitution between capital and labour. This latter point is confirmed by the presence of β_2 in this result. The relationship between β_2 and the elasticity of substitution, σ, may be established via the marginal product of labour function we used implicitly in equation (12),

$$\log MPL = -\beta_2(\log Y - \log K)$$

Now, along a profit maximising path $d(\log W)=d(\log MPL)$, so that

$$\begin{aligned}
\frac{d\log W}{d\log Y/N} &= \frac{d\log MPL}{d\log Y/N} \\
&= -\beta_2\frac{d\log Y/K}{d\log Y/N} \\
&= -\beta_2\frac{d\log Y/K}{d\log K/N}\frac{d\log K/N}{d\log Y/N} \\
&= -\beta_2\frac{d\log Y/K}{-d\log N/K}\frac{1}{(1-\gamma_1)} \\
&= \beta_2(\gamma_1)/(1-\gamma_1)
\end{aligned}$$

Now d(*log Y/N*)/d(*log W*) is an alternative expression for the elasticity of substitution.[10] Hence, we have $\beta_2=(1-\gamma_1)/\sigma\gamma_1$. Now since the effect of an increase in the capital stock on employment is increasing in β_2, it is therefore decreasing in σ.

Similar remarks apply to the impact of technical progress in the sense of there being two offsetting effects. A rise in labour augmenting technical progress reduces the amount of labour required per unit of output but also causes a price reduction which raises output. As with capital accumulation, a high demand elasticity obviously helps employment but in this case the employment change is increasing in the elasticity of substitution as it is decreasing in β_2. (This is intuitive since the technical progress raises the amount of efficient units of labour, a high degree of substitution will allow these extra units to be absorbed.) So the impact of technical progress on industry employment is fundamentally an empirical matter. However we can gain some idea of the orders of magnitude by noting that

$$\frac{\partial n_l}{\partial a_l}=\frac{\theta}{\gamma_1(1+\beta_2\theta)}-1$$
$$=\theta[\gamma_1+\theta/\sigma(1-\gamma_1)]^{-1}-1$$

recalling that $\beta_2=(1-\gamma_1)/\sigma\gamma_1$, which implies that $\frac{\partial n_l}{\partial a_l}>0$ if $\theta>\gamma_1[1-\frac{1-\gamma_1}{\sigma}]^{-1}$.

γ_1 being the share of labour, is around 0.6 and σ is about 0.8, so we need $\theta>1.2$.[11] Generally we would expect long run demand elasticities to be somewhat greater than

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[10]see Arrow, K., *et al*, in Review of Economics and Statistics (1961), pp 228-229.

[11]This is not strictly correct because in a Cobb-Douglas production function, the elasticity of substitution is one. However, our use of a Cobb-Douglas type log-linear production function is a simplifying approximation to something more general. In a discussion of real world magnitudes, therefore, it is more sensible to compare realistic values. In any case, plenty of allowance is given to the magnitude of θ in subsequent explorations.

this, so overall it seems likely that the *ceteris paribus* impact of technical progress is likely to be positive. However this can only be confirmed by empirical analysis, which will be the subject in the next chapter.

In the meantime, if our suspicion is correct, then the state of demand in the product market must be responsible for the fall in employment that we have discussed. To assess sensibly this possibility, we examine the role of demand in our model in the next sub-section.

IIIB. The Impact of Demand.

Recall that from (3),(4) and (10) in the model, demand shifts are captured by a taste factor, ω_I, aggregate potential output, $\bar{y}$, and a cyclical demand index, σ_I. The basic difference between ω_I and σ_I is that ω_I attempts to capture secular changes in demand whereas σ_I measures demand changes that, while not altogether transient, are nonetheless expected to disappear in the long run. Important examples of the former include relative income elasticities of demand for British industrial goods.[12] Examples of the latter type include the business cycle and, say, prolonged deviations of Sterling exchange rates from Purchasing Power Parity values.[13]

The sum of the taste variable, aggregate potential output and the average level of σ_I together determine trend industry output. However, deviations of σ_I from its average level affect pricing and wage behaviour, and hence generate a different outcome. For instance, as income increases, some industries will benefit because of a high income elasticity of demand. This creates a demand shift in (24) via ω_I. The ability and willingness of firms to supply this extra demand obviously depend on the interactions of the price and wage equations. In (25), we see that as this demand rise is a long term characteristic of the industry, profit margins are unaffected.[14] In the short run, when plant and machinery are unprepared, marginal product of labour drops as output is increased resulting in a rise in the marginal cost. Output price rises precisely by this

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[12]The relative weakness of world income elasticity of demand for British industrial products have been put forward as explaining loss of manufacturing markets by Panic (1975), for example.

[13]See, for instance, OECD studies on purchasing power parities (1985) and (1991).

[14]For the purposes of clarity, we abstract from the discussions on the adjustment process in the price equation as described by (25a) in the last subsection. This will add an extra complexity to the discussions about the short run which is easily assimilated.

amount so that profit margins remain the same. As economic rents do not arise, wages are not affected. (There may however be some second round effects coming through the unemployment terms. Industrial unemployment could be lowered signifying a dilution in the membership of the "insider" group. This would tend to lower wages. On the other hand, aggregate unemployment might be reduced, representing a somewhat tighter labour market, thus tending to push up wages. One would suspect that because of labour mobility, the relation between industry unemployment and employment are somewhat loose. The extent of any fall in aggregate unemployment is also likely to be small. Ultimately, this is an empirical matter, and we shall comment on it in due course.)

In the long run, producers would adjust their capital stock so that factor utilization is once again optimised. Then there is no decrease in the marginal product of labour and marginal costs are stable in (25). Hence, prices and wages are unchanged. The industry is able to absorb all the extra demand and output and employment increase proportionately. This result obviously relies on the availability of spare capacity in the economy, otherwise the aggregate level of unemployment might fall to such an extent that wages would rise via (26), upsetting some of the earlier assessments.

Another type of demand changes concern the cyclical or transitory factors. Take a recession in a business cycle. Though sometimes appearing to last for ever, they are nonetheless expected to go away. This we capture in the term σ_I. In the event of an increase in σ_I, the ability of industry to respond are again dependent on the interplay of equations (25) and (26).

As before, short run considerations will have to include the rise in marginal costs of production which partly offsets the increase in demand via a deterioration in the relative price. An extra complication in this case is that firms' price mark-up tend to react to this type of cyclical demand changes. Take the case where firms use boom times to recover profit margins and would absorb adverse cost developments in lean times. Then as σ_l rises, price mark-up on marginal cost is increased by $\mathbf{b_2 d\sigma_l}$ in (25). This creates an economic rent which workers are keen to exploit also, and wages are raised by $\lambda\mathbf{d}p_l$. Prices are then further increased by this amount to retain the higher mark-up. Wages then rise by $\lambda(\lambda\mathbf{d}p_l)=\lambda^2\mathbf{d}p_l$ which is again added on to prices. Using the usual multiplier arguments, the end result of this catching up is that relative prices would need to rise by $\mathbf{b_2/(1-\lambda)}$. Remember that this is in addition to any price rise which might have occurred as a result of increasing marginal costs. This implies that output and employment would rise by proportionately less than the rise in cyclical demand. In the long run, of course factor allocations in production are adjusted so that marginal cost stays the same. Employment and output then rise more as the increase in price is restricted to $\mathbf{b_2/(1-\lambda).d\sigma_l}$.

The formal comparative static results are set out in table 1B below, after which we give a description of the actual parameters (we have normalised σ_l to have zero mean in this table).

We present the results concerning trend demand and cyclical demand separately. Note also that as we generate the standard comparative static results from our model, these will refer to changes holding the capital stock constant. In the long run, however, the capital stock will adjust to demand shifts and it is worthwhile also examining the results which are generated when this adjustment has occurred. The natural adjustment we consider is when the capital stock shifts in proportion to the shift in output, that is when $dk_l=dy_l$.

Table 1B

Comparative Statics Associated with Demand Shifts[15]

Partial Derivatives

the case of fixed capital stock:

	w_l	p_l	y_l	n_l
$\frac{\partial}{\partial \omega_l}, \frac{\partial}{\partial \bar{y}}$	0	$\frac{\beta_2}{\Delta}$	$\frac{1}{\Delta}$	$\frac{1}{\gamma_1 \Delta}$
$\partial / \partial \sigma_l$	$\frac{\lambda b_2}{1-\lambda}$	$\frac{1}{\Delta}[\beta_2+\frac{b_2}{1-\lambda}]$	$\frac{1}{\Delta}[1-\frac{\theta b_2}{1-\lambda}]$	$\frac{1}{\Delta \gamma_1}[1-\frac{\theta b_2}{1-\lambda}]$

the case of adjusted capital stock: (dk_l=dy_l)

	w_l	p_l	y_l	n_l
$\frac{\partial}{\partial \omega_l}, \frac{\partial}{\partial \bar{y}}$	0	0	1	1
$\partial / \partial \sigma_l$	$\frac{\lambda b_2}{1-\lambda}$	$\frac{b_2}{1-\lambda}$	$1-\frac{\theta b_2}{1-\lambda}$	$1-\frac{\theta b_2}{1-\lambda}$

$$\Delta = 1+\theta\beta_2 = 1+\frac{\theta[1-\gamma_1]b_1}{\gamma_1}$$

The impact of long run demand factors, $\bar{y}, \omega$, are more obvious and straightforward. When the capital stock is fully adjusted, they have no impact on wages and prices.

[15]The derivation of these results is given in the appendix.

Production and employment, on the other hand, are changed proportionately. When the capital stock does not adjust, however, higher demand reduces trend labour productivity and this causes the price to rise. However, since the price mark-up is unaffected, there is no effect on firms' rent and hence no effect on wages. Output increases are moderated by a combination of rising marginal cost and the demand elasticity. Employment increases are further raised because of the reduced output per head.

Next, we discuss the impact of the demand index, σ_I. Consider first the impact on prices. If the capital stock is fixed, then prices rise with demand first because of the direct demand effect, $\mathbf{b}_2$, and second because, when the capital stock is fixed, there will be a fall in trend labour productivity and hence a rise in trend unit costs.(note 3)

Note that the weight attached to firm specific factors in wage determination, λ, is important here. As firm and industry prices rise via the direct demand effect, then wages will also rise if $\lambda>0$. This will raise costs and generate further price rises, the end result being that the direct demand effects, $\mathbf{b}_2$, is multiplied up by $1/(1-\lambda)$. Turning to the output and employment effects, there are two offsetting factors. The first is the direct positive impact of the rise in demand, the second is the offsetting effect due to the rise in prices which obviously depends on the demand elasticity, θ.

Once we allow the capital stock to adjust, there is no decline in trend productivity as output expands and one source of price increases disappears. The output effects are, therefore, bigger overall, because some of the price offset no longer occurs. On the other hand, the employment effects are reduced because capital is substituted for labour. The three key parameters which determine the impact of a demand shift are, therefore, the elasticity of demand, θ, the direct impact of demand on prices, $\mathbf{b}_2$, and the weight attached to firm specific factors in wage determination, λ. A rise in any one of these will reduce the impact of demand on output and employment.

IV. SUMMARY AND CONCLUSION.

In this chapter, we have presented a complete model of an imperfectly competitive industry in the presence of general wage setting behaviour. We then analyzed the long run effects of exogenous shifts on wages, prices, employment and output.

In particular, this model incorporated "insider" forces in wage setting. Our main purpose is to determine whether the change in British manufacturing employment can be explained by technical change and demand shifts. The model we built allows us to frame these questions in a clear way. We were then able to proceed with a theoretical analysis and some conclusions could be drawn. The general idea is that as productivity rises, both wages and profits rise in the short run but, over the longer term, competitive forces drive down the price of output relative to costs and eventually wages are forced back into line. Relative prices of industry output are then at a lower rate. In this framework, we find that the employment elasticity of labour augmenting technical progress are dependent on three factors, the partial elasticity of output to labour, the elasticity of substitution between labour and capital, and the demand elasticity. In general, there is some consensus about the magnitudes of the first two parameters, these being technical elements of the production function. This gives a range for the price elasticity of demand which would be sufficient to maintain employment. Thinking in this way, we find it unlikely that technical progress is the source of employment decline in British manufacturing. Ultimately, this is an empirical matter which we shall have to confirm and explore in the next chapter with actual data.

Some aspects of technical progress are inextricably linked to questions about product demand. Here, one would include obvious ideas like international competitiveness, both in terms of quality and price. While process innovations affect production efficiency and are more easily measurable, innovations in materials, product and design are less easily quantifiable. But these innovations will undoubtedly increase product or industry demand, for they increase choice in the high street and they improve the quality and reliability of products. What about the employment elasticity of demand shifts? Analytically, we found these to be positive, and higher in the long run than they are in the short run. In the next chapter, we shall investigate the size of these elasticities. Note also, that the ultimate impact of these effects depend not just on the elasticities, but also on the size of the demand changes themselves. And what evidence there is suggests that these could be very big indeed.

Last, we return to the issue of "insider" forces in wage setting. We find that although their role is minimal in the long run, they play an integral part in the transmission process. Of course, "insider" effects form a very important part of any labour market model. Therefore, we shall devote chapter 4 to a full analysis of this subject.

Appendix. The derivation of the comparative static results.

Our long run model may be represented by the following matrix formula:

$$\begin{bmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_1 & -b_1 \\ 1 & -\lambda & -\lambda b_1 & \lambda b_1 \end{bmatrix} \begin{bmatrix} w_i \\ p_i \\ y_i \\ n_i \end{bmatrix} = \begin{bmatrix} (1-\gamma_1)k_i+\gamma_1 a_i+\ldots \\ \omega_i+\theta p+\sigma_i+\ldots \\ -(1-b_1)a_i+b_2\sigma_i+\ldots \\ \lambda((1-b_1)a_i)+\ldots \end{bmatrix}$$

The determinant of the coefficients matrix is given by

$$\Delta' = \begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_1 & -b_1 \\ 1 & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$$= - \begin{vmatrix} 0 & 1 & -\gamma_1 \\ \theta & 1 & 0 \\ -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} - \begin{vmatrix} 0 & 1 & -\gamma_1 \\ \theta & 1 & 0 \\ 1 & b_1 & b_1 \end{vmatrix} = -(1-\lambda) \begin{vmatrix} 0 & 1 & -\gamma_1 \\ \theta & 1 & 0 \\ 1 & b_1 & b_1 \end{vmatrix}$$

$$= -(1-\lambda)(\gamma_1 + b_1\theta - b_1\theta\gamma_1)$$

$$= -(1-\lambda)(\gamma_1 + (1-\gamma_1)b_1\theta)$$

$$= -(1-\lambda)\gamma_1(1 + \theta(1-\gamma_1)b_1/\gamma_1)$$

$$= -(1-\lambda)\gamma_1(1 + \theta\beta_2)$$

Results in table 1A

Using Cramer's rule, we have the following partial derivatives:

$$\frac{\partial w_f}{\partial W} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ 0 & 1 & b_1 & -b_1 \\ 1-\lambda & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{1-\lambda}{-\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ \theta & 1 & 0 \\ 1 & b_1 & -b_1 \end{vmatrix}$$

$= -(1-\lambda)(\gamma_1 + b_1\theta - b_1\theta\gamma_1) \,/\, \Delta'$

$= -(1-\lambda)(\gamma_1 + (1-\gamma_1)b_1\theta) \,/\, \Delta'$

$= -(1-\lambda)\gamma_1(1 + \theta(1-\gamma_1)b_1/\gamma_1) \,/\, \Delta'$

$= -(1-\lambda)\gamma_1(1 + \theta\beta_2) \,/\, \Delta'$

$= 1.$

$$\frac{\partial w_f}{\partial P} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ \theta & \theta & 1 & 0 \\ 0 & 1 & b_1 & -b_1 \\ 0 & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{-\theta}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ 1 & b_1 & -b_1 \\ -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= 0.$ (singular matrix)

$$\frac{\partial w_l}{\partial k_l} = \frac{1}{\Delta'}\begin{vmatrix} 1-\gamma_1 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ 0 & 1 & b_1 & -b_1 \\ 0 & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} - \frac{1-\gamma_1}{\Delta'}\begin{vmatrix} \theta & 1 & 0 \\ 1 & b_1 & -b_1 \\ -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= 0$. (singular matrix)

$$\frac{\partial w_l}{\partial a_l} = \frac{1}{\Delta'}\begin{vmatrix} \gamma_1 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -(1-b_1) & 1 & b_1 & -b_1 \\ \lambda(1-b_1) & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= 0$. (singular matrix)

$$\frac{\partial p_l}{\partial W} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & 0 & 1 & 0 \\ -1 & 0 & b_1 & -b_1 \\ 1 & 1-\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} - \frac{1-\lambda}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ 0 & 1 & 0 \\ -1 & b_1 & -b_1 \end{vmatrix}$$

$= (1-\lambda)(-\gamma_1) \,/\, \Delta'$

$= 1 \,/\, (1+\theta\beta_2)$.

$$\frac{\partial p_l}{\partial P} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 0 & b_1 & -b_1 \\ 1 & 0 & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{\theta}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ -1 & b_1 & -b_1 \\ 1 & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= \theta(\lambda b_1 - b_1 - \gamma_1\lambda b_1 + \gamma_1 b_1) / \Delta'$

$= -\theta(1-\gamma_1)(1-\lambda)b_1 / \Delta' \quad = \theta(1-\gamma_1)b1 / \gamma_1(1+\theta\beta_2)$

$= \theta\beta_2 / (1+\theta\beta_2).$

$$\frac{\partial p_l}{\partial k_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 1-\gamma_1 & 1 & -\gamma_1 \\ 0 & 0 & 1 & 0 \\ -1 & 0 & b_1 & -b_1 \\ 1 & 0 & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{1-\gamma_1}{-\Delta'}\begin{vmatrix} 0 & 1 & 0 \\ -1 & b_1 & -b_1 \\ 1 & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= (1 - \gamma_1)(b_1 - \lambda b_1) / \Delta'$

$= (1-\lambda)(1-\gamma_1)b_1 / \Delta'$

$= -\beta_2 / (1+\theta\beta_2).$

$$\frac{\partial p_l}{\partial a_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & \gamma_1 & 1 & -\gamma_1 \\ 0 & 0 & 1 & 0 \\ -1 & -(1-b_1) & b_1 & -b_1 \\ 1 & \lambda(1-b_1) & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{1}{\Delta'}\begin{vmatrix} 0 & \gamma_1 & \gamma_1 \\ -1 & -(1-b_1) & b_1 \\ 1 & \lambda(1-b_1) & -\lambda b_1 \end{vmatrix}$$

$= \gamma_1 (1 - \lambda) / \Delta'$

$= -1 / (1+\theta\beta_2)$.

$$\frac{\partial y_I}{\partial W} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & 0 & 0 \\ -1 & 1 & 0 & -b_1 \\ 1 & -\lambda & 1-\lambda & \lambda b_1 \end{vmatrix} = \frac{\theta}{\Delta'} \begin{vmatrix} 0 & 0 & -\gamma_1 \\ -1 & 0 & -b_1 \\ 1 & 1-\lambda & \lambda b_1 \end{vmatrix}$$

$= \gamma_1 (1 - \lambda)\theta / \Delta'$

$= -\theta / (1+\theta\beta_2)$.

$$\frac{\partial y_I}{\partial P} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & \theta & 0 \\ -1 & 1 & 0 & -b_1 \\ 1 & -\lambda & 0 & \lambda b_1 \end{vmatrix} = \frac{-\theta}{\Delta'} \begin{vmatrix} 0 & 0 & -\gamma_1 \\ -1 & 1 & -b_1 \\ 1 & -\lambda & \lambda b_1 \end{vmatrix}$$

$= - \gamma_1 (1 - \lambda)\theta / \Delta'$

$= \theta / (1+\theta\beta_2)$.

$$\frac{\partial y_l}{\partial k_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1-\gamma_1 & -\gamma_1 \\ 0 & \theta & 0 & 0 \\ -1 & 1 & 0 & -b_1 \\ 1 & -\lambda & 0 & \lambda b_1 \end{vmatrix} = \frac{1-\gamma_1}{\Delta'}\begin{vmatrix} 0 & \theta & 0 \\ -1 & 1 & -b_1 \\ 1 & -\lambda & \lambda b_1 \end{vmatrix}$$

$= - (1 - \gamma_1)\ (1 - \lambda)\ b_1\theta\ /\ \Delta'$

$= \ \theta\ (1-\gamma_1)b_1/\ \gamma_1(1+\theta\beta_2)$

$= \ \theta\beta_2\ /\ (1+\theta\beta_2).$

$$\frac{\partial y_l}{\partial a_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & \gamma_1 & -\gamma_1 \\ 0 & \theta & 0 & 0 \\ -1 & 1 & -(1-b_1) & -b_1 \\ 1 & -\lambda & \lambda(1-b_1) & \lambda b_1 \end{vmatrix} = \frac{\theta}{\Delta'}\begin{vmatrix} 0 & \gamma_1 & -\gamma_1 \\ -1 & -(1-b_1) & -b_1 \\ 1 & \lambda(1-b_1) & \lambda b_1 \end{vmatrix}$$

$= \ \theta\ \gamma_1\ (1 - \lambda)\ (-1)\ /\ \Delta'$

$= \ \theta\ /\ (1+\theta\beta_2).$

$$\frac{\partial n_l}{\partial W} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_1 & 0 \\ 1 & -\lambda & -\lambda b_1 & 1-\lambda \end{vmatrix} = \frac{1-\lambda}{\Delta'}\begin{vmatrix} 0 & 0 & 1 \\ 0 & \theta & 1 \\ -1 & 1 & b_1 \end{vmatrix}$$

$= (1 - \lambda)\, \theta / \Delta'$

$= -\theta / \gamma_1(1+\theta\beta_2).$

$$\frac{\partial n_t}{\partial P} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & \theta & 1 & \theta \\ -1 & 1 & b_1 & 0 \\ 1 & -\lambda & -\lambda b_1 & 0 \end{vmatrix} = \frac{1}{\Delta'}\begin{vmatrix} 0 & \theta & \theta \\ -1 & 1 & 0 \\ 1 & -\lambda & 0 \end{vmatrix}$$

$= -(1 - \lambda)\, \theta / \Delta'$

$= \theta / \gamma_1(1+\theta\beta_2).$

$$\frac{\partial n_t}{\partial k_t} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & 1-\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_1 & 0 \\ 1 & -\lambda & -\lambda b_1 & 0 \end{vmatrix} = \frac{1-\gamma_1}{-\Delta'}\begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & b_1 \\ 1 & -\lambda & -\lambda b_1 \end{vmatrix}$$

$= -(1 - \gamma_1)(-\theta(\lambda b_1 - b_1)-(1-\lambda)) / \Delta'$

$= (1 - \gamma_1)(1 - \lambda)(1- \theta b_1) / \Delta'$

$= -(1 - \gamma_1)(1 - \lambda)\theta b_1 / \Delta' + (1 - \gamma_1)(1 - \lambda) / \Delta'$

$= -\gamma_1(1 - \lambda) / \Delta' -(1 - \gamma_1)(1 - \lambda)\theta b_1 / \Delta' + (1 - \lambda) / \Delta'$

$= 1 / (1+\theta\beta_2) + \beta_2 / (1+\theta\beta_2) - 1 / \gamma_1(1+\theta\beta_2)$

$= 1 - (1/\gamma_1(1+\theta\beta_2)).$

$$\frac{\partial n_t}{\partial a_t} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & \gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_1 & -(1-b_1) \\ 1 & -\lambda & -\lambda b_1 & \lambda(1-b_1) \end{vmatrix}$$

$$= \frac{1}{\Delta'}\begin{vmatrix} 0 & \theta & 0 \\ -1 & 1 & -(1-b_1) \\ 1 & -\lambda & \lambda(1-b_1) \end{vmatrix} - \frac{\gamma_1}{\Delta'}\begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & b_1 \\ 1 & -\lambda & -\lambda b_1 \end{vmatrix}$$

$$= (-\theta(1-b_1 - \lambda(1-b_1)) - \gamma_1(\lambda-\lambda b_1 - (1-\theta b_1))) / \Delta'$$

$$= -(1-\lambda)(1-b_1)\theta - \gamma_1(\lambda-1)(1-\theta b_1) / \Delta'$$

$$= -(1 - \lambda)(\theta(1 - b_1 + \gamma_1 b_1) - \gamma_1) / \Delta'$$

$$= -(1 - \lambda)\, \gamma_1\, (\theta(1/\gamma_1 - b_1(1-\gamma_1)/\gamma_1)) + 1) / \Delta'$$

$$= (\theta/\gamma_1 - (1 + \theta b_1(1-\gamma_1)/\gamma_1)) / (1+\theta\beta_2)$$

$$= \theta/(1+\theta\beta_2) - 1.$$

<u>Results in Table 1B.</u>

The case of fixed capital stock

$$\frac{\partial w_l}{\partial \omega_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 1 & \theta & 1 & 0 \\ 0 & 1 & b_1 & -b_1 \\ 0 & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{-1}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ 1 & b_1 & -b_1 \\ -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= 0.$ (singular matrix)

$$\frac{\partial p_l}{\partial \omega_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & 1 & 1 & 0 \\ -1 & 0 & b_1 & -b_1 \\ 1 & 0 & -\lambda b_1 & \lambda b_1 \end{vmatrix} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ -1 & b_1 & -b_1 \\ 1 & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$= -(1 - \lambda)(1 - \gamma_1)b_1 / \Delta'$

$= \beta_2 / (1+\theta\beta_2).$

$$\frac{\partial y_l}{\partial \omega_l} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & 0 & -b_1 \\ 1 & -\lambda & 0 & \lambda b_1 \end{vmatrix} = \frac{-1}{\Delta'}\begin{vmatrix} 0 & 0 & -\gamma_1 \\ -1 & 1 & -b_1 \\ 1 & -\lambda & \lambda b_1 \end{vmatrix}$$

$= -(1 - \lambda)(\gamma_1) \;/\; \Delta'$

$= 1 \;/\; (1+\theta\beta_2).$

$$\frac{\partial n_l}{\partial \omega_l} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & \theta & 1 & 1 \\ -1 & 1 & b_1 & 0 \\ 1 & -\lambda & -\lambda b_1 & 0 \end{vmatrix} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 1 \\ -1 & 1 & b_1 \\ 1 & -\lambda & -\lambda b_1 \end{vmatrix}$$

$= -(1 - \lambda) \;/\; \Delta'$

$= 1 \;/\; \gamma_1(1+\theta\beta_2).$

$$\frac{\partial w_l}{\partial \sigma_l} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 1 & \theta & 1 & 0 \\ b_2 & 1 & b_1 & -b_1 \\ 0 & -\lambda & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$$= \frac{1}{\Delta'} \begin{vmatrix} 1 & \theta & 0 \\ b_2 & 1 & -b_1 \\ 0 & -\lambda & \lambda b_1 \end{vmatrix} + \frac{\gamma_1}{\Delta'} \begin{vmatrix} 1 & \theta & 1 \\ b_2 & 1 & b_1 \\ 0 & -\lambda & -\lambda b_1 \end{vmatrix}$$

$= -b_2(\theta\lambda b_1) \;/\; \Delta' - \gamma_1 b_2(-\theta\lambda b_1 + \lambda) \;/\; \Delta'$

$$= -\lambda b_2(\theta b_1 - \gamma_1\theta b_1 + \gamma_1) / \Delta'$$

$$= -\lambda b_2\, \gamma_1(1 + \theta(1-\gamma_1)b_1/\gamma_1) / \Delta'$$

$$= \lambda b_2 / (1+\theta\beta_2).$$

$$\frac{\partial p_I}{\partial \sigma_I} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & 1 & 1 & 0 \\ -1 & b_2 & b_1 & -b_1 \\ 1 & 0 & -\lambda b_1 & \lambda b_1 \end{vmatrix}$$

$$= \frac{1}{\Delta'}\begin{vmatrix} 0 & 1 & -\gamma_1 \\ -1 & b_1 & -b_1 \\ 1 & -\lambda b_1 & \lambda b_1 \end{vmatrix} - \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & -\gamma_1 \\ -1 & b_2 & -b_1 \\ 1 & 0 & \lambda b_1 \end{vmatrix}$$

$$= -(1 - \lambda)(1 - \gamma_1)b_1 / \Delta' - \gamma_1 b_2 / \Delta'$$

$$= \beta_2 / (1+\theta\beta_2) + b_2 / (1-\lambda)(1+\theta\beta_2)$$

$$= (1 / (1+\theta\beta_2))\,(1 + b_2/(1-\lambda).$$

$$\frac{\partial y_I}{\partial \sigma_I} = \frac{1}{\Delta'}\begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_2 & -b_1 \\ 1 & -\lambda & 0 & \lambda b_1 \end{vmatrix} = \frac{\gamma_1}{\Delta'}\begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & b_2 \\ 1 & -\lambda & 0 \end{vmatrix}$$

$= -\gamma_1 (1 - \lambda - \theta b_2) / \Delta'$

$= (1/(1+\theta\beta_2)) (1 - \theta b_2/(1-\lambda))$.

$$\frac{\partial n_I}{\partial \sigma_I} = \frac{1}{\Delta'} \begin{vmatrix} 0 & 0 & 1 & 0 \\ 0 & \theta & 1 & 1 \\ -1 & 1 & -b_1 & b_2 \\ 1 & -\lambda & -\lambda b_1 & 0 \end{vmatrix} = \frac{1}{\Delta'} \begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & b_2 \\ 1 & -\lambda & 0 \end{vmatrix}$$

$= -((1 - \lambda) + \theta b_2) / \Delta'$

$= (1/(1+\theta\beta_2)) (1/\gamma_1 - \theta b_2/\gamma_1(1-\lambda))$.

The case of adjusted capital stock

Given a constant returns to scale production function, $\mathbf{dk_i = dy_i}$ implies that $\mathbf{dy_i = dn_i}$, i.e. factor usage is always optimal and there is no $\mathbf{b_1}$ effect. Hence, our long run model becomes

$$\begin{bmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & 0 & 0 \\ 1 & -\lambda & 0 & 0 \end{bmatrix} \begin{bmatrix} w_i \\ p_i \\ y_i \\ n_i \end{bmatrix} = \begin{bmatrix} (1-\gamma_1)k_i+\gamma_1 a_i+\ldots \\ \omega_i+\theta p+\sigma_i+\ldots \\ -(1-b_1)a_i+b_2\sigma_i+\ldots \\ \lambda((1-b_1)a_i)+\ldots \end{bmatrix}$$

The determinant of this coefficients matrix is given by

$$\Delta'' = \begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & 0 & 0 \\ 1 & -\lambda & 0 & 0 \end{vmatrix}$$

$= -\gamma_1 (1 - \lambda).$

Again using Cramer's rule, we derive the following:

$$\frac{\partial w_l}{\partial \omega_l} = \frac{1}{\Delta''} \begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 1 & \theta & 1 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & -\lambda & 0 & 0 \end{vmatrix}$$

$= 0.$ (singular matrix)

$$\frac{\partial p_l}{\partial \omega_l} = \frac{1}{\Delta''} \begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & 1 & 1 & 0 \\ -1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{vmatrix}$$

$= 0.$ (singular matrix)

$$\frac{\partial y_I}{\partial \omega_I},\ \frac{\partial n_I}{\partial \omega_I} = \frac{1}{\Delta''}\begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & 0 & 0 \\ 1 & -\lambda & 0 & 0 \end{vmatrix} = \frac{\gamma_1}{\Delta''}\begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & 0 \\ 1 & -\lambda & 0 \end{vmatrix}$$

$$= -\gamma_1\,(1-\lambda)\,/\,\Delta''$$

$$= 1.$$

$$\frac{\partial w_I}{\partial \sigma_I} = \frac{1}{\Delta''}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 1 & \theta & 1 & 0 \\ b_2 & 1 & 0 & 0 \\ 0 & -\lambda & 0 & 0 \end{vmatrix}$$

$$= \gamma_1\,(-b_2\lambda)\,/\,\Delta''$$

$$= \lambda b_2\,/\,(1-\lambda).$$

$$\frac{\partial p_I}{\partial \sigma_I} = \frac{1}{\Delta''}\begin{vmatrix} 0 & 0 & 1 & -\gamma_1 \\ 0 & 1 & 1 & 0 \\ -1 & b_2 & 0 & 0 \\ 1 & 0 & 0 & 0 \end{vmatrix}$$

$$= \gamma_1\,(-b_2)\,/\,(1-\lambda)$$

$$= b_2\,/\,(1-\lambda).$$

$$\frac{\partial y_l}{\partial \sigma_l}, \frac{\partial n_l}{\partial \sigma_l} = \frac{1}{\Delta''}\begin{vmatrix} 0 & 0 & 0 & -\gamma_1 \\ 0 & \theta & 1 & 0 \\ -1 & 1 & b_2 & 0 \\ 1 & -\lambda & 0 & 0 \end{vmatrix} = \frac{\gamma_1}{\Delta''}\begin{vmatrix} 0 & \theta & 1 \\ -1 & 1 & b_2 \\ 1 & -\lambda & 0 \end{vmatrix}$$

$$= -\gamma_1 (1 - \lambda - \theta b_2) / \Delta''$$

$$= 1 - \theta b_2/(1-\lambda).$$

CHAPTER 3. THE IMPACT OF TECHNICAL PROGRESS AND DEMAND SHIFTS ON INDUSTRIAL EMPLOYMENT: AN EMPIRICAL ANALYSIS.

I. Introduction.

This chapter is concerned with the empirical assessment of the impact of technical progress and demand shifts in British manufacturing employment. We have previously argued that the employment effects of other factors, such as wage push factors and import prices, are likely to act through their impact on industry demand. At the same time, technical progress is also intertwined with demand. Thus, the roles that technical progress and demand shifts play are crucial. Analytically, we also thought that in the long run, Labour augmenting technical progress is probably neutral in its employment consequences. In the short run, if prices adjust slowly, there could be some scope for rent-seeking activities. We shall confront this with data to see if we are correct.

In the long run, when the capital stock is fully adjusted, employment rises proportionally to secular changes in demand. As to the impact of cyclical demand factors, it is probably not sensible to adjust the capital stock. Therefore, we must consider its short run effects. Here, the employment effects are partly reduced by the fact that prices will rise. These reductions obviously depend on the elasticity of demand, the deterioration in the marginal costs, and the extent firms will raise their profit margins. Ultimately, the overall demand effects depend not only on the coefficients and elasticities, but also on the size of the demand shocks themselves. And we must look at the likely magnitudes of these variables.

To estimate the underlying parameters, we must first operationalise our theoretical model. This we do in section II. In section III, we report a whole host of estimation results, plus a summary of the important parameters. We then proceed to discuss their significance and implications. In section IV, we summarise our findings and provide concluding comments. Appendix 1 contains data definitions and an explanation of their sources. As part of the empirical work, we had to reconcile data based on the 1968 and 1980 Standard Industrial Classifications. This is a source of useful information and we present a note on this matching in appendix 2.

II. An Empirical Investigation.

In the last chapter, we have developed and discussed the theory regarding the impact of technical progress and demand shifts on industry behaviour. In the following, we aim to provide an empirical counterpart to allow us to further the investigation using actual data on British industries. In this activity, we shall refer back to some equations generated in the previous chapter. We were able to use industry by industry data to gather a large amount of information for our estimation. One particular problem we faced was that each industry has its peculiar characteristics. Therefore, we employ panel data techniques to control for these characteristics.

The empirical model

We have to make operational the basic model we developed in the last chapter. First, let us reproduce the four basic equations.

Production:

$$y_i - k_i = \gamma_o + \gamma_1 (n_i + a_i - k_i) \tag{1}$$

Demand:

$$y_i - \bar{y} = \omega_i - \theta(p_i - p) + \sigma_i \tag{2}$$

Pricing:

$$p_i - w_i = b_o - b_1(\bar{y}_i - \bar{n}_i) + (1 - b_1)a_i + b_2(\sigma_i - \bar{\sigma}_i) \tag{3}$$

Wages:

$$w_i = c_o + \lambda(p_i + b_1(\bar{y}_i - \bar{n}_i) + (1 - b_1)a_i) + (1 - \lambda)(w - c_1 u + z_w) + \lambda \beta_2 \gamma_1 u_{i-1} \tag{4}$$

Key parameter: $b_1 - \gamma_1\beta_2/(1-\gamma_1)$

In order to estimate the impact of technical progress on employment, we must obtain estimates of three key parameters, the partial elasticity of output to labour, γ_1, the impact of output on marginal cost, β_2, and the demand elasticity, θ (we retain the notation from chapter 2). Furthermore, for the investigation of demand shifts, we need to capture the direct demand effect on prices, $\mathbf{b_2}$, and the weight of insiders in wage determination, λ. We intend to do this by calibrating a production function, a demand equation, and a price equation for each industry. Estimates of λ will be taken from chapter 4. The data set we shall use is based on the Census of Production, 1974-1985, from which we have consistent data on 45 three digit industries which we group into 9 two digit industries. For each two digit industry we pool the data.

Production function

Production functions are notoriously difficult to estimate. The problem is that factors are often not used to their maximum. Thus, we have to control for capacity utilization. If we let *i* refer to the two digit industry, and *j* to the three digit industry and *t* to time, our basic production for industry *j* has the form

$$y_{jt} - \gamma_{oj} + \gamma_{1i} n_{jt} + (1-\gamma_{1i}) k_{jt} + \gamma_i a_{jt} + \gamma_{2i} lu_{jt} \tag{5}$$

where ***y***, ***n***, ***k***, ***a*** are as before and ***lu*** refers to labour utilisation. *j*, of course, refers to all the three digit industries in *i*. Note that we allow the constant term to be specific to the three digit industry which captures its time invariant features. There are a number of problems arising from the nature of the data. First, the Census of Production does not provide capital stock data at the three digit level. It does, however, have investment data, so we utilise the following approximation:

$$\Delta k_{jt} = \frac{\Delta K_{jt}}{K_{jt}} = \frac{I_{jt} - \delta_j K_{jt}}{K_{jt}}$$
$$\text{or} \quad \Delta k_{jt} = \frac{\nu_j I_{jt}}{\overline{Y}_{jt}} - \delta_j \tag{6}$$

where I=investment, δ_j =exponential rate of decay and $\overline{Y}$ =a moving average of value-added output, ν_j =output capital ratio. Thus instead of normalising on the capital stock, we use a smoothed version of value-added as the scale normalisation.

Second, we must find a proxy for the technical progress term, ***a***. We have a measure of ***a*** at the two digit level, a_{it}, based on the standard production function residual method (see data appendix), so we use a proxy of the form

$$a_{jt} = \gamma_{3j} a_{it} \tag{7}$$

Finally, as a proxy for labour utilisation, we follow Mendis and Muellbauer (1984) and make use of overtime hours, OH_{it}, to define

$$lu_{jt} = \gamma_{4j} OH_{jt} + \gamma_{5j}(1 + OH_{jt})^{-1}$$

These variables are substituted into the wage equation (5). The equation is then first differenced to eliminate the time invariant industry specific effects, yielding

$$\begin{aligned}\Delta y_{jt} = (\gamma_{1j} - 1)\delta_j + \gamma_{1j}\Delta n_{jt} + (1 - \gamma_{1j})\nu_j I_{jt}/\overline{Y}_{jt} + \gamma_{3j}\Delta a_{it} \\ + \gamma_{4j}\Delta OH_{jt} + \gamma_{5j}\Delta(1 + OH_{jt})^{-1}\end{aligned} \tag{8}$$

which forms the basis for our production function estimates.

Demand equation

Turning to the demand equation, we require a measure of demand (in terms of temporary deviations from potential output), σ_i, and a proxy for secular changes in demand, ω_i. Considerations of σ_i include things like competitiveness as these are influenced by exchange rates which will only equilibrate prices in the long run. From equation (4) in chapter 2, we use as our demand index,

$$\sigma_{it}=\alpha_{1i}(p^{*}-p)+\alpha_{2i}(p_i^{*}-p)+\alpha_{3i}y_i^{*}+\alpha_i$$

where p^*=price of world manufacturing exports in domestic currency, p=aggregate price index, p_i^*=world price index of output for industry i in domestic currency and y_i^*=detrended index of world production for industry i. Secular changes in demand include such things as tastes and fashion, and income elasticities of demand. On the whole, we would expect these to be highly trended, and could be proxied by

$$\Delta ta_i=\Delta(y_i-\overline{y}_i^{*}) \tag{9}$$

where y_i=industrial production of industry i and $\overline{y}_i^{*}$ =the index of world production for industry i. So the demand equation to be estimated has the form

$$y_{it}-\overline{y}_t=\alpha_i+\omega_i\Delta ta_{it}-\theta(p_{it}-p_t)+\alpha_1(p_t^{*}-p_t)+\alpha_2(p_{it}^{*}-p_t)+\alpha_3 y_{it}^{*} \tag{10}$$

Price equation

The price equation requires a measure of trend productivity $\overline{y}_{it}-\overline{n}_{it}$ and this is defined by the fitted value of the regression of $y_{it}-n_{it}$ on a cubic polynomial trend. So the price equation based on equation (3) has the form

$$\begin{aligned}p_{it}-w_{it}=\;&b_{0i}+b_{2i}\alpha_i-b_{1i}(\overline{y}_{it}-\overline{n}_{it})-(1-b_{1i})\gamma_{3i}a_{it}+b_{2i}\alpha_{1i}(p_t^{*}-p_t)\\&+b_{2i}\alpha_{2i}(p_{it}^{*}-p_t)+b_{2i}\alpha_{3i}y_{it}^{*}-b_{3i}\Delta^2 w_{it}\end{aligned} \tag{11}$$

where note that we have also included a term in $\Delta^2 w$ in order to capture nominal inertia in price setting.[1] Finally, in order to compute the parameter β_2, recall that

$$b_{1l} = \frac{\beta_{2l}\gamma_{1l}}{1-\gamma_{1l}}$$.(see equation 12b in chapter 2)

Lagged dependent variables will be added prior to estimation. The extent of the lag in this equation is particularly interesting for they create short term economic rents when technical progress occurs.

[1]The idea here is that some prices may be set in advance of wages so that they may depend on w^e as well as w. Then $p = \alpha w + (1-\alpha)w^e$ can be written as $p - w = -(1-\alpha)(w - w^e)$. If wage inflation follows a random walk, we have $\Delta w = \Delta w_{-1} + \epsilon$ which implies $w^e = w_{-1} + \Delta w_{-1}$ and hence $w - w^e = \Delta^2 w$.

III. Results

Parameter estimates for the production function, demand and price equations for each of the nine industries are presented in tables 1 to 3. Note that we have included certain additional lags in each of the equations to account for further dynamics.

The least reliable estimates are the demand elasticities which clearly depend on our ability to capture secular changes in demand. This we can only do in a very crude fashion. So when considering our results we present a range of possible values of demand elasticities in order to see how sensitive our results are to variations in this parameter.

In general, our equations appear to be reasonably successful with good explanatory power. There are only one or two weak results. In particular, the production function in the motor and vehicles sector were very difficult to estimate. This is probably due to the fact that some companies were making losses through most of the period, and hence the observed factor shares do not add up.

In terms of the partial labour elasticity of output, the high ones include textiles, clothing, miscellaneous (small) industries. The low ones include electrical engineering, and the food sector. β_2, which gives the rise in marginal cost when the output-capital ratio rises, measures the difficulty of expanding production with existing machinery. The only high ones here include the food sector, electrical engineering, and bricks and glass.

We find high demand elasticities in metal manufacturing, electrical engineering, food, drinks and tobacco, and the clothing sector. As we have already noted, since our proxy for secular demand factors is somewhat crude, we shall allow a wide range of values in our final assessments. $\mathbf{b}_2$, the pro-cyclicality of pricing to demand, are found to be highest in food, drinks and tobacco, clothing, and miscellaneous industries.

These are mainly non-durables. Last, we also include λ values from chapter 4 for completeness. We next discuss the implied effects of technical progress and demand shifts based on the above parameters.

Technical Progress

In table 4, we present our final parameter estimates and the corresponding partial derivatives which capture the employment effects. The most important point to be made overall is that even given considerable latitude in our estimates of the demand elasticity, the impact of technical progress is generally to increase employment, *ceteris paribus*. The only exceptions to this are Bricks and Glass, and Textiles. This is much as we expected and emphasises the fact that if we are seeking an explanation as to why manufacturing employment has declined so rapidly in the last decade, technical progress is not the answer.

Also notable is that, in general, lags are significant in the price equations. This means that when there is labour augmenting technical progress, prices do not fall instantly. Thus profit margins rise, creating short term rents. Industries which are particularly affected include bricks and glass, food, metal manufacturing, and miscellaneous industries.

Demand Shifts

In table 5, we present our final parameter estimates and the corresponding partial derivatives which capture the demand effects. The key factors which influence the impact of demand on output and employment are those which affect the size of the wage/price offset. This will be bigger if the direct impact of demand on prices ($\mathbf{b_2}$) is large and/or the elasticity of demand (θ) is large. These will be assisted if the insider effects on wage setting (λ) are also large, because then wages will also adjust in the same direction as prices, causing a further reinforcement of the price effect.

On the basis of this, we see from table 5 that the industries with small demand effects are MM, MNES (large θ), and VE, CI and F (large $\mathbf{b_2}$) with the last named having a rather dramatic negative effect. That is, in the food sector an inward shift in the demand curve for food actually leads to a rise in output and employment! This arises because the impact of demand on prices is very large and when this is reinforced by insider wage setting the final result is for price reductions to more than offset the demand fall. While this result is probably excessive, it may be possible to explain the very high pro-cyclicality of prices by inventory costs. Given that food is perishable and has a restricted shelf life, it may be economical for firms to lower prices in recessions to minimise inventory losses.

Those industries with large demand effects are EE, TX, DT (small $\mathbf{b_2}$) and BG (small θ). In the case of DT and TX, once capital has adjusted there is essentially no price offset and the change in demand passes through one for one into a change in output and employment. We have investigated the relationship between these effects and certain industry characteristics such as concentration and import penetration. We have not, however, found any significant correlations. Finally, it should be remembered that although certain industries, such as metal manufacture, respond well to demand shocks, the ultimate outcome depends additionally on the size of the shocks which in this case is rather big. In this context, note that there is a positive relation between the demand elasticity and the size of competitiveness shocks, for the simple reason that high domestic demand elasticity is directly related to high international demand elasticity in the absence of trade barriers.

Table 1

<u>Production Function, 1974-85</u>

Dependent Variable Δy_i

Industry	MM	BG	EE	VE	F	DT	TX	CL	MNES
Δy_{i-1}	-0.35 (0.8)	0.32 (1.2)	0.016 (0.3)	0.00 (0.0)	0.07 (0.4)	0.44 (1.1)	-0.29 (1.7)	-0.45 (2.6)	-0.15 (2.3)
Δn_i	0.67 (2.1)	0.67 (2.7)	0.012 (0.3)	0.10 (0.1)	0.84 (3.3)	0.78 (1.6)	1.05 (5.7)	0.38 (1.5)	0.66 (3.9)
Δn_{i-1}	-0.008 (0.0)	-0.38 (1.3)	0.22 (0.5)	0.59 (0.8)	-0.42 (1.5)	-0.40 (0.7)	0.01 (0.0)	0.63 (2.3)	0.36 (1.8)
$10^{-2} I_i/\overline{Y_i}$	0.36 (0.5)	0.20 (0.6)	1.17 (0.9)	-0.15 (0.1)	-0.30 (0.8)	0.69 (1.4)	-0.25 (0.7)	-0.12 (0.1)	0.043 (0.1)
Δa_i	0.23 (1.3)	0.40 (1.6)	-0.64 (0.6)	0.29 (0.1)	0.38 (1.3)	-0.35 (0.7)	0.21 (0.8)	0.14 (0.2)	0.13 (0.4)
$10^{1}\Delta OH_i$	0.20 (1.3)	0.19 (1.6)	1.66 (1.0)	0.20 (0.4)	-0.11 (0.9)	-0.11 (0.5)	0.28 (2.8)	0.11 (0.7)	0.52 (3.8)
$\Delta(1+OH_i)^{-1}$			0.53 (0.5)						0.018 (2.3)
number of sub-industries	6	5	4	3	6	5	6	6	4
NT	66	55	44	33	66	60	66	72	48
se	0.104	0.089	0.145	0.271	0.089	0.183	0.069	0.155	0.090

<u>Notes</u>

(i) MM = metal manufacure, BG = bricks and glass, EE = electrical engineering, VE = vehicles, F = food, DT = drinks and tobacco, TX = textiles, CL = clothing and footwear, MNES = manufacturing not elsewhere specified.

(ii) The equations also include 3 digit industry dummies.

(iii) The equations are estimated by instrumental variables, with Δy_{i-1} being treated as endogenous. Instruments include further lags on output.

(iv) Estimation performed using DPD. Autoregression and Instrument validity tests were conducted and passed. However, due to small sample properties, these are not presented.

Table 2

Demand Equation, 1974-85

Dependent Variable $[y_i - \bar{y}]$

Industry	MM	BG	EE	VE	F	DT	TX	CL	MNES
$(y_i - \bar{y})_{-1}$	0.91 (19.)	0.75 (13.)	0.87 (21.)	0.58 (4.1)	0.66 (9.3)	0.60 (5.3)	0.78 (14.6)	0.86 (23.4)	0.83 (14.2)
$(p_i - p)$	-1.47 (4.3)	-0.40 (1.1)	-1.21 (5.1)	-1.49 (3.4)	-1.01 (5.6)	-1.34 (3.4)	-0.27 (1.3)	-0.84 (5.9)	-1.58 (2.5)
$(p_i - p)_{-1}$	1.07 (3.2)	0.391 (1.0)	1.05 (5.0)	1.17 (3.8)	0.54 (2.8)	0.45 (1.0)	0.23 (1.1)	0.57 (3.9)	0.46 (0.8)
$(p^* - p)$	0.66 (3.6)	0.40 (2.4)	0.50 (3.8)	0.70 (2.0)	0.24 (2.1)	0.62 (1.7)	0.82 (7.0)	0.44 (2.3)	1.00 (3.7)
$10^{-2} y_i^*$	0.21 (0.7)			0.90 (1.6)		3.39 (1.1)		0.43 (0.7)	0.058 (0.1)
Δta_i	-0.086 (0.5)	0.65 (2.1)	-0.10 (0.4)	0.76 (1.5)	1.35 (2.9)	1.56 (2.1)	0.27 (1.4)	0.62 (2.0)	0.66 (1.7)
number of sub-industries	6	5	4	3	6	5	6	6	4
NT	72	60	48	36	72	60	72	72	48
se	0.10	0.075	0.068	0.141	0.083	0.131	0.077	0.129	0.099

Notes

(i) MM = metal manufacure, BG = bricks and glass, EE = electrical engineering, VE = vehicles, F = food, DT = drinks and tobacco, TX = textiles, CL = clothing and footwear, MNES = manufacturing not elsewhere specified.

(ii) The equations also include 3 digit industry dummies.

(iii) The equations are estimated jointly with the subsequent price equation imposing the cross equation restrictions implied by the structure of the demand term (cf the demand terms in equations (33) and (34)). The term in the industry specific world price was never used because it turned out to be unsatisfactory (i.e. generally wrong signed and insignificant).

(iv) note (iv) in table 1.

Table 3

Price Equation, 1974-85

Dependent Variable $(p_i - w_i)$

Industry	MM	BG	EE	VE	F	DT	TX	CL	MNES
$(p_i - w_i)_{-1}$	0.78 (7.7)	0.88 (15.)	0.30 (2.1)	0.26 (2.4)	0.66 (5.5)	0.60 (8.1)	0.00 (0.0)	0.39 (3.1)	0.66 (5.6)
$(\overline{y_i} - \overline{n_i})$	-0.13 (2.4)	--.085 (1.4)	-0.28 (2.2)	-.047 (0.7)	-0.21 (2.0)	-0.14 (3.2)	-0.83 (10.7)	-0.45 (2.4)	-0.25 (2.6)
a_i	0.036 (1.0)	0.07 (2.2)	-0.20 (1.4)	0.79 (4.4)	0.14 (1.2)	0.34 (6.7)	0.13 (1.1)	-0.11 (0.8)	0.042 (0.4)
$(\sigma_i - \overline{\sigma_i})$	0.35 (2.7)	0.053 (0.9)	0.20 (2.0)	0.56 (1.7)	0.22 (1.7)		0.14 (1.5)	1.13 (1.9)	0.20 (2.5)
$\Delta^2 w_i$	-0.29 (3.3)	-0.24 (2.8)	-0.07 (0.6)	-0.35 (5.2)	-0.34 (1.9)	-0.23 (2.0)	0.052 (0.9)	-0.23 (1.5)	-0.11 (1.0)
number of sub-industries	6	5	4	3	6	5	6	6	4
NT	72	60	48	36	72	60	72	72	48
se	0.041	0.032	0.046	0.058	0.074	0.039	0.041	0.104	0.031

Notes

(i) MM = metal manufacure, BG = bricks and glass, EE = electrical engineering, VE = vehicles, F = food, DT = drinks and tobacco, TX = textiles, CL = clothing and footwear, MNES = manufacturing not elsewhere specified.

(ii) The equations also include 3 digit industry dummies.

(iii) The equations are estimated jointly with the demand equations. $\Delta^2 w_{jt}$ is treated as endogenous. Instruments are $\Delta^2 w_{jt-1}$, $\Delta^2 w_t$, $\Delta^2 w_t$, the latter two being aggregate variables.

(iv) note (iv) in table 1.

Table 4

Employment Effects of Technical Progress

Industry		MM	BG	EE	VE	F
γ_1		0.49	0.43	0.28	0.69	0.39
β_2		0.63	0.91	1.04	0.028	0.97
θ max.		5	1	2	1	2
θ *estimated*		4.48	0.06	1.24	0.75	1.38
θ min.		1	0.05	1	0.7	1
$\frac{\partial n_l}{\partial (w-p)}$	θ max.	-2.45	-1.22	-2.32	-1.41	-1.51
	θ est.	-2.37	-0.12	-1.93	-1.07	-1.32
	θ min.	-1.25	-0.11	-1.75	-1.00	-1.13
$\frac{\partial n_l}{\partial k_l}$	θ max.	0.51	-0.22	0.016	-0.41	0.24
	θ est.	0.47	-1.21	-0.56	-0.42	0.04
	θ min.	-0.25	-1.22	-0.75	-0.43	-0.13
$\frac{\partial n_l}{\partial a_l}$	θ max.	1.45	0.22	1.32	0.41	0.51
	θ est.	1.37	-0.88	0.93	0.07	0.32
	θ min.	0.25	-0.89	0.75	0.00	0.13

Notes

(i) The parameter estimates are based on the appropriate long run coefficients from the individual equations.

Table 4 (cont.)

Employment Effects of Technical Progress

Industry		DT	TX	CL	MNES
γ_1		0.68	0.82	0.70	0.89
β_2		0.165	0.18	0.36	0.09
θ max.		3	1	3	7
θ *estimated*		2.19	0.21	1.98	0.46
θ min.		1	0.1	1	1.5
$\frac{\partial n_l}{\partial (w-p)}$	θ max.	-2.94	-1.03	-2.07	-4.83
	θ est.	-2.37	-0.25	-1.66	4.59
	θ min.	-1.26	-0.12	-1.05	-1.49
$\frac{\partial n_l}{\partial k_l}$	θ max.	0.02	-0.03	0.31	0.31
	θ est.	-0.08	-0.17	0.16	0.29
	θ min.	-0.26	-0.20	-0.05	0.01
$\frac{\partial n_l}{\partial a_l}$	θ max.	1.94	0.03	1.07	3.83
	θ est.	1.37	-0.75	0.66	3.59
	θ min.	0.26	-0.88	0.05	0.49

Notes

(i) The parameter estimates are based on the appropriate long run coefficients from the individual equations.

Table 5

Demand Effects on Wages, Prices, Output and Employment

Industry			MM	BG	EE	VE	F
γ_1			0.49	0.43	0.28	0.69	0.39
β_2			0.63	0.91	1.04	0.028	0.97
b_2			0.14	0.27	0.075	0.32	0.93
λ			0.25	0.17	0.16	0.52	0.33
θ max.			5	1	2	1	2
θ estimate			4.48	0.06	1.24	0.75	1.38
θ min.			1	0.05	1	0.7	1
$dk_f=0$	$\partial w_l/\partial \sigma_l$	θ max.	0.20	0.65	0.37	0.67	0.80
		θ est.	0.21	1.18	0.49	0.68	0.99
		θ min.	0.50	1.19	0.55	0.68	1.20
	$\partial y_l/\partial \sigma_l$	θ max.	0.01	0.35	0.27	0.32	-0.61
		θ est.	0.038	0.93	0.39	0.49	-0.38
		θ min.	0.50	0.94	0.45	0.52	-0.20
	$\partial n_l/\partial \sigma_l$	θ max.	0.02	0.81	0.96	0.46	-1.56
		θ est.	0.078	2.16	1.39	0.71	-0.97
		θ min.	1.02	2.19	1.61	0.75	-0.51
	$\frac{\partial n_l}{\partial \bar{y}}\left(\frac{\partial n_l}{\partial \omega_l}\right)$	θ max.	0.49	1.22	1.16	1.41	0.76
		θ est.	0.53	2.21	1.56	1.42	0.96
		θ min.	1.25	2.22	1.75	1.43	1.13
$dk_f=dy_l$	$\partial w/\partial \sigma_l$		0.048	0.056	0.014	0.35	0.46
	$\partial p_l/\partial \sigma_l$		0.19	0.33	0.089	0.67	1.45
	$\partial y_l/\partial \sigma$, $\partial n_l/\partial \sigma$	θ max.	0.045	0.67	0.82	0.33	-1.78
		θ est.	0.14	0.98	0.89	0.50	-0.92
		θ min.	0.81	0.98	0.91	0.53	-0.39

Notes

(i) The parameter estimates are based on the appropriate long run coefficients from the individual equations.

Table 5(cont.)

Demand Effects on Wages, Prices, Output and Employment

			DT	TX	CL	MNES
Industry			DT	TX	CL	MNES
	γ_1		0.69	0.82	0.70	0.89
	β_2		0.165	0.18	0.36	0.091
	b_2		0.0	0.037	0.25	0.10
	λ		0.33	0.12	0.04	0.24
	θ max.		3	1	3	7
	θ estimated		2.19	0.21	1.98	0.46
	θ min.		1	0.10	1	1.5
$dk_l=0$	$\partial w/\partial\sigma_l$	θ max.	0.11	0.19	0.30	0.13
		θ est.	0.12	0.21	0.36	0.14
		θ min.	0.14	0.22	0.46	0.19
	$\partial y/\partial\sigma_l$	θ max.	0.67	0.81	0.099	0.042
		θ est.	0.73	0.95	0.28	0.089
		θ min.	0.86	0.98	0.54	0.70
	$\partial n/\partial\sigma_l$	θ max.	0.99	0.99	0.14	0.047
		θ est.	1.06	1.16	0.40	0.10
		θ min.	1.26	1.20	0.77	0.79
	$\frac{\partial n_l}{\partial\bar{y}}(\frac{\partial n_l}{\partial\omega_l})$	θ max.	0.98	1.03	0.69	0.69
		θ est.	1.08	1.17	0.84	0.71
		θ min.	1.26	1.20	1.05	0.99
$dk_l=dy_l$	$\partial w/\partial\sigma_l$		0.000	0.005	0.011	0.032
	$\partial p/\partial\sigma_l$		0.000	0.042	0.27	0.13
	$\partial y/\partial\sigma_l, \partial n/\partial\sigma$	θ max.	1	0.96	0.21	0.069
		θ est.	1	0.99	0.48	0.14
		θ min.	1	1.00	0.74	0.80

notes

(i) The parameter estimates are based on the appropriate long run coefficients from the individual equations.

IV. Summary and Conclusion.

We have examined the impact of technical progress and demand shifts on industry behaviour.

Beginning with the effects of technical progress on employment, the key results are as follows. First, in the long run, the existence of insider wage setting has no implications for the employment effects of technical change. The fact that insiders can capture the productivity gains in the short run are irrelevant because competitive forces in the product market ensure that these gains are eventually spread throughout the population via their impact on product prices. Second, the impact of technical progress on employment depends on two offsetting forces. A negative effect arises from the fact that fewer workers are needed to produce any given output. A positive effect is generated by the increased demand arising from the fall in marginal cost and hence reduces price. The elasticity of demand is clearly a key parameter here and so long as this is greater than about unity, technical progress will not cost jobs. Our parameter estimates indicate that for the majority of industries, this is indeed the case.

Next we move onto the impact of demand shifts on output and employment in a variety of manufacturing industries. The major results are as follows. First, there are two factors which determine the effect on demand shifts on industry output and employment. If demand rises, there is a positive direct effect in the product market. However, if the demand shock is of a cyclical nature, it will induce changes in the price mark-up and hence an offsetting negative effect. The size of this latter effect depends on (i) the impact of cyclical demand on prices and (ii) the demand elasticity. If these two parameters are large, then the price offset will, itself, be large. Second, the size of firm/industry specific effects in wage determination are also important here because if industry wages respond directly to industry output prices (via firms' 'ability to pay'), then this will magnify the price changes induced by demand shifts.[2] Finally, the results indicate a wide range of output and employment responses to demand shifts across different industries. We have not, however, found any relationship between the sizes of these effects and the structural characteristics of the industries concerned.

In an explanation of the secular changes in industrial employment, it is important to note that the actual employment effect of the demand variables depend not only on the elasticities but also on the size of the demand shocks themselves. There has been some evidence that British industries have indeed suffer large demand shocks. First, Layard and Nickell (1986) demonstrated significant declines in price competitiveness from the 1950s to the mid-1980s.[3] Second, in terms of trend demand, Thirwall (1978) presented income elasticities of demand for various British industries which he found to be generally lower than those in other industrialised countries.[4] Third, Gomulka (1979) noted that the number of technical innovations in Germany and Japan had overtaken their British counterparts since the early 1960s.[5] While the effects of these innovations are sometimes difficult to quantify, they would have increased quality and choice of foreign products relative to British ones. This would lead to a serious loss of demand.

These features are captured in our model in the following way. If industry demand, aggregate real wages, industry capital and technical progress all move up in proportion, our comparative static results suggest that employment is unchanged (see tables 1A and 1B, chapter 2). What has happened is that because of the decline in

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[2]The examination of these "insider" effects is the subject of the next chapter.

[3]See Layard, R. and S. Nickell, 1986, *The Rise in Unemployment*, pp 128-130.

[4]See Thirwall A., "The U.K.'s economic problems: A Balance of Payments Constraint?" in National Westminster Bank Quarterly Review, Feb. 1978.

[5]See Gomulka, S. (1979), "Increasing Inefficiency versus Slow Rate of Technological Change", p169, in "Slow Growth in Britain" edited by Beckerman (1979).

competitiveness over this period, industry demand has not kept pace with the other variables. It is this which has generated the decline in employment.

Appendix 1

The data are mainly drawn from the Census of Production. They refer to some 51 3-digit industries grouped into ten 2-digit headings. This is more complicated than might appear at first sight because of the dramatic change in the Standard Industrial classification (SIC) which occurred in 1980. The procedure for matching is described in appendix 2 and the numbers below refer to this appendix. The industry groups are (*i*) Metal Manufacture (MM) containing 1,2,3,4,5,6, (*ii*) Bricks and Glass (BG) containing 7,8,9,10,11, (*iii*) Chemicals (CH) containing 12,13,14,15,16,17, (*iv*) Electrical Engineering (EE) containing 18,19,20,21, (*v*) Vehicles (VE) containing 22,23,24, (*vi*) Food (F) containing 25,26,27,28,29,30, (*vii*) Drink and Tobacco (DT) containing 31,32,33,34,35, (*viii*) Textiles (TX) containing 36,37,38,39,40,41, (*ix*) Clothing and Footwear (CL) containing 42,43,44,45,46,47, (*x*) Manufacturing not elsewhere Specified (MNES) containing 51,52,53,54.

The precise definition and sources of all the variables are as follows

p_l : Log output price. British Business various issues, table 4 and Department of Trade and Industry.

y_l : Log gross value added=log(nominal value added)- p_l . The former is taken from Census of Production.

n_l : Log employment. Census of Production.

$I_l/\overline{Y}_l$: Nominal net capital expenditure/3 year moving average of nominal value-added. Census of Production.

a_l : Log technical progress. Two digit variable, source as in Nickell and Kong(1988).

OH_l : Overtime hours. Average weekly hours - Normal weekly hours. Department of Employment Gazette, various issues.

$\bar{y}$: Log potential output. Layard and Nickell (1986).

p : Log Total Final Expenditure deflator at factor cost. Layard and Nickell (1986).

p_l^* : Log world price. (The world price is derived from an average of the US, German and Japanese industry prices converted to domestic currency using the appropriate exchange rate).

p^* : Log world output price. This is a unit value index of world manufacturing exports from UN Monthly Digest of Statistics, converted into domestic currency.

y_l^* : Log world production (detrended). The detrending is carried out via a regression on a quintic in time. The series refers to market economies and is taken from UN Monthly Digest of Statistics.

ta_l : $y_l - \bar{y}_l^*$ where $\bar{y}_l^*$ is the variable used to generate y_l^* prior to detrending.

w_l : Log wage including non-wage labour costs. This is derived from the wage bill plus employers social security contributions divided by employment, taken from the Census of Production.

$\bar{y}_l - \bar{n}_l$: trend version of $y_l - n_l$ using the fitted values from a regression on a cubic polynomial in time.

Appendix 2.

Matching of 1980 SIC and 1968 SIC Using Census of Production Data.

We begin with data based on SIC(1980).

Two CSO publications: "Indexes to the Standard Industrial Classification Revised 1980", and "Standard Industrial Classification Revised 1980-Reconciliation with Standard Industrial Classification 1968" are then used to match earlier data based on SIC(1968) to their SIC(1980) counterpart.

We then check the match with 1979 Gross Value Added numbers which are published in the two different SICs in the Census of Production 1979 and 1980. Given that the approach of the two SICs are different, one is based on processes whereas the other is based on products, the matching can only be approximate.

In total, we managed 55 reasonably consistent series; the accuracy of the matching may be summarised:

Matched to	within 1%	29 industries
	1% to 2%	9 industries
	2% to 3%	6 industries
	3% to 4%	6 industries
	4% to 5%	5 industries(*)

(*) 3 of these are exact matches according to the CSO information.

We adjust the earlier data by these percentages before we splice them onto the later data. The details of the industries matched are listed by industry group:

Match	SIC (1980)	SIC (1968)	% Diff
1	221:Iron & Steel.	311	
	223:Drawing,Rolling,Forming of Steel.	394	
	224:Non-Ferrous Metal.	321,322,323,[394],[396]	
	311:Metal Foundries.	313,321,322	
	312:Forging	393,399/12,[399/4]	
	313:Chains & Surface, Treatment of Metal.	399/12,[399/11]	
	314:Metal Doors & Windows.	399/12,[399/2]	
	316:Hand Tools.	391,392,399/1,399/6-7 399/12,[399/3]	
V.A.	5462.6	5321.5	-2.5
2	222:Steel Tubes	312	
V.A.	272.7	278.6	2.1
3	323:Textile Machinery	335	
V.A.	142.3	143.7	0.9
4	325:Mining & Earth-Moving Equipment	336,337,339/1	
V.A.	1062.0	1057.8	-0.4
5*	330:Office & Electronic Equipment	338,336	
V.A.	720.9	687.0	-4.7
6	320:Fabricated Steel Work	341	
	324:Food Processing Machinery	341,339/7-9	
	326:Power Transmission Equipment	349	
	327:Woodwork,Rubber,Paper, Laundry Machines	339/2,339/9	
	328:Internal Combustion Engines (not cars),Marine Engines.	333,334,339/3-6,339/9, 370	
	361:Water Vessels.	370	
V.A.	6115.4	6132.3	0.3

note. [...] indicates a small element which is not included in the match.
* indicates CSO matches.

Match	SIC (1980)	SIC (1968)	% Diff
7	241:Structural Clay Products	461/2	
V.A.	191.3	190.5	-0.4
8	231:Slate Quarrying 242:Cement,Lime Plaster 243:Other Building Material of Cement,etc. 245:Processed Minerals	102,103,109/4 469/2,464 469/2,464 102,469/2	
V.A.	1377.1	1430.6	3.8
9	246:Abrasives	469/1	
V.A.	81.9	81.4	0.0
10	247:Glass	463/1-2	
V.A.	548.6	547.6	0.0
11	248:Refractory Goods	461/1,462	
V.A.	442.9	445.4	0.6

note. [...] indicates a small element which is not included in the match.
* indicates CSO matches.

Match	SIC (1980)	SIC (1968)	% Diff
12	251:Basic Chemicals	271/1-2,276,277,278	
	483:Plastic Products	492,496	
V.A.	3378.8	3406.8	0.8
13	255:Paint	271/3,274,279/5	
	256:Adhesives,Treatment of Oil/Fat,Explosives	371/3,279/2-3	
	329:Ammunition	271/3,279/4,342,491	
V.A.	1540.0	1516.3	-1.5
14	257:Pharmaceutical Products	272,279/6,[353/1]	
V.A.	1056.9	1077.7	1.9
15	258:Soap and Perfume	273,275	
V.A.	439.0	460.0	4.7
16	259:Photographic & Misc. Chemicals	279/1,279/7,[275,364/3]	
V.A.	159.7	154.0	-3.5
17	260:Man-made Fibres	411	
V.A.	246.2	254.3	3.2

note. [...] indicates a small element which is not included in the match.
This is not used in the estimation.

Match	SIC (1980)	SIC (1968)	% Diff
18	341:Insulated Wires	362	
V.A.	312.2	311.2	-0.3
19	342:Electrical Machinery	361,[369/5]	
V.A.	961.4	928.3	-3.4
20	343:Batteries/Electrical Equipment 344:Telecom.,Radio & Control Systems	367,369/1-3,[369/5] 354,363,367	
V.A.	2508.7	2489.9	-0.7
21	346:Domestic Electric Appliances	368	
V.A.	350.2	353.4	0.9

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
22	351:Motor Vehicles	381	
	352:Vehicle Bodies	381,[496]	
	353:Vehicle Parts	381	
V.A.	3663.7	3738.6	2.0
23	363:Motor & Pedal Cycles	382	
V.A.	63.8	63.9	0.1
24	364:Aerospace Products	383	
V.A.	1355.5	1371.8	1.2

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
25	412:Slaughterhouses/Curing	214	
	415:Fish Processing	214	
V.A.	692.1	716.2	3.4
26	413:Milk Products	215	
	421:Ice Cream/Sugar Confectionery	217	
V.A.	1084.5	1090.5	0.5
27	414:Vegetarian/Fruit Products	218	
	416:Grain Milling	211	
	423(48):Starch,Tea,Coffee	229/2	
V.A.	1039.9	1014.6	-2.4
28*	419:Biscuits & Bread	212,213	
V.A.	870.9	908.7	4.3
29	420:Sugar & By-products.	216	
V.A.	176.0	176.0	0.0
30	422:Animal Fats	219,[272]	
V.A.	391.9	389.0	-0.7

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
31	424:Spirits	239/1,[271/2]	
V.A.	589.2	589.2	0.0
32	426:Cider,Perry,Wine	239/2	
V.A.	49.3	49.3	0.0
33	427:Beer & Malt Products	231	
V.A.	913.3	914.6	0.1
34	428:Soft Drinks	232	
V.A.	325.7	320.1	-1.7
35	429:tobacco	240	
V.A.	555.2	563.5	1.5

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
36	431:Wool	414	
V.A.	397.0	405.2	2.0
37*	432:Cotton	412,413	
	433:Throwing,Texturing of Continuous Filament Yarn	412	
	434:Spinning & Weaving of Flax	412,413	
V.A.	420.6	441.5	4.9
38	435:Jute	415	
V.A.	40.8	40.6	-0.5
39	436:Knitted Fabrics	417	
V.A.	516.4	515.9	0.0
40	437:Finishing of Fabrics	423	
V.A.	227.4	227.9	0.2
41	438:Carpets	419,429/2	
	439:Lace,Rope,Elastics.	416,418,421,429/2	
V.A.	375.5	367.0	-2.2

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
42	441:Leather & Fellmongering	431	
V.A.	103.5	107.5	3.8
43	442:Travelling Goods and Leather for Industry	432	
V.A.	71.5	70.5	-1.3
44	451:Footwear	450	
V.A.	400.3	400.1	0.0
45	453:Clothes	441-6,449	
V.A.	1315.9	1323.2	0.5
46	455:Soft Furnishings & Household Textiles.	422/1-2,473	
	467:Upholstered Furniture	472-4	
V.A.	1083.0	1101.1	1.7
47	456:Fur Goods	433	
V.A.	36.8	37.9	2.9

note. [...] indicates a small element which is not included in the match.

Match	SIC (1980)	SIC (1968)	% Diff
48	46:Timber and Furniture	Order XVII	
V.A.	1743.7	1742.9	0.0
49	471:Pulp & Printing Paper 472:Wall Covering, Household Paper and Packaging	481 482/1-2,483,484	
V.A.	1713.6	1702.4	-0.6
50	475:Printing & Publishing	485(486),489	
V.A.	2819.5	2834.0	0.5

note. [...] indicates a small element which is not included in the match.
This is not a homogeneous group and is not used in the estimation.

Match	SIC (1980)	SIC (1968)	% Diff
51	481:Rubber	491	
V.A.	782.9	806.6	2.9
52	492:Music Instruments	499/1	
V.A.	27.6	27.9	1.0
53	494:Toys & Sports Goods 365:Baby Carriages & Wheelchairs	494/1,494/3 494/2,[382],[399/12]	
V.A.	259.8	257.2	-1.0
54	495:Stationery & Misc.	495,499/2	
V.A.	177.6	169.0	-4.8

note. [...] indicates a small element which is not included in the match.

and,

Match	SIC (1980)	SIC (1968)	% Diff
55	500:Construction	500	
V.A.	8455.5	8455.5	0.0

note. [...] indicates a small element which is not included in the match.
This is not used in the estimation.

CHAPTER 4. THE POWER OF INSIDERS IN WAGE SETTING

I. Introduction.

In this chapter, we analyze certain basic characteristics of the model we have been using in previous chapters. In particular, we want a more precise justification of "insider" effects in wage setting, and an empirically assessment of their magnitudes.

When managers are asked how wage increases are determined, a common response is to state that 'productivity plus inflation' is the basis for negotiation. Thus, for example, managers questioned in the British 1984 Workplace Industrial Relations Survey put forward profitability/productivity and increases in the cost of living as by far the most important influences on pay settlements, with the external pay structure coming a poor third [see Blanchflower and Oswald (1988,table 3) for example].

The fact that increases in worker productivity *within the firm* are thought of as being a prime determinant of wage rises, irrespective of what is happening to pay elsewhere, suggests that 'insider' factors must play an important role in wage bargaining. If the labour market were competitive, 'outside' factors, particularly wages paid elsewhere and possibly the overall state of the labour market, would be the key determinants of pay within the firm.

If insiders are important in pay bargaining this will have profound implications for the behaviour of the macroeconomy. In earlier chapters, we have already established that any "insider" effects will complicate the short run impact of technological progress and demand shifts. Under certain circumstances insider wage setting leads to a high level of hysteresis in the economy which implies that the impact of shocks may persist for very long periods even under rational expectations [see Blanchard and Summers (1986) for example]. It may also lead to asymmetric behaviour and ratchetting, whereby employment responds less, and wages more, to demand increases than to demand falls [see Lindbeck and Snower (1986), for example].

In the light of this, it is our purpose to investigate the importance of insider forces in pay determination in the British industrial sector. In order to do this we further develop the idea in chapter 2 to set up a model of union pay bargaining where unions and firms bargain over wages but firms set employment unilaterally. We utilise this framework because this is the predominant form of pay determination in British industry [see Oswald and Turnbull (1985)]. The general idea is that unions are concerned with the wage and long term employment prospects of a fixed group of workers, the insiders, and firms are concerned with longer term profitability. Long term here is taken to mean the situation which arises when employment has been fully adjusted to the wage bargain. The resulting model of wage determination, a generalisation of that presented in Blanchard and Summers (1986), is one where wages are a weighted sum of the wage which would, on average, induce the firm to employ all the insiders and the wage that would rule if only outside opportunities were significant.

This model is then confronted with data from a number of 2 digit industrial sectors and several hypotheses are investigated. First, are insider factors important? Second, is the importance of insider factors related to union power as our model, in fact, predicts? Third, does the state of play in the external labour market influence wages and is the importance of this factor inversely related to union power? Finally, if insider factors are important, are the insiders a restricted group of workers such as the existing employees or do they extend into the unemployed who last worked in the industry? Only in the former case does insider wage setting translate into hysteresis. Having set out the questions we may now proceed towards the answers.

Our theoretical model is set out in section II. We then discuss the analytical implications of this model in section III. An empirical counterpart is then developed in section IV, followed by a presentation and discussion of the results in section V. Because the data requirements in this activity are different from those in earlier chapters, we were able to use a longer run of 2-digit industry information in our empirical work. After conclusions in section VI, we present in an appendix an interesting comparison study in which we exploit an alternative empirical route and the 3-digit industrial data we used in previous chapters. As well as confirming the consistency in the two data sets, the results there are also helpful in checking some of our empirical specifications. There are also some differences in the theoretical development which we explain in the following section.

II. A Model of Industry Wage Determination.

In the following, we present an imperfectly competitive industry model which is a variant of the one we used in Chapters 2 and 3. There are several reasons for the differences. We are principally concerned with an explicit derivation of a union bargaining set-up that includes "insider" forces. This explains our use of explicit functional forms in our technical equations to minimise ambiguities. In particular, our main aim is to obtain estimates of the strength of "insider" forces in the wage equation. Therefore, we have no need to formulate or estimate any other equation except to help in identifying the "insider" parameter. As a result, we need only to incorporate and estimate a marginal revenue condition instead of the production function itself. This is a major advantage as production functions are notoriously difficult to estimate satisfactorily. A consequence of this approach is that we can use 2-digit industry data where, because of the availability of capital stock data as well as industrial unemployment rates, we can work out the capital-labour ratio as a measure of labour intensity.

Suppose that each industry consists of price setting firms. Since we shall assume that the firms have a constant returns technology and that prices and wages are uniform across the industry, we may take it that factor input/output ratios are also uniform. We thus have an industry production function which we assume, for expositional simplicity, to have the Cobb-Douglas form[1]

$$Y = BN^{a}, \tag{1}$$

where $\boldsymbol{Y}$= value added, $\boldsymbol{N}$= employment, $\boldsymbol{B}$= capital plus technical progress coefficient. To avoid clutter, we drop industry subscripts. Note that the term $\boldsymbol{B}$ has the form

[1]This assumption is not carried over to the empirical work.

$$B = K^{1-a}A^{a}, \tag{2}$$

where K= capital and A= technical progress (written as labour augmenting).

The industry faces a demand for its product of the form

$$Y = \omega(P/\overline{P}_{e})^{-\eta}\,\hat{\theta}, \tag{3}$$

where ω reflects long-run secular movements in demand due to changes in tastes and possibly effects of a non-unitary income elasticity of demand, P= price of industry value added, $\overline{P}^{e}$= expected price of aggregate value added and $\hat{\theta}$ is a random variable reflecting short-run demand shifts. Note that we can recover the original demand equation in chapter 2 if we make $\hat{\theta}=\sigma_{i}\overline{Y}^{e}$. We suppose that decisions are taken in the following sequence. Wages are determined via bargaining between firms and unions before $\hat{\theta}$ is revealed. Prices, employment and output are then fixed after $\hat{\theta}$ is revealed but before the aggregate price level is known. These precise assumptions about timing have no substantive consequences and are not carried over to the empirical section.

Although we suppose that there are employment adjustment costs of the standard type, it is convenient at this stage to analyze the static equilibrium employment behaviour of the industry. In order to do this, we begin with the pricing decision. If the industry behaved as a single monopoly, the resulting monopoly price, $\hat{P}$, would satisfy

$$\hat{P} = \frac{W}{a\epsilon}\,Y^{(1-a)/a}B^{-1/a}, \tag{4}$$

where W is the pre-determined wage and $1/\varepsilon = \eta/(\eta-1)$, the standard monopoly mark-up on marginal cost. The fundamental question is the relationship between the joint monopoly price and that which is actually set. In a Cournot-Nash industry, the actual price is a fixed proportion of the monopoly price.[2] However, other theories indicate that deviations of industry prices from the joint monopoly level are sensitive to short-run demand fluctuations [see Stiglitz (1984), Rotemberg and Saloner (1986), or Bils (1987) for example]. The general view appears to be that industries behave more competitively when demand is high, indicating a pricing equation of the form

$$P = \frac{W f(\hat{\theta})}{a\epsilon} Y^{(1-a)/a} B^{-1/a}, \tag{5}$$

with $f \leq 1$, $f' \leq 0$. Corresponding to this price-marginal cost relationship is the standard marginal revenue product condition obtained by using the product function to eliminate Y from (5). This may be written as

$$N^* = \left(\frac{f(\hat{\theta})}{a\epsilon} \frac{W}{PB}\right)^{-1/(1-a)}, \tag{6}$$

where N^* is the equilibrium level of employment. Recall that under static expectations, convex adjustment costs imply that actual employment follows an approximate partial adjustment process of the form

$$n = \varphi n_{-1} + (1-\varphi) n^*, \tag{7}$$

where lower case letters indicate logs. This equation, which along with (6) yields a dynamic version of the marginal revenue product condition, forms the basis of our

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[2]In fact the mark-up is given by $\eta/(\eta-H)$ where **H** is the Herfindahl Index. See Cowling and Waterson (1976), for example.

empirical analysis of employment.[3]

However, our key purpose in this section is to lay down the foundations for the wage bargaining model. As we have already noted, we suppose that when firms and unions bargain about wages, they concern themselves with the long run consequences of any choices. That is, the union is concerned with the employment consequences when the firm has fully adjusted to the new wage. Similarly the firm is concerned with the long run impact on profitability. Furthermore, since wages are determined prior to the revelation of the demand index $\hat{\theta}$, unions and firms are interested in the expectations of the relevant variables.

By making use of (1),(3),(5), we can express ex-post employment and profit in terms of wages and variables exogenous to the industry. For employment we obtain

$$N^{*} = \tilde{\phi} B_1 (W/\bar{P}^{e})^{-(1+\gamma)},$$

where

$$\tilde{\phi} = [\tilde{\theta}^{1/n} / f(\tilde{\theta})]^{(1+\gamma)}, \; B_1 = (a\epsilon)^{1+\gamma} \omega^{(1+\gamma)/\eta} B^{\epsilon(1+\gamma)}, \; 1+\gamma = (1-a\epsilon)^{-1}. \tag{8}$$

Real profit $\pi = (P/\bar{P}^{e})Y - (W/\bar{P}^{e})N - F$, where F are fixed costs, is given by

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[3]The use of (6) as a basis for the empirical analysis of employment may be questioned in the sense that it is arguably preferable to use an expression for N^{*} which contain variables which are either pre-determined or exogenous to the firm [e.g., eqn (8)] rather than one which contains the endogenous output price of the firm, P. However,, alternatives will inevitably contain the variable ω which captures secular changes in demand. Since these are both unobservable and hard to proxy, we may utilise the marginal revenue product condition, (6), which, in effect, makes use of the output price in order to capture these long run taste changes. Concerning the dynamic structure of (7) we make no attempt here to go beyond this simple dynamic formulation by allowing for non-static expectations, for example. Our justification for this is first that it will make the empirical analysis overly complex in a direction away from the main point at issue and second that given that real wages approximately follow a random walk with drift, the assumption of static expectations is unlikely seriously to violate the data.

$$\pi = B_2(W/\bar{P}^{e})^{-\gamma} - F,$$

where

$$B_2 = B_1^{\alpha\epsilon} B^{\epsilon} \bar{\phi}^{\alpha\epsilon} (\omega\tilde{\theta})^{1/\eta} - \tilde{\phi} B_1. \tag{9}$$

As a basis for bargaining ex-ante, therefore, unions and firms are concerned with expectations of (8),(9).

2.1 A bargaining model of wage determination

The foundation of wage determination we take to be the Nash bargaining model,[4] the strategic justification for which is given by Binmore et al. (1986). In order to make it operational we first consider the union objective. We suppose that unions are concerned only with the welfare of a group of members, N' in number. At this stage we make no assumptions as to who they are. They could, for example, range from a small subset of existing employees to a wide group including all existing employees and recently unemployed union members who are potential employees. We now suppose that the union objective is the expected utility of a representative member of this group. If we suppose that L is the probability that a member of the group does not obtain employment in the industry, U is the member's utility if he does obtain employment and $\bar{U}$ his expected utility if he does not, then the union's objective, **Z**,

[4]The model developed here is essentially static and therefore misses out on some potentially interesting phenomenon. For example, agents will recognize that the higher the wages that are set today, the lower will be employment and the fewer the number of insiders for tomorrow's wage bargain. Unfortunately, there exists no satisfactory sequential bargaining model which is rich enough to cover all the basic issues dealt with here and yet simple enough to be suitable as a foundation for empirical analysis. We would also contend that the static model which we use here is adequate for analyzing the data in the sense that the interpretations placed on the results would not be very different were a sequential bargaining model to be used to provide the underlying theoretical framework.

is

$$Z = (1-L)U + L\tilde{U}. \tag{10}$$

The status quo point, $\bar{Z}$, for the Nash bargain refers to the utility that the representative member can obtain while bargaining proceeds if immediate agreement is not forthcoming. This we suppose to be $\tilde{U}$ since, for the duration of any conflict, existing employees can obtain this elsewhere and any other members of the group can obtain this in any event. So the union's contribution to the Nash bargain is

$$Z-\bar{Z} = (1-L)(U-\tilde{U}). \tag{11}$$

On the firm's side, the concern is with expected profit $E(\pi)$ and the status quo point, $\bar{\pi}$, is simply $-F$ since the firm has to pay out its fixed costs for the duration of the conflict. So the firms' contribution to the Nash bargain is

$$E(\pi)-\bar{\pi} = \bar{B}_2(W/\bar{P}^e)^{-\gamma},$$

from (9), where $\bar{B}_2$ is the mean of B_2. The generalised Nash objective is, therefore,

$$\Omega = (1-L)(U-\tilde{U})\bar{B}_2(W/\bar{P}^e)^{-\gamma\beta}, \tag{12}$$

where β is a measure of firms' bargaining power. The wage outcome is obtained simply by maximizing Ω with respect to W but before this can be analyzed we must discuss the precise form of the L and U functions.

The L function measures the probability of a union member not obtaining work within the industry and is given by

$$L = P(N^* \leq N^I)\left(1-\frac{E(N^*|N^* \leq N^I)}{N^I}\right). \tag{13}$$

So if the random variable $\tilde{\phi}$ has a mean $\bar{\phi}$ and a distribution function *G(.)*, then

it may be shown, using (8), that[5]

$$L(W/\bar{P}^{e},N') = \frac{1}{\mu}\int_{0}^{\mu} G(\tilde{\phi})\,d\tilde{\phi},$$

where

$$\mu = N'(W/\bar{P}^{e})^{(1+\gamma)}B_1^{-1}. \tag{14}$$

The utility function of the representative worker, *U*, we specify as

$$U = V_1(W(1-\upsilon)/\bar{P}^{e}) + V_2(W/\bar{W} - (W/\bar{W})_{-1}),\; V'_1, V'_2 > 0,\; V''_1, V''_2 < 0, \tag{15}$$

where υ is the factor which transforms the real product wage into the post-tax real consumption wage and $\bar{W}$ is the average wage in the economy. The term υ, commonly referred to as the wedge, includes taxes on labour and consumption as well as the real price of imports. Note that utility is allowed to depend not only on the level of real disposable income but also on the gain in wages relative to the economy wide average. This latter term allows for the possibility that individual utility is influenced not only by the level of real income but also by changes in the individual's relative position. While this is not standard in economics, it is both a commonplace

[5]we derive this as follows:

$$P(N^{*}) \le N') = P(\bar{B}_1(W/\bar{P}^{e})^{-(1-\gamma)} \le N') = G(\mu), \textit{ where } \mu = N'(W/\bar{P}^{e})^{(1+\gamma)}B_1^{-1}. \textit{ So}$$

$$L = G(\mu) - \frac{G(\mu)}{N'}\int_{0}^{\mu} B_1(W/\bar{P}^{e})^{-(1+\gamma)}\frac{\tilde{\phi}}{G(\mu)}\,dG(\tilde{\phi}) = G(\mu) - \frac{1}{\mu}\int_{0}^{\mu}\tilde{\phi}\,dG(\tilde{\phi}) = \frac{1}{\mu}\int_{0}^{\mu} G(\tilde{\phi})\,d\tilde{\phi}$$

using integration by parts.

observation that individuals are particularly motivated both by relativities and by deviations from the habitual state of affairs, as well as being an aspect of human behaviour which is well known to social psychologists [see Argyle (1987), for example]. Finally we express expected utility outside the industry as

$$\begin{aligned}\tilde{U}=(1-\bar{u})[V_1[\overline{W}(1-\upsilon)/\bar{P}^e)+V_2(1-(W/\overline{W})_{-1})]\\ +\bar{u}[V_1(\rho\,\overline{W}(1-\upsilon/\bar{P}^e)+V_2(\rho-(W/\overline{W})_{-1})],\end{aligned} \tag{16}$$

where ρ is the benefit replacement ratio and $\bar{u}$ is the aggregate unemployment rate; $\tilde{U}$ is thus the weighted sum of utility in alternative employment and utility while unemployed.

We may now maximise the Nash objective Ω with respect to W to obtain the first-order conditions[6]

$$1-\frac{U-\tilde{U}}{W(\partial U/\partial W)}[(1+\gamma)\frac{G(\mu)-L(\mu)}{1-L(\mu)}+\beta\gamma]=0, \tag{17}$$

which serves as the basis of our wage equation. Before we log-linearise, there is one problem which must be dealt with in preparation for the empirical implementation of this model. As we have already noted in footnote 3, it is convenient to exclude the long-run taste variable ω [see eq.(3)] from our empirical model. Recalling from (14) that μ is given by

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[6]From (12) we have

$$\frac{\partial\Omega}{\partial W}=(\frac{W}{P^e})^{-\gamma\beta}\{-\frac{\partial L}{\partial W}(U-\tilde{U})+(1-L)\frac{\partial U}{\partial W}-\gamma\beta\frac{(1-L)(U-\tilde{U})}{W}\}$$

and from (14)

$$W(\partial L/\partial W)=(1+\gamma)(G(\mu)-L(\mu))$$

giving us the first-order condition (17) in the text.

$$\mu = N'(W/\bar{P}^{e})^{(1+\gamma)}B_{1}^{-1}, \tag{18}$$

we see from eq.(8) that B_1 is a function of ω. However, note that (8) implies

$$\mu = N'\bar{\Phi}/E(N^{*}),$$

and we can utilise the marginal revenue product condition (6) to generate an alternative expression for $E(N^{*})$, namely

$$E(N^{*}) = \left(\frac{f(\hat{\theta})W}{a\kappa P^{e}B}\right)^{-1/(1-a)}, \tag{19}$$

where P^{e} is the price which the firm expects to set and $\hat{\theta}$ is the value of $\tilde{\theta}$ corresponding to $\bar{\Phi}$. Thus we can make use of the fact that we observe the industry output price, P, in order to eliminate the unobserved taste variable ω. Noting the definition of B in eq.(2), we are now able to write μ as

$$\mu = \left(\frac{W}{P^{e}}\right)^{1/(1-a)}\frac{N'}{KA^{a/1-a}}B_{3},$$

where

$$B_{3} = \bar{\Phi}\left(\frac{f(\hat{\Phi})}{a\kappa}\right)^{1/(1-a)}, \text{ a constant} \tag{20}$$

Returning to the first-order condition (17), it is easy to show that, to a high degree of approximation, the term $(U-\bar{U})/W(\partial U/\partial W)$ is homogeneous of degree zero[7] in $W/\bar{P}^{e}, \bar{W}/\bar{P}^{e}$

[7] This can be shown as follows

and so it can be written as

$$\frac{U-\bar{U}}{W(\partial U/\partial W)} = \chi_1(W/\bar{W},(W/\bar{W})_{-1},\nu,\rho,\bar{u}). \tag{21}$$

Writing *(G-L)/(1-L)* as $\chi_2(\mu)$, then (17) reduces to

$$1-\chi_1[W/\bar{W},(W/\bar{W})_{-1},\nu,\rho,u][(1+\gamma)\chi_2(\mu)+\beta\gamma]=0, \tag{22}$$

$$\frac{\partial}{\partial(W/\bar{P}^e)}[\frac{U-\bar{U}}{W(\partial U/\partial W)}] = \frac{1}{W(\partial U/\partial W)}\{vV^1{}_1 - \frac{(U-\bar{U})}{W(\partial U/\partial W)}(vV^1{}_1+vV^{11}{}_1\frac{Wv}{\bar{P}^e})\}$$

$$\textit{where}\, V^1{}_1 = \frac{\partial V_1}{\partial[\gamma W/\bar{P}^e e]}, V^{11}{}_1 = \frac{\partial^2 V_1}{\partial(vW/\bar{P}^e)^2}$$

Omitting second-order terms, and we may approximate $(U-\bar{U})/W(\partial U/\partial W)$ by $(W-\bar{W})/W+[u\bar{W}/W](1-\rho)$. Making use of this and omitting all terms containing $\bar{u}V^{11}{}_1$ as second order, we find that

$$\frac{\partial}{\partial(W/\bar{P}^e)}[\frac{U-\bar{U}}{W(\partial U/\partial W)}] = \frac{\bar{W}vV^1{}_1}{W^2(\partial U/\partial W)}\{1-\bar{u}(1-\rho) - \frac{v(W-\bar{W})}{\bar{P}^e}\frac{V^{11}{}_1}{V^1{}_1}\}.$$

Consider next

$$\frac{\partial}{\partial(W/\bar{P}^e)}[\frac{U-\bar{U}}{W(\partial U/\partial W)}] = -\frac{((1-\bar{u})vV^1{}_1\bar{W}+\bar{u}\rho\, vV^1{}_1\rho)}{W(\partial U/\partial W)}$$

where $V^1{}_1\bar{W} = V^1{}_1$ evaluated at $\bar{W}$. $V^1{}_1\rho$ is defined similarly. Using Taylor expansions we find that

$$\frac{\partial}{\partial(W/\bar{P}^e)}[\frac{U-\bar{U}}{W(\partial U/\partial W)}] = \frac{1}{W(\partial U/\partial W)}\{(1-\bar{u})v(V^1{}_1+\frac{V^{11}{}_1 v}{\bar{P}^e}(\bar{W}-W))+\bar{u}\rho\, vV^1{}_1\}$$

$$= \frac{-vV^1{}_1}{W(\partial U/\partial W)}\{1-\bar{u}(1-\rho) - \frac{vV^{11}{}_1}{\bar{P}^e V^1{}_1}(W-\bar{W})\}$$

$$= -\frac{W}{\bar{W}}\frac{\partial}{\partial(W/\bar{P}^e)}[\frac{U-\bar{U}}{W\partial U/\partial W}].$$

which is the result in the text. Note also that if V_1 is a constant elasticity function, this approximation is exact.

with μ given by (20). If we log-linearise, we obtain a wage equation of the form[8]

$$\begin{aligned} w = {} & c_0+\lambda(p^{e}+(1-a)(k-n^{l})+a\log A) \\ & +(1-\lambda)(\bar{w}-c_1\bar{u}+c_2\log\nu+c_3\log\rho)+c_4(w-\bar{w})_1, \end{aligned} \tag{23}$$

where it is possible to show that $\lambda<1$; $c_1,c_2,c_3>0$. Unfortunately we are unable to demonstrate that λ is positive for a general distribution G although it is positive for a uniform distribution, for example.[9] However, it is clear that if λ is negative we have a potentially unstable situation since the industry wage would respond to the average wage level, $\bar{w}$, with a greater than unit elasticity, so we shall ignore this possibility in what follows.

This type of industry wage model has a very appealing interpretation. If we log-linearise our expression for the expectation of equilibrium unemployment [eq.(19)], we obtain [using (2)]

$$\log E(N^{*}) = -\frac{1}{1-a}(w-p^{e})+k+\frac{a}{1-a}\log A+\mathit{constant}, \tag{24}$$

so the expression in the first bracket of the wage equation can be interpreted as the

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[8]Note that in our definition of μ in eqn.(20) we have supposed the mean of the short-run demand shift $\bar{\Phi}$ to be constant. We are assuming here that the long-run employment expectation induced at different wages is independent of any short-run fluctuations in the mean of the demand shift term. We, in fact, investigated this proposition by including current and/or lagged demand shift variable in the model reported in table 2. In not one industry was a demand term positive and significant at the 5% level so we did not pursue this any further and remain satisfied with our implicit assumption.

[9]λ has the form

$$\frac{(1+\gamma)\chi'_2\mu}{1-a}\left\{\frac{W}{\bar{W}}\frac{\chi_{11}}{\chi^2_1}+\frac{(1+\gamma)\chi_2\mu}{1-a}\right\}^{-1}.$$

It is easy to show that $\chi_{11}>0$ but it is not possible to sign χ'_2 for a general distribution function. We can, however, demonstrate that the denominator is positive.

wage that would be required in order to induce the industry, on average, to employ all N^I insiders. To see this, simply replace log $E(N^I)$ by n^I in (24) and solve for $\mathbf{w}$. If we deem this to be the 'insider' wage, then it seems natural to call the term in the second bracket of the wage equation the 'outsider' wage since it reflects the alternative opportunities available to the worker. The actual wage is thus a weighted sum of the insider and outsider wages and is, therefore, a natural generalisation of the Blanchard and Summers (1986) model which involves only the insider wage, with N^I set equal to last period's employment. Furthermore, it is easy to show that the weight on the insider wage, λ, is a decreasing function of β, the firm's bargaining power [see eq.(12)].[10] So the more powerful is the union in the bargain, the higher is the weight on the insider wage. This hypothesis we investigate in due course.

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[10]From footnote 9 we see that λ has the form

$$\lambda = \frac{(1+\gamma)\chi'_2\mu}{1-a}\left\{\frac{W}{\bar{W}}\frac{\chi_{11}}{\chi^2_1}+\frac{(1+\gamma)\chi'_2\mu}{1-a}\right\}^{-1}$$
$$= \frac{(1-\gamma)\chi'_2\mu}{1-a}\left\{\frac{W}{\bar{W}}\chi_{11}\left(\beta\gamma+(1+\gamma)\chi_2\right)^2+\frac{(1+\gamma)\chi'_2\mu}{1-a}\right\}^{-1}$$

from the definition of χ_1 in (22). This expression is clearly diminishing in β.

III. Industry Wage Behaviour in the Long Run

It is clear from the above analysis that if insider forces are important in wage determination, then wage rises in an industry are influenced by productivity growth within the industry. Suppose, then, that we have two industries, one of which has a rate of productivity growth which is consistently faster than the other. Does this mean that wages in the two industries will continuously diverge? If this were so, it would be an extremely worrying implication of the model since it would imply that the fundamental force of competition was being permanently overridden. In fact, however, this is not an implication of the model because, in the long run, as productivity grows, competition exerts a downward pressure on the industry price and hence on the industry wage.

To see how this operates, consider the log-linear version of the marginal revenue product condition (6), (7) along with the wage equation where we have dropped the lagged dependent variables:

$$n-k=a_0+a_1\log\bar{\theta}-\frac{1}{1-a}(w-p)+\frac{a}{1-a}\log A, \tag{25}$$

$$w=c_0+\lambda(p+(1-a)(k-n^I)+a\log A)+(1-\lambda)(w-c_1\bar{u}+z), \tag{26}$$

where $a_1\log\tilde{\theta}=-1/(1-a)\log f(\tilde{\theta})$ and $z=c_2\log v+c_3\log\rho$, the 'wage pressure' variables. Now suppose that in equilibrium, the number of insiders, n^I, is a fixed proportion of the employees. So

$$n^I=n+\delta. \tag{27}$$

Then, if we further suppose that short-run demand shifts are set at their average level reveals that

$$dw = d\bar{w} - c_1 d\bar{u} + dz - \frac{\lambda(1-a)}{(1-\lambda)} d\delta. \tag{28}$$

Thus industry productivity growth, as captured by ***k*** and ***log A***, has no impact on wages which are influenced solely by outside opportunities and the proportion of employees who are insiders. This result indicates that while insiders can generate a wage 'mark-up' which is higher the lower the proportion of employees who are actually insiders $(\partial w / \partial \delta < 0)$, competitive forces ensure that industry productivity growth is transmitted into lower prices in the long run rather than higher wages.

IV. The Empirical Model

In order to confront this model with the data, we must both generalise it and specify some of the unobserved variables such as the number of insiders. We start out from the wage equation (23) and the marginal revenue product condition (6), (7) which in full dynamic form is

$$n=\varphi n_{-1}+(1-\varphi)[a_o+a_1\log\tilde{\theta}+k-\frac{1}{1-a}(w-p)+\frac{a}{1-a}\log A] \tag{29}$$

Our first problem is that we have no data on value-added prices by industry. If p_f is the final output price and p_m the price of material inputs, then we have the relation (ignoring constants)

$$p=p_f-\frac{s}{1-s}(p_m-p_f), \tag{30}$$

where s is the share of materials in final output. Second, we see no strong reason to impose the Cobb-Douglas assumption on the data and thus we simply write

$$1/(1-a)=a_2. \tag{31}$$

In general a_2 need not be greater than unity since it is the elasticity of substitution divided by the share of capital. Inserting these into the basic model yields

$$\begin{aligned} n=\varphi n_{-1}&+(1-\varphi)[a_o+a_1\log\tilde{\theta}+k-a_2(w-p_f) \\ &-\frac{a_2 s}{1-s}(p_m-p_f)+(a_2-1)\log A], \end{aligned} \tag{32}$$

where

$$\begin{aligned} w=c_o&+\lambda[p_f^e-\frac{s}{1-s}(p_m^e-p_f^e)+\frac{1}{a_2}(k-n^e)+\frac{(a_2-1)}{a_2}\log A] \\ &+(1-\lambda)(\bar{w}-c_1\bar{u}+c_2\log\nu+c_3\log\rho)+c_4(w-\bar{w})_{-1}. \end{aligned} \tag{33}$$

The following terms must now be specified. First, short-run demand shifts are captured by aggregate competitiveness, ***comp***, and deviations of industry specific world production from trend, ***wt***. Thus we have

$$a_1 \log\tilde{\theta} = a_{11} comp + a_{12} wt + \epsilon_1, \tag{34}$$

where ε_l is a further random error reflecting productivity shocks.

The number of insiders, N^I, we capture by

$$N^I = \omega_1 U_{-1} + \omega_2 N_{-1},$$

where ω_2 is the exogenous proportion of previous employees who count as insiders, ω_1, is the exogenous proportion of the unemployed who count as insiders and U_{-1} refers to those unemployed who recently worked in the industry. The insiders therefore reflect some proportion of the existing employees plus some proportion of the relevant group of unemployed workers. If we define the labour force 'attached' to the industry as

$$L = U + N,$$

then

$$N^I = \omega_1 U_{-1} + \omega_2 (L_{-1} - U_{-1}) = \omega_2 L_{-1} \left[1 - \left(1 - \frac{\omega_1}{\omega_2}\right) u_{-1}\right],$$

where ***u=U/L***, the industry specific unemployment rate. This yields

$$n^I = l_{-1} - \left(1 - \frac{\omega_1}{\omega_2}\right) u_{-1} + constant. \tag{36}$$

Note that this formulation generates a positive impact of lagged unemployment on wages so long as the proportion of unemployed who count as insiders is lower than the proportion of existing employees who do so ($\omega_1 < \omega_2$). This is the foundation of the hysteresis element in the insider model.

Finally we deal with the price expectation terms in the wage equation by the standard measurement error method [see Wickens (1982) for example] replacing p_f^e, p_m^e by the actual values p_f, p_m and incorporating the innovations $\epsilon_3 = p_f - p_f^e, \epsilon_4 = p_m - p_m^e$ into the equation error.

Substituting (34),(35),(36) into our basic eqs.(32),(33) yields

$$\begin{aligned} n = {} & \varphi n_{-1} + (1-\varphi)[a_o + a_{11} comp + a_{12} wt + k - a_2(w - p_f) - \frac{a_2 s}{1-s}(p_m - p_f)] \\ & + (a_2 - 1)(\hat{a} + \gamma \hat{t}) + (1-\varphi)[\epsilon_1 + (a_2 - 1)\epsilon_2], \end{aligned} \tag{37}$$

$$\begin{aligned} w = {} & c_o + \lambda[p_f - \frac{s}{1-s}(p_m - p_f) + \frac{1}{a_2}(k - l_{-1}) + \frac{(a_2 - 1)}{a_2}(\hat{a} + \gamma \hat{t})] \\ & + (1-\lambda)\overline{w} - (1-\lambda)c_1\overline{u} + \frac{\lambda}{a_2}(1 - \frac{\omega_1}{\omega_2})u_{-1} + (1-\lambda)c_2 \log \nu \\ & + (1-\lambda)c_3 \log \rho + c_4(w - \overline{w})_{-1} + \lambda[\frac{(a_2 - 1)}{a_1}\epsilon_2 - \frac{(\epsilon_3 - s\epsilon_4)}{1-s}] \end{aligned} \tag{38}$$

For the purpose of estimation we suppose that $k, \hat{a}$ are known in advance and hence predetermined whereas it is clear that w, p_f, p_m may all be influenced by productivity shocks and must, therefore, be treated as endogenous. We also treat *comp* and *wt* as endogenous as a precautionary measure. In the wage equation, the price innovations in the error may be correlated with any current dated variables except for $k, \hat{a}$ which are known in advance and so all such variables must be instrumented by lagged values.

In the light of these remarks, we therefore investigate the following structural model based on (37),(38).

Marginal revenue product condition

$$n-k=\alpha_0-\alpha_1(1-\alpha_5)(w-p_f)-\alpha_2(1-\alpha_5)(p_m-p_f)+\alpha_{31}comp \\ +\alpha_{32}wt+\alpha_4(1-\alpha_5)\hat{a}+\alpha_4(1-\alpha_5)\gamma t+\alpha_5(n_{-1}-k), \tag{39}$$

n=employment, **w**=hourly labour cost*, $\mathbf{p_m}$=material input price*, $\mathbf{p_f}$=final output price*, **comp**=aggregate competitiveness*, **wt**=industry world activity*, **k**=capital stock, $\hat{a}$= residual based measure of technical progress; *variables are treated as endogenous. In (37) it has been assumed that the value-added restriction holds. If this is not the case, then the coefficient on the materials price, α_2, can take either sign. Furthermore, (37) also contains the restriction that technical progress is labour augmenting(LATP). In terms of (39) this restriction has the form

$$\alpha_4=\alpha_1-1 \tag{40}$$

Wage equation

$$w-\bar{w}=\gamma_0+\lambda[(p_f-\bar{w})+\gamma_1(k-l_{-1})-\gamma_2(p_m-p_f)+\gamma_3\hat{a}+\gamma_4 t] \\ +\gamma_5\bar{u}+\gamma_6 u_{-1}+\gamma_7\log v+\gamma_8(w-\bar{w})_{-1}, \tag{41}$$

$\bar{w}$= wages expected to rule elsewhere in the economy, $\bar{u}$= aggregate unemployment rate, **u**=industry specific unemployment rate, **log** v=wedge between employers' real wage and the real consumption wage. This is $t_1+t_2+t_3+s(\bar{p}_m-\bar{p}_f)$ where $\mathbf{t_1}$ is the employer's labour tax rate, $\mathbf{t_2}$ is the income tax rate, $\mathbf{t_3}$ is the excise tax rate, $\bar{p}_m-\bar{p}_f$ is the aggregate real price of imports and **s** is the appropriate share. All current dated variables except $k, \hat{a}$ are treated as endogenous. The model restrictions implied by (37),(38) are $\gamma_1=1/\alpha_1$, $\gamma_2=\alpha_2/\alpha_1$, $\gamma_3=\alpha_4/\alpha_1$, $\gamma_4=\alpha_4\gamma/\alpha_1$. The third of these is not required if the LATP restriction (40) is satisfied and the fourth does not appear if γ=0, for then the time trend is omitted from the model entirely.

V. The empirical investigation.

Our aim in this section is to investigate the four hypotheses set out in the introduction using 25 years of annual data for 14 two-digit industrial sectors in Britain. The data are described in the appendix.

The first stage is to investigate the overall importance of insider factors and we do this by fitting a very general unrestricted wage equation for each industry and testing for the joint significance of the insider variables. Thus, based on the wage equation (41), we simply regress $w-\bar{w}$ on two lags of itself and all the dependent variables except the productivity terms ($k-l_{-1}$), $\hat{a}$ which are so heavily trended that only one lag makes much sense. We also include a trend and constant. The F-tests for the joint significance of the insider variables $(p_f-\bar{w}), (k-l_{-1}), (p_m-p_f), \hat{a}, u_{-1}$ are presented in table 1 and indicate that in 11 of the 14 industries, this group is jointly significant at the 10% level (8 at the 5% level). Furthermore two of the remaining three results indicate that insider factors are of considerable importance.

While such equations are useful for investigating overall effects, the degree of over-fitting and the consequent shortage of degrees of freedom arising from a regression with 15 variables using 25 data points makes them all but useless for any intensive investigation of individual coefficients. However, to avoid charges of data mining and the like, we feel that it is worth presenting results from unrestricted estimates of the wage equation which are identical in form across all industries. So we regress $w-\bar{w}$ on the first lag of all the independent variables in (41) except aggregate unemployment where we use the current value in order to preserve the theoretically important temporal difference between this variable and the industry unemployment rate. Relevant statistics from these regressions are presented in table 2. The first important point is that for most of the industries λ is strongly positive and appears to be larger in those industries with strong unions (chemicals, engineering, vehicles, paper and printing) relative to those with weak unions (textiles, clothing, bricks and glass, construction). This impression will be confirmed more precisely when we have considered estimates of our structural model. The second point worth noting is that the unemployment terms do not give a very clear cut impression. Recall that aggregate unemployment effects should be negative and since it is an outsider factor we might expect it to be more important in those industries where λ is small and unions are weak [see eq.(38)]. Ten out of the fourteen industries have negative aggregate effects and these are indeed large where unions are weak (textiles, clothing, bricks and glass, construction). Again we shall firm up this impression in due course. However, only eight of the fourteen industries have positive industry unemployment effects and overall these unemployment effects are badly determined. This is, perhaps, not wholly surprising given the high degree of collinearity between the two unemployment variables (correlation coefficients are typically in the range 0.91-0.97) so we should not be too disappointed. However, there are clear instances of overall positive unemployment effects in some industries and this will make a contribution to hysteresis in the economy as a whole.

In table 3 we present estimates of the key wage parameters of structural model set out in eqs. (39),(41). The remaining parameters may be found in table 3' in the appendix. our general strategy in estimating this model is as follows. We allow the equations to differ across industries by dropping material prices (p_m-p_f), the trend term and the wedge term (log v) if their coefficients are small and insignificant. We impose the labour augmenting technical progress restriction if it is not rejected. Otherwise, the first equation for each industry is the same throughout, whereas in the second equation we drop one of the unemployment terms if this seems sensible.

Overall, the wage equations are fairly satisfactory in the sense that they always have considerably lower standard errors than a simple first order autoregression, they exhibit stable parameters over the two episodes of greatest 'structural change' in the economy, 1973-1974, 1979-1980 and they generally have serially uncorrelated errors. The cross equation restrictions implied by the theoretical structure are never rejected.

The insider effects, λ, are well determined and differ quite systematically between industries as we might expect. Furthermore, since they are all significantly below unity and typically below one half, this implies that the outside wage is a very important factor in wage determination. Other features worth noting include the fact that the lagged dependent variable, which typically covers a multitude of sins in time series models, usually has a gratifyingly small coefficient. This is consistent with the variables in the wage equation being cointegrated, which in all bar a couple of cases they are. A discussion of the implications of non-stationarity for these equations is provided in an appendix.

Unfortunately the unemployment terms tend not to be well determined, partly as a consequence of their lack of independent variation. If their overall effect seems to be negative we drop the lagged industry term and if positive, we drop the aggregate unemployment rate. Once we do this, then in most cases we obtain a significant effect. This is not, however, a wholly satisfactory procedure.

We are now in a position to present tentative answers to the four questions posed in the introduction. First, are insider forces important? The results reported in all three tables indicate a resounding yes. Industry wages do not simply track aggregate wages modified by the situation in the aggregate labour market but are strongly influenced in the short run by industry price and productivity terms. The second and third questions refer to the relationship between insider/outsider effects and union power. Recall our theoretical framework indicates that the 'insider weight', λ, should be increasing in union power (see fn. (10)) and this implies that the coefficient on aggregate unemployment should also be increasing in union power [see eq.(38)]. Note that an increase in the unemployment coefficient implies that the unemployment effect on wages becomes less important, since it is generally negative. To investigate these issues we analyse the cross industry variation in the λ coefficient and that on aggregate unemployment in relation to union power. Our measure of union power in each industry, which we consider to be relatively stable through time, is the mark-up on union on non-union manual male wages in 1976 as reported in Stewart (1983). As a measure of union power this is superior to union density in the British context, since, for a variety of reasons, several heavily unionised industries have rather weak unions. However this measure does have the drawback that it reflects not only union power but the rents which are available to be captured. To deal with this, we also control for the 1976 industry 5-Firm Concentration Ratio, $\mathbf{C_5}$, when examining the relationships. In table 4, we tabulate Union Power, the 5-Firm Concentration Ratio and the value of λ and the aggregate unemployment coefficients from both table 2 and table 3. We also present some relevant regressions in order to summarise the overall picture. The results here indicate that there is a significant positive correlation across industries between the insider effect, λ, and our measure of union power. This is consistent with the theoretical framework set out in section 2. Furthermore, there is evidence of a positive cross industry correlation between the aggregate unemployment effect and union power. This is the correct sign because larger negative unemployment effects should be associated with weaker unions. Finally, the positive concentration ratio effects are of independent interest. There is evidence of some association between strong insider or weak outsider effects and high levels of concentration within the industry, holding union power constant. This is consistent with the evidence on efficiency wag models presented in Katz (1986), for example. However we do not wish to speculate further at this stage but simply leave it as an interesting result.

The last question posed in the introduction concerns the extent to which insiders are a restricted group of workers such as the existing employees, as opposed to a wider group including the recently unemployed. In this case, we should observe positive lagged industry unemployment effects generating hysteresis in the economy. The evidence here is rather mixed. It is clear from tables 2 and 3 that there are such effects in a minority of industries, in particular CH, MM, VE and CL. Overall, however, we do not find any strong evidence that hysteresis generated by insiders[11] is a pervasive phenomenon.

Finally, the functional relationship between the insider effect and union power we derived in footnote 10 (and estimated in table 4) suggests an alternative empirical route to the estimation of λ. We attempt this interesting exercise in appendix 2, where we also repeat it with the 3-digit industry data we used in previous chapters. It is reassuring that the estimates of λ generated by both sets of data are remarkably similar.

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[11]Hysteresis can arise for other reasons. For example, if the long-term unemployed have only a weak impact on wage determination this will generate hysteresis via the dynamics of the relationship between the unemployment rate and the proportion of long term unemployed [see Nickell (1987) for example].

VI. Summary and conclusions.

The purpose of this exercise has been to investigate the importance of insider factors in wage determination. Starting with a variant of the general model in chapter 2, we have developed a theoretical framework based on union bargaining which indicates that the wage outcome is a weighted sum of that wage which will just ensure the employment of the 'insiders' and the wage which will attract and retain workers in the face of outside competition for their services. The weight attached to the former is found to be an increasing function of the power of the union.

When confronted with the data, this model in both unrestricted and tightly specified form reveals insider factors to be important and indicates that insider forces are stronger and outsider forces weaker when unions are powerful. However, the insider group does not, in general, appear to be restricted to the current incumbents and, as a consequence, hysteresis arising from insider behaviour does not seem to be a pervasive phenomenon. These results based on industry data are generally consistent with those derived using firm data which are reported in Nickell and Wadhwani (1990).

Table 1

Wage equations (VAR type): F tests for insider variables (dependent variable: $w-\bar{w}$, 1961-1985)

Industry	F-statistic	Industry	F-statistic
FDT	1.99	ENES	5.25*
CH	2.03	TX	4.98*
MM	4.32*	CL	7.36*
ME	3.50*	BG	1.20
IE	3.57*	TF	2.81**
EE	5.21*	PP	2.41**
VE	2.37**	CON	4.53*

notes.

i. The equation includes two lags on $w-\bar{w}$, $p_f-\bar{w}$, p_m-p_f, $\bar{u}$, **u**, **log** υ; one lag on $\mathfrak{a}$, $k-l_{-1}$ plus **c** and trend. The F tests the joint significance of the insider terms, namely two lags on $p_f-\bar{w}$, p_m-p_f, **u** and one lag on $\mathfrak{a}$, $k-l_{-1}$.

ii. In order to specify the expected outside wage, $\bar{w}$, we proceed as follows. If wage bargainers are fully informed, then the expected outside wage would simply be, w_a, the aggregate wage. If, as seems more likely, they are less than fully informed about aggregate wages but have a good knowledge of aggregate prices, they would sensibly estimate aggregate wages by $w_{a-1}+\Delta\bar{p}+g$ where $\Delta\bar{p}$ is the change in aggregate prices and **g** is rend real wage growth. So we define $\bar{w}$ as $\alpha w_a+(1-\bar{\alpha})(w_{a-1}+\Delta\bar{p})$, assuming **g** is a constant. In the analyses reported here, we set $\bar{\alpha}=0.5$. In fact, varying $\bar{\alpha}$ on the unit interval makes very little odds to the results.

iii. FDT=food, drink, tobacco; CH=chemicals; MM=metal manufacture; ME=mechanical engineering; IE=instrumental engineering; EE=electrical engineering; VE=vehicles; ENES=other engineering; TX=textiles; CL=clothing and footwear; BG=bricks and glass; TF=timber and furniture; PP=paper and printing; CON=construction.

iv. The relevant statistic is F(8,10), 5%=3.07, 10%=2.37. So * represents a 5% rejection, ** a 10% rejection.

Table 2

Unrestricted wage equations (single lag)
(dependent variable: $w-\overline{w}$, 1961-1985)

Industry	Parameters $\lambda(p_f-\overline{w})_{-1}$	$\gamma_5(\overline{u})$	$\gamma_6(u_{-1})$	se	R^2
FDT	0.49(3.8)	0.68(1.8)	-0.27(0.7)	0.013	0.93
CH	0.34(2.6)	0.11(0.2)	0.06(0.1)	0.017	0.89
MM	0.38(3.0)	-0.37(1.0)	0.18(1.2)	0.015	0.70
ME	0.36(4.0)	-0.62(2.0)	0.87(2.1)	0.012	0.82
IE	0.26(2.1)	-0.63(1.7)	1.04(1.1)	0.016	0.84
EE	0.26(3.7)	-0.25(1.1)	-0.29(0.6)	0.011	0.72
VE	0.32(1.5)	0.07(0.1)	0.26(0.4)	0.025	0.92
ENES	0.22(3.1)	-1.26(5.6)	0.24(1.7)	0.010	0.86
TX	0.13(1.4)	-0.65(1.8)	-0.27(1.3)	0.012	0.94
CL	0.02(0.2)	-1.26(3.1)	0.46(1.8)	0.015	0.92
BG	0.26(2.3)	-0.53(1.2)	-0.16(0.4)	0.016	0.67
TF	0.39(3.5)	-0.73(2.1)	0.44(1.4)	0.013	0.89
PP	0.50(3.7)	0.93(1.7)	-1.38(1.5)	0.019	0.90
CON	-0.10(0.1)	-0.68(2.2)	-0.09(0.5)	0.015	0.79

notes.

i. The equation includes one lag on $w-\overline{w}$, $p_f-\overline{w}$, p_m-p_f, u, log υ, $\hat{a}$, $k-l_{-1}$, the current value of $\overline{u}$ plus **c** and trend.

ii. Notes ii) and iv) on table 1 also apply.

iii. t-statistics in parentheses.

Table 3

Wage equation [structural model, eqs (39,40)]

Parameters	Industry FDT	CH	CH	MM	MM	ME	ME
λ	0.33(4.4)	0.21(2.8)	0.22(2.8)	0.26(2.8)	0.25(3.1)	0.27(4.6)	0.30(5.3)
$\gamma_5(\bar{U})$	0.11(0.4)	0.50(1.5)	-	0.18(0.5)	-	-0.20(1.2)	-0.21(2.7)
$\gamma_6(u_{-1})$	-.068 (0.2)	-0.35 (0.8)	0.19 (0.9)	0.025 (0.2)	0.094 (2.6)	0.036 (0.2)	-
$\gamma_7(\log \upsilon)$	-	-	-	-	-	-	-
$\gamma_8(w-\bar{w})_{-1}$	0.59(4.0)	0.29(1.6)	0.39(2.2)	0.14(0.8)	0.14(0.9)	0.21(1.5)	0.18(1.4)
se	0.0157	0.0182	0.0182	0.0201	0.0196	0.0136	0.0138
se(1st-order autoregression)	0.0200	0.0237	0.0237	0.0213	0.0213	0.0204	0.0204
Autocorrelation, LM, χ^2_2	3.30	1.58	3.18	7.11*	7.40*	3.48	2.08
Parameter stability '73/74 F(12,x)	1.27	0.83	1.10	1.17	0.96	0.92	0.97
Parameter stability '79/80 F(6,x)	1.31	0.82	0.20	0.70	0.79	0.30	0.32
Cross equation restriction χ^2(df)	1.52(2)	1.36(2)	0.82(2)	3.17(3)	5.06(3)	0.30(2)	0.30(2)

Parameters	Industry IE	IE	EE	EE	VE	VE
λ	0.35(5.1)	0.33(5.3)	0.21(3.3)	0.16(2.7)	0.64(3.7)	0.52(3.2)
$\gamma_5(\bar{U})$	-0.07 (0.3)	-0.22 (2.0)	0.27 (1.1)	-0.19 (1.9)	0.96 (1.9)	-
$\gamma_6(u_{-1})$	-0.32 (0.6)	-	-0.82 (2.0)	-	0.35 (0.7)	0.86 (2.0)
$\gamma_7(\log \upsilon)$	-	-	0.054 (1.1)	0.069 (1.4)	-	-
$\gamma_8(w-\bar{w})_{-1}$	0.14(0.9)	0.18(1.2)	0.07(0.4)	0.20(1.1)	0.88(4.3)	0.74(3.9)
se	0.0122	0.0124	0.0123	0.0125	0.0204	0.0204
se(1st-order autoregression)	0.0192	0.0192	0.0153	0.0153	0.0278	0.0278
Autocorrelation, LM, χ^2_2	1.53	1.96	3.34	3.55	0.66	0.75
Parameter stability '73/74 F(12,x)	1.31	1.25	1.30	1.42	1.04	0.78
Parameter stability '79/80 F(6,x)	1.01	0.39	1.24	0.84	1.17	0.57
Cross equation restriction χ^2(df)	6.77(3)	6.50(3)	4.20(2)	3.35(2)	0.43(4)	0.26(4)

Notes.LATP restrictions: $\alpha_4 = \alpha_1 - 1$.

$$w-\bar{w}=\gamma_o+\lambda[(p_f-\bar{w})+\gamma_1(k-l_{-1})-\gamma_2(p_m-p_f)+\gamma_3\hat{a}+\gamma_4 t] \qquad (41)$$
$$+\gamma_5\bar{u}+\gamma_6 u_{-1}+\gamma_7\log\nu+\gamma_8(w-\bar{w})_{-1},$$

$$n-k=\alpha_o-\alpha_1(1-\alpha_5)(w-p_f)-\alpha_2(1-\alpha_5)(p_m-p_f)+\alpha_{31}comp \qquad (39)$$
$$+\alpha_{32}wt+\alpha_4(1-\alpha_5)\hat{a}+\alpha_4(1-\alpha_5)\gamma t+\alpha_5(n_{-1}-k),$$

Table 3(cont.)

Wage equation [structural model, eqs (39,40)]

Parameters	Industry ENES	ENES	TX	TX	CL	BG	BG
λ	0.27(4.2)	0.24(3.9)	0.14(2.0)	0.12(1.9)	0.037 (1.6)	0.17(1.8)	0.17(1.9)
$\gamma_5(\bar{U})$	0.23(0.7)	-0.33(2.9)	-0.49(1.6)	-0.79(4.7)	-1.40(4.7)	-0.76(0.2)	-0.14(1.0)
$\gamma_6(u_{-1})$	-.40(1.8)	-	-0.23(1.2)	-	0.62(3.6)	-0.68(0.2)	-
$\gamma_7(\log \upsilon)$	0.10(1.9)	0.13(2.7)	0.25(4.0)	0.26(4.1)	0.18(2.4)	0.84(1.2)	0.87(1.3)
$\gamma_8(w-\bar{w})_{-1}$	-0.03(0.2)	0.11(0.7)	0.24(1.4)	0.37(2.7)	0.74(5.4)	0.31(1.5)	0.31(1.6)
se	0.0160	0.0141	0.0114	0.0114	0.0137	0.0163	0.0163
se(1st-order autoregression)	0.0194	0.0194	0.0199	0.0199	0.0213	0.0190	0.0190
Autocorrelation, LM, χ^2_2	0.92	3.44	1.98	0.12	0.24	0.34	3.95
Parameter stability '73/74 F(12,x)	1.36	1.23	1.19	1.25	1.58	1.33	1.19
Parameter stability '79/80 F(6,x)	0.43	0.49	1.87	1.24	3.14*	0.37	0.23
Cross equation restriction χ^2(df)	2.84(2)	1.51(2)	0.02(2)	0.79(2)	3.78(3)	6.58(3)	5.26(3)

Parameters	Industry TF	TF	PP	PP	CON	CON
λ	0.26(1.9)	0.24(2.2)	0.29(1.8)	0.42(2.3)	0.12(1.2)	0.12(1.2)
$\gamma_5(\bar{U})$	-0.28 (0.7)	-0.43 (2.5)	-0.15(0.3)	-0.17(0.6)	-0.09(0.1)	-0.54(1.7)
$\gamma_6(u_{-1})$	-0.17 (0.4)	-	0.23(0.3)	-	-0.14 (0.4)	-
$\gamma_7(\log \upsilon)$	-	-	-	-	0.02(0.2)	0.05(0.6)
$\gamma_8(w-\bar{w})_{-1}$	0.046 (0.2)	0.075 (0.3)	0.82(3.6)	0.81(3.6)	-4.2(2.0)	-4.0(2.0)
se	0.0145	0.0142	0.0221	0.0229	0.0148	0.0142
se(1st-order autoregression)	0.0205	0.0205	0.0258	0.0258	0.0278	0.0278
Autocorrelation, LM, χ^2_2	3.17	2.04	0.83	0.63	3.98	4.01
Parameter stability '73/74 F(12,x)	0.70	0.85	1.17	1.22	0.95	0.99
Parameter stability '79/80 F(6,x)	0.84	0.86	1.16	1.23	0.88	0.52
Cross equation restriction χ^2(df)	5.10(3)	4.71(3)	2.81(2)	2.08(2)	0.35(3)	0.58(3)

notes. Cross equation restrictions: $\gamma_1=1/\alpha_1$, $\gamma_2=\alpha_2/\alpha_1$, $\gamma_3=\alpha_4/\alpha_1$, $\alpha_4=\alpha_4\gamma/\alpha_1$.

All current terms except $\mathbf{a}$ and **k** are treated as endogenous - the first lags on all these variables are used as instruments. The model was estimated using non-linear 3SLS on TSP4.1A.

* indicates rejection of null hypothesis.

Table 4

The Relation between Insider Power and Industry Characteristics

Industry	Union Power (U_m)	5 firm Concentration Ratio(C5)	Coefficients λ(table 2)	λ(table3)	$\bar{u}$(table2)	$\bar{u}$(table3)
FDT	0.161	0.618	0.49	0.33	0.68	0.11
CH	0.241	0.602	0.34	0.22	0.11	0
MM	0.116	0.642	0.38	0.25	-0.37	0
ME	0.122	0.351	0.36	0.30	-0.62	-0.21
IE	0.167	0.322	0.26	0.33	-0.63	-0.22
EE	0.108	0.635	0.26	0.16	-0.25	-0.19
VE	0.272	-0.677	0.32	-0.52	-0.07	0
ENES	0.198	0.275	0.22	0.24	-1.26	-0.33
TX	0.111	0.476	0.13	0.12	-0.65	-0.79
CL	0.127	0.254	0.02	0.04	-1.26	-1.40
BG	0.101	0.489	0.26	0.17	-0.53	-0.14
TF	0.269	0.279	0.39	0.24	-0.73	-0.43
PP	0.312	0.323	0.50	0.42	0.93	0.17

OLS regressions

$\lambda(\text{table2})=-0.0038+\underset{(2.1)}{0.98U_p}+\underset{(1.4)}{0.29C5}$ $R^2=0.36$

$\bar{u}(\text{table2})=-2.3+\underset{(2.4)}{4.8U_p}+\underset{(2.6)}{2.3C5}$ $R^2=0.53$

$\lambda(\text{table3})=-0.0640+\underset{(3.0)}{1.17U_p}+\underset{(1.4)}{0.25C5}$ $R^2=0.36$

$\bar{u}(\text{table3})=-1.3+\underset{(1.5)}{1.9U_p}+\underset{(2.7)}{1.6C5}$ $R^2=0.45$

Note. The 5 firm concentration ratio is based on net output and refers to the weighted average across all the 3-digit industries within each 2-digit industry. Union power is taken directly from Stewart(1983), table 3 and corresponding to the raw differential.

Table 5

Marginal Revenue Product Condition [structural model, eqs (39,40)]

	Industry						
Parameters	FDT	CH	CH	MM	MM	ME	ME
α_1	1.62(11.9)	1.05(7.5)	0.93(6.5)	3.13(5.3)	2.96(7.4)	2.16(8.7)	2.08(10.1)
α_2	-	-	-	-	-	-	-
α_{31}	0.14(3.4)	0.20(2.7)	0.24(4.1)	0.53(4.3)	0.55(4.4)	0.25(3.3)	0.30(3.7)
α_{32}	1.20(3.2)	0.30(1.8)	0.40(2.2)	0.32(1.6)	0.32(1.6)	0.51(2.6)	0.82(3.6)
α_4	α_1-1	α_1-1	α_1-1	0.69(1.6)	0.55(2.2)	α_1-1	α_1-1
$\alpha_4\gamma$	-	-	-	-	-	-	-
α_5	0.93(20.6)	0.86(8.3)	0.91(9.5)	0.89(14.5)	0.86(16.0)	0.81(13.0)	0.76(11.3)
se	0.0131	0.0203	0.0206	0.0412	0.0426	0.0263	0.0285

	Industry					
Parameters	IE	IE	EE	EE	VE	VE
α_1	1.13(12.9)	1.12(12.5)	1.29(7.3)	1.24(6.9)	1.92(2.8)	1.66(2.6)
α_2	-	-	-	-	-	-
α_{31}	0.12(1.8)	0.13(1.8)	0.20(3.8)	0.20(3.7)	0.31(5.9)	0.33(6.1)
α_{32}	0.26(1.2)	0.25(1.2)	0.69(5.2)	0.68(5.1)	0.33(2.6)	0.33(2.5)
α_4	α_1-1	α_1-1	-0.13(0.4)	-0.23(0.8)	2.22(2.7)	1.86(2.6)
$\alpha_4\gamma$	-0.023(9.2)	-0.023(8.9)	-	-	-0.041(4.0)	-0.036(3.7)
α_5	0.76(9.9)	0.76(9.9)	0.80(15.7)	0.80(15.2)	0.95(29.1)	0.93(21.0)
se	0.0258	0.0257	0.0174	0.0174	0.0193	0.0192

Notes.

Table 5(cont.)

Marginal Revenue Product Condition [structural model, eqs (39,40)]

	Industry						
Parameters	ENES	ENES	TX	TX	CL	BG	BG
α_1	1.57(9.2)	1.55(9.5)	1.46(7.6)	1.41(7.7)	1.16(2.7)	3.58(10.4)	3.57(10.7)
α_2	-	-	0.94(1.9)	1.06(2.2)	-	-	-
α_{31}	0.28(3.7)	0.30(3.9)	0.49(6.2)	0.51(6.3)	0.37(7.0)	0.31(4.7)	0.31(4.8)
α_{32}	0.81(2.7)	0.92(3.1)	0.73(3.5)	0.76(3.7)	0.64(2.6)	0.86(6.2)	0.86(6.3)
α_4	α_1-1	α_1-1	α_1-1	α_1-1	α_1-1	0.90(4.2)	0.90(4.3)
$\alpha_4\gamma$	-	-	-	-	-	-	-
α_5	0.81(14.1)	0.80(13.9)	0.81(20.8)	0.80(20.5)	0.84(19.9)	0.90(26.3)	0.90(26.3)
se	0.0266	0.0268	0.0198	0.0199	0.0190	0.0187	0.0187

	Industry					
Parameters	TF	TF	PP	PP	CON	CON
α_1	2.24(5.5)	2.18(5.9)	2.11(5.1)	2.01(11.9)	1.60(0.7)	2.78(0.7)
α_2	-	-	-	-	-	-
α_{31}	0.23(2.7)	0.24(2.9)	-	-	AD2.03(2.9)	AD2.21(3.2)
α_{32}	0.71(3.6)	0.71(3.7)	0.26(2.0)	0.40(3.0)	-	-
α_4	-0.01(0.0)	-0.05(0.1)	α_1-1	α_1-1	-1.19(1.3)	-1.89(0.7)
$\alpha_4\gamma$	-	-	-	-	-0.053(2.1)	-0.038(0.8)
α_5	0.91(18.7)	0.91(18.2)	0.93(21.4)	0.84(15.9)	0.90(8.3)	0.95(10.6)
se	0.0264	0.0265	0.0178	0.0170	0.0315	0.0318

APPENDIX 1. Non-stationarity in the wage model

The variables used in the wage model (see table 3) are $(w-\bar{w})$, $\bar{u}$, u, *log v*, and $[p_f-\bar{w}+\hat{\gamma}_1(k-l_{-1}-\hat{\gamma}_2(p_m-p_f)+\hat{\gamma}_3\hat{a}+\hat{\gamma}_4\hat{t}]-\hat{z}$, say. The $\hat{\gamma}$ coefficients used to define $\hat{z}$ for the purposes of this analysis are taken from appendix table 3'. $\bar{u}$, *log v* are aggregate variables and the rest are industry specific. In table A.1, we present Augmented Dickey-Fuller (ADF) tests of the null hypotheses that the series are I(1) and I(2). If the ADF statistics are less than around -3.5 (5%) or -3.2 (10%), then we may reject the null and suppose that the series are I(0) or I(1), respectively.

The general impression given by table A.1 is that the variables are I(1) although in some industries $(w-\bar{w})$ and **z** may be I(0). We should, however, be highly sceptical about results of this kind based on 25 observations since discriminating between a unit root and one which takes the value 0.9, say, is very difficult with so little data.

Were we to have observations for 125 years as opposed to 25 years, it could well be a very different story. Just as a simple example, in the case of aggregate unemployment we do, in fact, have observations from 1850. Over the period 1859-1985, aggregate unemployment fluctuates a great deal, but strictly between the bounds 0-14% (on current definitions). Furthermore, the unemployment series crosses 3% no less than 22 times and 8% no less than 12 times. The probability that such a series is generated by an autoregression with a unit root is more or less negligible. Nevertheless,many short stretches of the series look like a random walk.

However, if we proceed in the standard fashion and suppose the variables to be I(1), we must next check to see if the wage equation variables are cointegrated. In table A.2, we present the appropriate ADF tests and these reveal that aside from one or two exceptions, the variables are indeed cointegrated. The coefficients and t ratios reported in table 3 are thus generally reliable and although we could, perhaps, gain some extra efficiency by using the Johansen (1988) multivariate procedure, the potential rewards would be minimal given the short length of the time series.

These are standard Augmented Dickey-Fuller statistics, using one lag on the differenced residual in the equation generating the statistic.

Table A.1

ADF statistics (1961-1985)

	$(w-\bar{w})$		u		z		$\bar{u}$		$\log v$	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
FDT	-3.8	-4.8	-1.4	-5.7	-3.5	-4.4	-0.2	-4.5	-3.0	-3.2
CH	-5.0	-7.0	-1.8	-5.0	-3.0	-3.7				
MM	-2.9	-5.8	-0.9	-3.3	-2.6	-3.7				
ME	-3.4	-5.0	-1.7	-4.4	-3.3	-3.2				
IE	-2.3	-4.0	-1.9	-5.0	-2.5	-3.6				
EE	-3.1	-5.0	-1.9	-4.8	-2.3	-3.4				
VE	-1.8	-3.8	-1.6	-4.2	-2.9	-3.6				
OE	-2.9	-4.3	-1.4	-4.0	-2.8	-4.0				
TX	-1.6	-4.3	-0.9	-4.1	-3.6	-4.9				
CL	-2.5	-3.3	-0.5	-4.2	-3.3	-4.2				
BG	-4.1	-5.2	-2.0	-4.5	-2.5	-3.3				
TF	-3.2	-4.7	-1.7	-5.2	-2.6	-5.6				
PP	-1.8	-3.7	-2.3	-4.4	-2.3	-3.9				
CN	-2.9	-6.6	-2.6	-5.0	-2.0	-3.0				

Table A.2

ADF tests of cointegration for the wage equations of table 3

FDT	-3.5	EE	-5.8	BG	-3.9
CH	-5.0	EE	-6.0	BG	-3.9
CH	-5.2	VE	-2.5	TF	-3.9
MM	-4.4	VE	-2.5	TF	-4.0
MM	-4.4	OE	-4.1	PP	-4.1
ME	-5.5	OE	-4.1	PP	-4.1
ME	-5.4	TX	-4.9	CN	-5.1
IE	-3.0	TX	-5.1	CN	-6.7
IE	-3.0	CL	-1.5		

APPENDIX 2. An alternative empirical route to identifying λ.

In footnote 10, we derived a relation which showed that the insider power variable, λ, is a function of Union Power, **Up**. In table 4, we showed that empirically, this relation is rather strong. This opens up an alternative route for identifying λ by the joint estimation of:

$$\lambda = \alpha_o + \beta_o(Up - \overline{Up}) \tag{A1}$$

$$\begin{aligned} w = c_o + \lambda[p_f - \frac{s}{1-s}(p_m - p_f) + \frac{1}{a_2}(k - l_{-1}) + \frac{(a_2-1)}{a_2}(\hat{a} + \gamma \hat{t})] \\ + (1-\lambda)\bar{w} - (1-\lambda)c_1\bar{u} + \frac{\lambda}{a_2}(1 - \frac{\omega_1}{\omega_2})u_{-1} + (1-\lambda)c_2\log\nu \\ + (1-\lambda)c_3\log\rho + c_4(w - \bar{w})_{-1} + \lambda[\frac{(a_2-1)}{a_1}e_2 - \frac{(e_3 - se_4)}{1-s}] \end{aligned} \tag{38}$$

In (A1), we have mean-deviated **Up** so that α_o will give the average level of λ. We are also ignoring the concentration variable as these are not very significant in Table 4.

Part of the reason for this exercise is to compare results using 3-digit as well as 2-digit data. To do that, we now derive a version of (38) that could be operational on 3-digit information. First, we have to drop material prices and industry unemployment from (38) because these are not available at the 3-digit level for the whole sample period. The replacement ratio is also dropped because of statistical insignificance.

There are some further problems which arise because the capital stock is not available at the 3-digit level and neither is the industry "labour force", *l*, for the whole sample. To deal with this problem we suppose that *l* can be approximated by $\bar{n}$ plus a constant, where $\bar{n}$ is smoothed employment. We then note that the production function has the form

$$y = a_1 (n+a) + (1-a_1) k$$

which implies that

$$\bar{y} = a_1 (\bar{n}+a) + (1-a_1) k, \tag{A2}$$

$\bar{y}$ being smoothed output. Manipulating (A2) yields

$$k-\bar{n} = \frac{1}{(1-a_1)}(\bar{y}-\bar{n}) - \frac{a_1}{(1-a_1)} a \tag{A3}$$

If we now replace k-l by the above expression for $k-\bar{n}$ in (38) we obtain

$$\begin{aligned} w = c_o - \lambda(p_f + b_2(\bar{y}-\bar{n}) + (1-b_2)a) + (1-\lambda)(\bar{w} - c_1 \bar{u} + c_2 \log v) \\ + c_4 (w-\bar{w})_{-1} + e \end{aligned} \tag{A4}$$

This equation plus equation (A1) serve as the foundation for the empirical work at the 3-digit level. The insider terms in the first bracket capture the industry own price, p, smoothed productivity, $\bar{y}-\bar{n}$, and the technical progress factor, a. It is hypothesised that the weight, λ, depends positively on union power.

Estimation

2-digit level

First, we present the empirical version of (38) which we use to estimate with 2-digit level data as

$$\begin{aligned} w-\bar{w} = \gamma_o + \lambda[(p_f-\bar{w}) + \gamma_1(k-l_{-1}) - \gamma_2(p_m-p_f) + \gamma_3\hat{a} + \gamma_4 t] \\ + \gamma_5\bar{u} + \gamma_6 u_{-1} + \gamma_7 \log v + \gamma_8(w-\bar{w})_{-1}, \end{aligned} \tag{41}$$

In contrast to the main text, the estimation here is based on a pooling of all the industries but allowing certain coefficients to change systematically across the cross section. In particular, we always have an industry specific constant and allow the insider weight to vary across the industries as a function of Union Power (see eqn A1). In order to simplify the estimation,we impose the coefficients on the insider variables, taking them from individual industry estimates of the employment wage model set out in table 3B. The pooled estimates parameter in (A1) and (41) are then

$$\lambda = \underset{(7.0)}{0.13} + \underset{(3.5)}{0.87}(Up - \bar{Up})$$

Thus, there is a strong tendency for insider factors to be accorded a higher weight when union power is higher.

3-digit level

Turning now to the 3-digit estimation based on equation (A4) and (A1), we found that allowing common coefficients aside from the constant across 54 industries was not satisfactory, so we divided up the industries into 11 groups and allowed the productivity, wedge, and unemployment parameters to vary across these groups. As before, we allow an individual industry constant and obtained the following results from a pooled regression.

$$\lambda = \underset{(4.4)}{0.15} + \underset{(1.5)}{0.71}(Up - \bar{Up})$$

Thus we were able to compare the consistency of the two data sets and confirm our estimates of the parameters for the insider effects.

APPENDIX 3. Data Definitions and Sources.

N_i Employees in employment in industry *i*, male and females, G.B., mid-year. Source: *Employment Gazette.*

K_i Gross capital stock (plant and machinery) in industry *i*. Between 1963 and 1977, data taken from Panic(1978). Before 1963 and after 1977, annual gross capital stock (plant and machinery) from the *Blue Book* were used.

W_i Real labour cost in industry *i*. First we compute male hourly wage rate, W_m^i and female hourly wage rate, W_f^i by the expressions

$E_m^i = W_m^i \times NH + W_m^i \times 1.3 \times (H_m^i - NH),$

$E_f^i = W_f^i \times H_f^i,$

where E_m^i, E_f^i are male and female average weekly earnings in the industry *i*. H_m^i H_f^i are male and female average weekly hours in industry *i*. Then we calculate

$$W_i = [\frac{N_m^i}{N_i} x W_m^i + \frac{N_f^i}{N_i} x W_f^i] * (1 + t_1)$$

where N_m^i, N_f^i are male and female employment in industry *i*.

Sources: Earnings and hours are October figures in the *Employment Gazette*. Employment are mid-year figures from *Employment Gazette*. Employment taxes, t_1 are from *Layard and Nickell (1986).*

P_i Output price in industry *i*. Up to 1977, data taken from the *Cambridge Growth Model data bank* via the Macroeconomic Modelling Bureau, Warwick University. After 1977, these are the wholesale price indices in *British Business.*

P_{mi} Price of raw materials purchased by industry *i*. Source: *British Business.*

A_i Five-year moving averages of technical progress in industry *i*, (TP_i) Using a constant returns to scale production function,

$\mathbf{Y_g{}^i = f^i(M_i,K_i,N_i,TP_i)}$,

where $\mathbf{Y_{gi}}$ = gross output in industry *i* at constant prices, $\mathbf{M_i}$ = raw materials input of industry *i* at constant prices; $\mathbf{TP_i}$ was calculated in the manner described by Layard and Nickell (1986). Source: Output and materials at current prices from the *Census of Production* are deflated by the respective price indices.

comp Competitiveness series as described in *Layard and Nickell (1986).*

$\boldsymbol{wt_i}$ Index of world production (market economies), detrended by a quintic in time. Source: *UN monthly statistics.*

$\boldsymbol{u}$ Male unemployment rate, mid-year, G.B. Source: *Layard and Nickell (1986).*

$\boldsymbol{u_i}$ Industry unemployment rate, male and female, mid-year, G.B., defined as $\mathbf{UR_i/(N_i+UR_i)}$. Source for $\mathbf{UR_i}$: *Employment Gazette.* After 1982, when these are no longer published, they are estimated from several proxy indicators; lagged $\mathbf{UR_i}$, *u*, deviations of $\mathbf{N_i}$ from a moving average. The weights used to combine these proxy indicators result from a regression with $\mathbf{UR_i}$ as the dependent variable.

$\mathbf{Y_i}$ Index of industrial production. Source: *Blue Book.*

$\bar{Y}$ Potential output of the economy. Source: *Layard and Nickell (1986).*

W Average aggregate hourly wage, male, October. Source: *Layard and Nickell (1986).*

P Output price index (TFE deflator at factor cost) described in *Layard and Nickell (1985).* Source: *Blue Book.*

AD Adjusted Fiscal Stance. Source: *Layard and Nickell (1986).*

$\boldsymbol{U_p}$ Union power. Unadjusted union mark-up. Source: *Stewart (1983).*

Wedge Taxes plus relative price of imports weighted by the share of imports in final expenditure. Source: *Layard and Nickell (1986).*

t_1 'Tax' rate on labour paid by employers. Source: *Layard and Nickell (1986).*

C_5 Five-firm concentration ratio. This is based on net output and is averaged over the three-digit industries within each two-digit one. Source: *Census of Production.*

CHAPTER 5. UNEMPLOYMENT AND MORTALITY IN ENGLAND AND WALES.

I. Introduction.

In previous chapters, we have studied the decline in industrial employment and its various causes. Obviously, economists are interested in these developments not just for esoteric reasons but are really concerned about their human consequences. In this chapter, we look at one particular aspect of those consequences, namely the mortality impact of unemployment on the working population in England and Wales.

To begin with, let us look at the pattern of male mortality statistics. Figure 1[1] shows that male mortality rates in various age groups have declined steadily in the last one hundred years, punctuated only by the two world wars.

In recent years, the main causes of mortality among working age men have been circulatory diseases (around 33%), cancers (around 25%), followed by physical injuries which are important among younger males (around 25%), but less so for older men (around 3%). The main types of physical injuries which lead to deaths are motor accidents and suicides, each making up around 40% of fatalities in this category. Between 1974 and 1991, the mortality rates in these age groups declined substantially. Apart from incidence of suicides, deaths from major causes have come down in step. The absolute rise in the suicide rates in the 35-44 age group means that suicide rates now decline with age. This is a reversal of the situation in the seventies. (Figure 2)

In terms of the regional picture, the mortality pattern exhibits strong persistence. While mortality rates in every region declined in absolute terms over the last three decades, the North, Yorkshire and Humberside and the North West suffer higher death

[1]Figures are presented on pages 164-168.

rates consistently. East Anglia and the South-east, on the other hand, have far lower mortality rates. This is true for all the age groups we studied (35-44, 45-54, 55-64) and has persisted over the entire sample period. In figure 3, we compare regional mortality rates relative to the average for England and Wales, for males aged 35-44. Figures 4 and 5 repeat this exercise for males aged 45-54 and males aged 55-64. It is obvious from all three pictures that there is no indication that regional variations in the mortality pattern have narrowed or changed in any significant way.

There are many possible reasons why a rise in unemployment could cause mortality. The more traditional view that unemployment creates material deprivation leading to deaths from malnutrition is probably less secure nowadays with the general provision of social security. More and more, the consensus among those who believe in the mortality effect of unemployment is that psychological channels are at work. Employment is not just a source of income, but contributes to people's social status, whether real or self-perceived. It also generates activity and rhythm in life. Thus job-loss can quite easily bring about dis-orientation in sufferers. The resulting mental stress could lead to behaviour which may be considered irrational or reckless in normal circumstances.

A less discussed topic is that a general rise in unemployment can also create uncertainty in the minds of the employed through loss of job security. The implication of this for some people could be just as severe as if they were actually unemployed. In this respect, the rise in unemployment above a certain critical level (when a sense of doom pervades) could have very wide implications indeed.

From the employers' side, times of high unemployment are also times when business volume and profits are low. That could lead to them giving less consideration to costly environmental or safety concerns. This could also have mortality consequences although strictly speaking, it would not be an unemployment effect. We shall return to these issues in the next section as we review the literature on this subject.

In terms of methodology, we note that there has always been problems in this area of research, particularly in the effort to separate cause from effect. A major problem is simultaneous equation bias, i.e. the presence of reverse causation. That health status affects employment prospects is well known (for example, see Nickell, 1979). An associated problem is that unemployment and illness are both related to chronic poverty. Indeed unemployment tends to be concentrated at the unskilled end of the labour market, at the bottom of the income scale (see Layard *et al*, 1991). In this poverty trap situation, people suffer economic deprivation in or out of work. It is not clear how unemployment as such is bad for health.

To overcome this, the use of aggregate time series methods seems more promising. Even here problems persist. First, the causes of ill-health and mortality are many and varied. In a particular year, severe weather conditions could cause more accidents and physical injuries, for example. Where these factors are un-correlated with unemployment rates, their presence creates statistical noise, lowering observed correlations. Where they are correlated with unemployment rates, then we have a serious problem in omitted variables bias. Second, in the modelling of mortality, we have to separate the effects of the cyclical factors like unemployment from the secular changes brought about by, say increased medical and social provision. However, the secular decline in mortality may not be smooth or predictable. Improvements in healthcare and social infrastructures may not happen with sufficient regularity. It is thus difficult to differentiate the secular factors from the cyclical. If we observe that mortality rates rise or fall in a certain period, we cannot tell with confidence whether such changes are part of a long term trend or due to cyclical factors like unemployment. Third, data on unemployment can mean different things over time. For example, the natural rate of unemployment changes over time. To the extent that this reflects labour supply decisions, it will have minimal impact on health. Thus, if people choose not to work because generous unemployment benefits are easily available, then they are actually better off in an unemployed state. Furthermore, the definition of unemployment was substantially revised in the early eighties. And in recent times, there have been reports that employment agencies are more severe in testing benefit entitlements. With more people rejected as unemployed, this obviously lowers the jobless count.

To control for these difficulties, we develop our model in the context of a pooled time series-cross section technique in section III. Section IV describes the data, the estimation equations and the results. We conclude with a summary in section V. Before that, we give a brief survey of the literature on this subject.

II. Background Literature.

The literature in this area may be chronologically separated into two groups, those done in the inter-war years, and those done since the late 1970s.

The inter-war studies are of a cross-section nature, generally associating unemployment with destitution and hence, ill-health such as tooth-decay and maternal mortality (Pilgrim Trust,1938; Rowntree,1941). Some also describe the mental strain of being unemployed (Pilgrim Trust, 1938; Halliday,1935). There is, however, great difficulty in separating out the effects of unemployment from the effects of chronic poverty. Many workers earned wages at or below the recommended minimum for subsistence (Rowntree,1941). To overcome this problem, Titmuss & Morris(1944) used a short time series (1930-1934) of a cross section containing 77 county boroughs, and correlated the change of sickness rates with the change of unemployment rates across the boroughs. They found that the correlations between changes in maternal mortality and diphtheria mortality with changes in unemployment were statistically established; and the corresponding correlations of infant mortality, tuberculosis, diarrhoea and enteritis with unemployment were positive but, each statistic on its own, insignificant. This is by far the best study of the period, and provides the most promising method of research. The shortness of the time series did not allow the dynamics to work through. And the data were not adjusted for changes in demography and inter-regional migration. On this latter point, it is interesting to note that sometimes there are less problems with demographic changes or migration if we compare larger areas. While there may be a lot of migration from rural villages to town centres, say, a large region can contain both types of conurbations so that most of the migration will happen within the region.

Next we turn to the post-war literature. This debate was rekindled with a series of influential papers by Harvey Brenner (1979, 1983). Using time series techniques, Brenner regressed various indices of sickness on measures of economic activity and health care. In the Lancet paper of 1979, he conducted this study using aggregate data for England and Wales, 1936-1976, arriving at the conclusion that while increasing healthcare accounted for the secular decline in mortality, changes in unemployment explain the variations of mortality. His work stirred up some controversy. In addition to the general weakness of aggregate time series studies discussed above, the paper was also attacked in several respects. A criticism of the use of mortality rates as a measure of sickness was that only extreme cases of ill-health are included in the analysis. In Brenner's formulation, unemployment leads to loss of material welfare causing more sickness, eventually resulting in deaths. Each of these mechanisms involves some lag. Thus, he was able to use up to eleven years in lagged unemployment to explain mortality. Of course unemployment may cause illness or death in a much shorter time frame. In his paper in the International Journal of Health Services, Eyre (1977) looked at the impact of job loss on psychology and life-style. He found that induced stress caused mortality rates to peak around economic recessions. Here, the shock of becoming unemployed was associated with increased probability of physical injuries. Another way unemployment could have an immediate impact on mortality was by striking down the already weak. Thus, in the life studies Eyre carried out, he concluded that the latent lag of cause to effect could be of the order of weeks or months.

The alternative to using mortality rates is to study the incidence of particular diseases in relation to unemployment. Unfortunately, this suffers from the problem of imprecise reporting of sickness either because of difficulties in diagnosis or because of differing reporting methods. An extreme example of this was observed in the 1930s when some of the poorest areas were reporting the lowest malnutrition figures, presumably because doctors were so used to seeing malnutrition that they did not report it (Webster,1982). Another data problem in this method is the low rate of incidence, making reliable statistically analysis very difficult. Thus our feeling is that this is probably not a sensible way to proceed.

With the increasing availability of panel or survey type information, we also have more recent longitudinal studies. The results are mixed. Cook, *et al* (1982) found among the unemployed more heavy smokers and a higher incidence of ischaemic heart disease. Fox and Goldblatt (1982) had the surprising result that unemployed men seeking work had a greater mortality rate than others, for all causes but especially in accidents and violence, including suicide. Thus, Fox, *et al* concluded "unemployment may have contributed to an excess of deaths from suicide and related cases but it is not likely to explain the excess of cancers. Other factors should therefore be sought to explain the latter excess." In a study using panel data on individuals from OPCS surveys, Narendranathan, *et al* (1985) found that long spells of unemployment increase the probability of further spells of unemployment; and that past history of sickness raise the probability of future occurrence of sickness. However, they found little evidence that unemployment spells raise the probability of future sickness.

There is a problem with longitudinal studies of mortality. Say we have individuals drawn from two populations. The first population contains very healthy individuals who, therefore have low probabilities of unemployment and mortality. The second group all have terminal illnesses and are as a consequence in very poor health. They therefore have high probabilities of unemployment although their eventual demise has nothing to do with their employment history. But in a comparison of the two populations over time, we will observe a strong positive relation between mortality and unemployment. Here, we once again discover an advantage in using a large unit of aggregation because there is no reason to suspect that each large area has a significantly different health structure in the population.

This brings us to a study using data on standard regions. Junankar (1991), using data on working age men (16-64) in the standard regions over three two-year periods, was able to demonstrate a significant association between unemployment and mortality after controlling for social class and region of residence. This exercise was conducted using standard mortality rate for all causes and for ischaemic heart disease only. In both cases the results were positive. Lower social class was found to be positively associated with mortality rate for all causes but not correlated with death rate due to ischaemic heart disease.

In recent years, there have also been many studies conducted by the medical profession, epidemiologists and sociologists. They have increasingly concentrated on the mental stress that comes from unemployment. Compared to the pre-war period, we do nowadays have wider availability of social benefits. It is perhaps to be expected that the ill-effects of unemployment may come from the psychological shock more than through physical or nutritional deprivation. The effect of this stress is to lead to increased incidence of mental or physical illness. Sometimes this leads to mortality as a result of suicides and serious accidents. Examples in this area of research include the papers by Kelvin and Jarrett (1984), and Moser et al (1984, 1986).

However, we may have presented a false picture of overwhelming consensus on this issue. As another example of a statistical study which did not find any mortality effects of unemployment, we have the paper by Forbes and McGregor (1984) who used the Brenner methodology on Scottish postwar data. Even in papers which have found mortality effects, the significance, magnitudes and timing of the effects are often not in agreement.

The following analysis attempts to build on these developments and clarify some of the controversial aspects. Our approach is close to that in Junankar. However, we shall use much longer time series (26 years) on the standard regions. We shall also make use of duration data on unemployment to help explain mortality. This is done because among the unemployed, there are significant differences between the long term unemployed and the others both in terms of their chances of getting back to work, and also in their mental state. Further, we shall improve on the use of standard mortality rates by focusing on tighter age groups.

III. The Theory.

We start with a model of the form

$$M_{i,t}=\varrho M_{i,t-1}+\beta_1 U_{i,t-1}+\beta_2 \Delta U_{i,t-1}+\mu_i+\mu_t+e_{i,t} \tag{1}$$

i=1,N are regional indices,

t=1,T are annual indices.

M is the age specific mortality rate, for the whole of the current period. ***U*** is the age specific unemployment rate, measured at the end of the previous period. μ_i captures stable regional characteristics such as geography, industrial and occupational patterns and social mix. μ_t captures general factors over time, common to all regions, including the secular decline in mortality rates brought about by steady improvements in healthcare. The lagged dependent variable allows us to capture the dynamics in this relation.

We control for the demographic structure by looking at age specific mortality and unemployment rates. Further, since we concentrate on working age men, we hope to isolate a more direct relationship between unemployment and ill-health.

The unemployment term in equation (1) is obviously used to capture the unemployment effects on mortality. Together with the lagged dependent variable, we hope to capture its impact and the long run effect. The presence of the difference in unemployment is used to capture a kind of shock effect experienced by those people becoming unemployed. Hence, this term will allow us to assess the argument that unemployment influences health and mortality via psychological channels.

While equation (1) gives us a simple model to frame our analysis, it is perhaps not complete. First, changes in unemployment could be due to changes in unemployment duration, without more people entering unemployment. In that case, the same number of people are getting unemployed but for a longer period of time. Therefore, the effect due to changes in unemployment we measure in (1) is a mixture of the shock effect we referred to earlier, plus a duration effect. Second, much previous literature highlighted the material deprivation brought about by unemployment which led to ill-health. In this context, it would be useful for us to incorporate a long-term unemployment effect, as this group could be expected to suffer most from economic hardship. Once again, including an unemployment duration variable alongside our unemployment variables seem sensible. Equation (2) is a general way we propose to do this.

$$M_{l,t}=\varrho M_{l,t-1}+\beta_1 U_{l,t-1}+\beta_2 \Delta U_{l,t-1}+\alpha_1 \rho_{l,t-1}+\alpha_2 \rho_{l,t-2}+\mu_l+\mu_t+e_{l,t} \tag{2}$$

where ρ is the proportion of long-term unemployment in the overall unemployment rate. In (2), the α's assess a duration effect controlling for overall unemployment and changes in unemployment. Furthermore, now the parameter on the change in unemployment can be more clearly interpreted as a psychological shock kind of influence.

Perhaps the biggest problem in the estimation of equations (1) and (2) is the simultaneous equation bias due to reverse causation. Of course, mortality cannot cause unemployment, but the precursor illness can. We can minimize this problem by looking at aggregate data. While at the individual level, probability of job loss is significantly increased by a history of ill-health, it is less clear that similar effects hold at the regional level. At the individual level, there is more choice for employers to substitute one worker for another. At the regional level, if the whole workforce is less healthy, there is less scope to replace them. Certainly, no one has claimed that the

North South divide in economic prosperity and unemployment is caused by unhealthy workers. Nor is it easy to argue that incidence of illness drives unemployment or business cycles to any extent. While we have made a case for how aggregate unemployment, its change and its duration may affect aggregate mortality rates, it is difficult to argue that the incidence of illness can explain innovations in all these unemployment variables.

In (1) and (2), note also the use of lagged unemployment and duration data to reduce simultaneous equation bias.

IV. The Empirical Investigation.

To control for demograhic differences in the regions, we focused on three 10-year age groups of working age men. These are men aged 35-44, 45-54 and 55-64 in the nine standard regions of England and Wales, over the period 1966-1991. The watershed we use to distinguish between short and long-term unemployment is 52 weeks duration. Furthermore, we allow for time-invariant regional characteristics and eliminate general macro-factors in the following way.

Estimation.

Both equations are transformed before estimation. Take equation (1),

$$M_{l,t}=\rho M_{l,t-1}+\beta_1 U_{l,t-1}+\beta_2\Delta U_{l,t-1}+\mu_l+\mu_t+e_{l,t}$$

We study regional differences by looking at deviations from the national average, so that if $\overline{X}_t=\frac{1}{N}\sum_l X_{l,t}$,

$$M_{l,t}-\overline{M}_t=\rho(M_{l,t-1}-\overline{M}_{t-1})+\beta_1(U_{l,t-1}-\overline{U_{t-1}})+\beta_2(\Delta U_{l,t-1}-\overline{\Delta U_{t-1}})+(\mu_l-\overline{\mu})+(e_{l,t}-\overline{e}_t) \quad (3)$$

Since $\mu_t-\frac{1}{N}\sum_l\mu_t=0$, we have eliminated secular or time effects in (3). We first estimate (3) using the Least Squares Estimator (GLS) in TSP. With the use of highly aggregated regional data, we hope to alleviate the problem that unemployment and mortality rates are jointly determined. Hence, we feel reasonably confident of these estimates. To make sure of the absence of endogenous biases, we repeat these estimations by instrumenting for the unemployment rates and the lagged dependent variable. The instruments we use are regional unemployment rates in other age groups. The drawback here involves the loss of efficiency and the small sample properties of the Instrumental Variable (IV) Estimator. In terms of the former, if our explanatory power diminishes, the lagged dependent variable effect tends to increase. This gives the impression of a longer lag structure than is true. As far as the small sample properties of the IV estimator is concerned, it is difficult to counter them systematically. It is thus dangerous to place too much confidence in them. Hence, we prefer to interpret from our GLS estimates below. We shall also present the corresponding IV estimates, in which we hope to find comparable long-run effects from our unemployment variables. This will help to confirm that our GLS estimates are sound.

Results.

Log-linear versions of equations (1) and (2) are transformed as in (3) prior to estimation. Estimation results for equation (1) are shown below:

Table 1. GLS Estimates of Equation 1.

Dependent Variable: Mortality Rates(MR)	Male 35-44	Male 45-54	Male 55-64
Lagged MR	0.174 (2.5)	0.075 (1.1)	0.176 (2.6)
Lagged Unemployment Rate (UR)	0.010 (0.3)	0.024 (2.2)	0.060 (4.4)
Change in UR (lagged)	0.038 (1.2)	0.021 (1.4)	0.018 (1.2)
Long run U effect	0.013	0.026	0.051
Ave SE	*0.055*	*0.030*	*0.023*
Ave DW	*1.60*	*1.70*	*1.30*
NT	*207*	*207*	*207*

t-statistics in parentheses.
Regional dummies not shown.

Three features stand out. First, overall unemployment effects rise with age. This is reasonable in the sense that older people are, in general, less able to sustain a period of physical hardship. Second, there are some indications that the unemployment shock effect decreases with age. This is consistent with the view that job loss can represent a shock in psychology and life-style that leads to higher mortality in things like accidents and suicide. As we observed before, the number of fatalities caused by these events have been volatile and increasing in younger men. Third, the coefficients on the lagged dependent variables are small, implying fairly short lags for the unemployment effects to work through. These results give a preliminary picture of significant associations between unemployment rates and mortality rates.

For a more complete assessment, we continue with an estimation of equation (2), reported below.

Table 2. GLS Estimates of Equation 2.

Dependent Variable: Mortality Rates(MR)	Male 35-44	preferred	Male 45-54	preferred	Male 55-64
lagged MR	0.199 (3.0)	0.228 (3.5)	0.103 (1.6)	0.104 (1.6)	0.409 (7.1)
lagged Unemployment Rate(UR)	-0.047 (1.5)	-0.033 (1.1)	0.000 (0.0)	0.000 (0.0)	0.036 (4.1)
Change in UR (lagged)	0.060 (1.8)	0.035 (1.3)	0.036 (2.2)	0.036 (2.3)	0.051 (3.8)
ρ_{t-1}	0.047 (1.6)		0.000 (0.0)	-	0.019 (1.5)
ρ_{t-2}	0.111 (4.2)	0.141 (7.1)	0.047 (2.6)	0.047 (2.9)	-0.071 (6.2)
Ave SE	*0.051*	*0.045*	*0.030*	*0.029*	*0.022*
Ave DW	*1.78*	*1.80*	*1.78*	*1.79*	*1.75*
N	*207*	*207*	*207*	*207*	*207*

t-statistics in parentheses.
Regional dummies not shown.

In this more correct formulation, we find that the unemployment shock variable is uniformly significant for all the age groups we cover. This is so after we have controlled for the variations in unemployment duration. Further, these shock effects appear more potent than the level effect of the unemployment rate which is only significant for the 55-64 age group.

The unemployment duration terms are also significant, though the pattern of their influence is more complex. The strongest effect appears on the equation for the 35-44 age group. This is halved in the 45-54 equation. What is more intriguing is the negative impact the duration variable seems to have on the mortality of older men aged 55-64. One possible explanation could be that over 55, people can move from long term unemployment into retirement. Obviously, it is then less of a stigma to have left employment. Also at that age, many people would have had time to save up sufficient resources. Hence, they are more prepared psychologically and materially.

The coefficients on the lagged dependent variable are in general small, ranging from 0.1 to 0.4, indicating a fairly short time lag for the various unemployment effects to work through. This is consistent with the overwhelming importance of the shock variable which is expected to have a more direct and immediate impact on mortality through events such as suicide or accidents. Although the duration variables are significant, their overall impact is perhaps limited because the change in unemployment duration over the sample period is small relative to the change in the unemployment rate.

After controlling for duration and unemployment shock, the unemployment rate itself is only important in the equation for the age group 55-64. Correspondingly, the lag in this equation is longer. This is consistent with the view that the 'pure' unemployment rate affects mortality in a longer time frame.

Finally, we repeat the estimation of our preferred equation with Instrumental Variables method (see appendix 1). The instruments used are the second lags of unemployment and duration for all the regions but at other age groups than those being estimated. Therefore, we are confident of their independence from the error processes in the estimation. On the whole, we find that these estimates are remarkably similar to our GLS results. The only differences relate to a lengthening of the lags and that now, the duration effects in the over-55 equation are consistent with a shock impact with no perverse level influence.

On the whole, then, our estimation seems to have been reasonably robust. The impression we get (short lags, unemployment shocks or duration shocks) support the idea of a psychological channel at work. Also significant is that there is virtually no mortality effect coming from the level of unemployment. There are, however, substantial effects associated with the duration of unemployment. Given that we have discounted the material deprivation story, how do we explain this? One possibility is that at times of high unemployment, many people go through short spells of unemployment. It is only when they cannot find work for some time that the stress becomes important. This would also be consistent with the result that, having controlled for duration, the unemployment shock became quite significant for the over 55 group. It is easy to see that, for these people, once they have become unemployed their chances of finding another job is very slim. Thus, stress can set in very early on. On the other hand, after the initial shock, the duration of unemployment has minimal impact on them, presumably because they can easily assimilate into retirement.

V. Summary and Conclusion.

Recent macro-economic studies have often referred to the lingering effects of demand or supply shocks to the real economy. The cyclical, and indeed, secular rises in unemployment carries a big cost not only in numbers, but also in human terms.

In this paper, we have estimated models of the mortality effects of unemployment, having controlled for various macro-economic, regional and demographic influences.

We find that unemployment affects mortality in a variety of different ways depending on the age group. For those men 35-44, unemployment shock and duration seem to be most important. This is also true for men 45-54, but in their case, both effects are smaller. For men 55-64, both unemployment rate and unemployment shock have equal impact, though they seem to endure increases in unemployment duration well, possibly turning a state of long term unemployment into permanent retirement.

Overall, the lags involved in these mechanisms appear to be fairly short, typically with over half of it happening after the first year. This is consistent with the hypothesis that unemployment affects health and mortality via psychological shocks, and hence changes in social status and habits.

In terms of its long run effect, we find that the unemployment effect on mortality increases with age in the male working-age population. Although we found no mortality effects coming from the level of unemployment, we cannot conclude that unemployment have no adverse implication for health. First, we found that unemployment duration or its rise are significantly associated with mortality. Second, whether it is the level or the change in unemployment that matters, the end result is that more people die or they die prematurely.

Finally, the somewhat complex pattern in which unemployment affects mortality may explain why previous investigators have found different results on this subject.

Obviously, if we just correlate mortality with the level of unemployment, and the true model is as we discussed, then the observed correlation will very much depend on the sample correlation of unemployment with the change in unemployment and durations. As an interesting exercise, we can re-interpret table 1 in this way and this gives us the following sample values:

Implied Mortality Effects in Sample.

Difference 66-70 to 86-91.	Male 35-44	Male 45-54	Male 55-64
Elasticities	0.013	0.026	0.051
Ave. change in UR	3.36X	3.96X	2.03X
Ave. Mortality Rates	1.99	6.8	19.2
Implied increase/000	0.087	0.700	1.988

APPENDIX 1.

Table 3. Instrumental Variable Estimates of Preferred Equations.

Dependent Variable: Mortality Rates(MR)	Male 35-44	Male 45-54	Male 55-64
lagged MR	0.354 (6.9)	0.366 (5.4)	0.699 (10.7)
lagged Unemployment Rate(UR)	-0.070 (2.0)	0.000 (0.0)	0.012 (0.9)
Change in UR (lagged)	0.122 (2.9)	0.059 (4.1)	0.074 (3.8)
$\rho_{,t-1}$	-	-	0.040 (2.2)
ρ_{t-2}	0.160 (2.6)	0.056 (3.8)	-0.033 (2.1)
N	*207*	*207*	*207*

t-statistics in parentheses.
Instruments are second lags of unemployment and durations of all the regions, but referring to other age groups than those being estimated.

Appendix 2.

Age specific mortality rates were collected for men aged 35-44, 45-54, 55-64 in the nine standard regions of England and Wales. Numbers of Male unemployment by duration in these groups were also collected. From time to time, the Employment Gazette changed the age groups for which they reported these unemployment numbers. Hence, we have to use the standard national distribution to allocate to the precise age brackets.

The watershed we use to distinguish between short or long-term unemployment is 52 weeks duration. To calculate unemployment rates, we normalize these jobless numbers by the mid-year population in each age group. It may appear that we have implicitly assumed 100% participation rates. However, as we are comparing regions, we are in fact supposing the same participation rates across regions which is a fairly reasonable assumption. The same argument could be applied to the assumption of changes in the natural rates of unemployment.

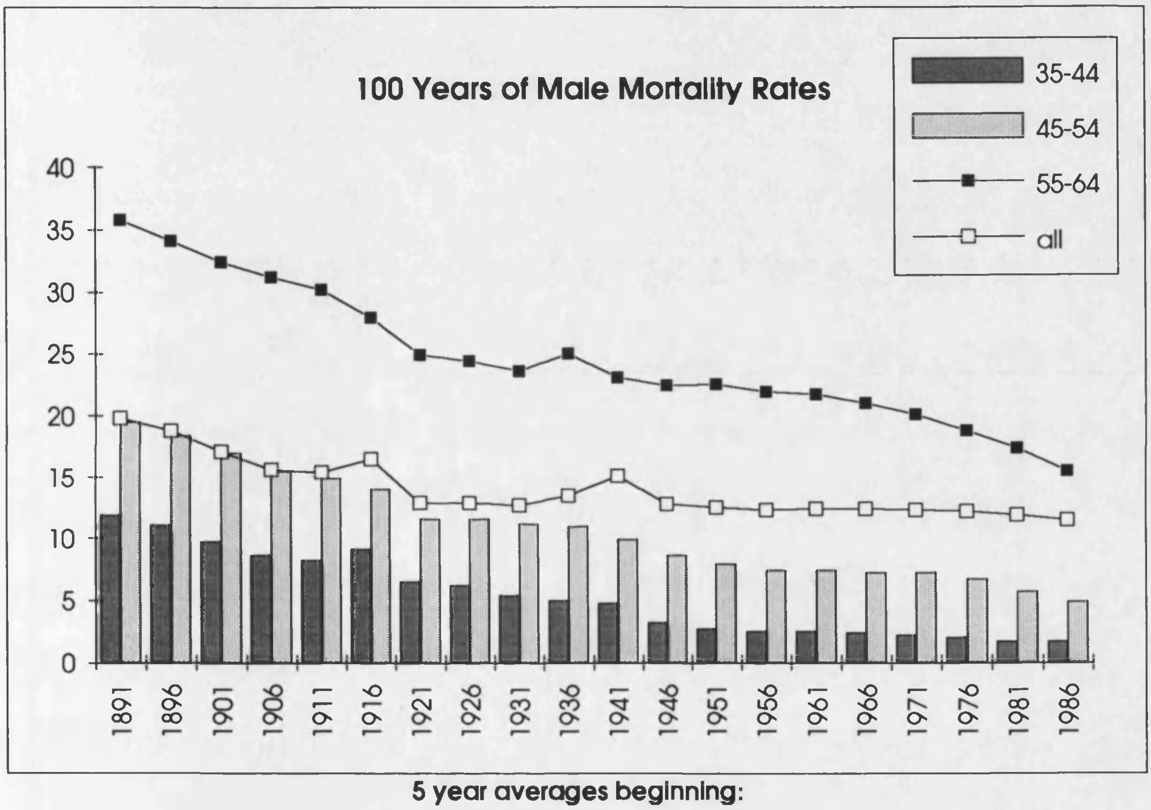
Finally, because of a substantial change in the definition of some standard regions in January 1974, we allow them a different regional characteristic before and after this point. These regions are the North, Yorkshire and Humberside, East Midlands and the North West. In effect, we treat data from these regions before and after 1974 as if they represent different regions.

<u>Data Sources</u>

Age specific mortality rates and population, male: OPCS Mortality Statistics, 1974-1991. Annual Report of the Registrar General of England and Wales, 1966-1973.

Age specific unemployment by duration: Employment Gazette, 1966-1991. Where the age groups are not exact, the data have been computed as described above.

Figure 1.



note. Standardised mortality rates per thousand population.
Data are 5 year averages beginning with the year shown.

Figure 2.
Major Causes of Mortality for Working age Men: 1974 and 1991.

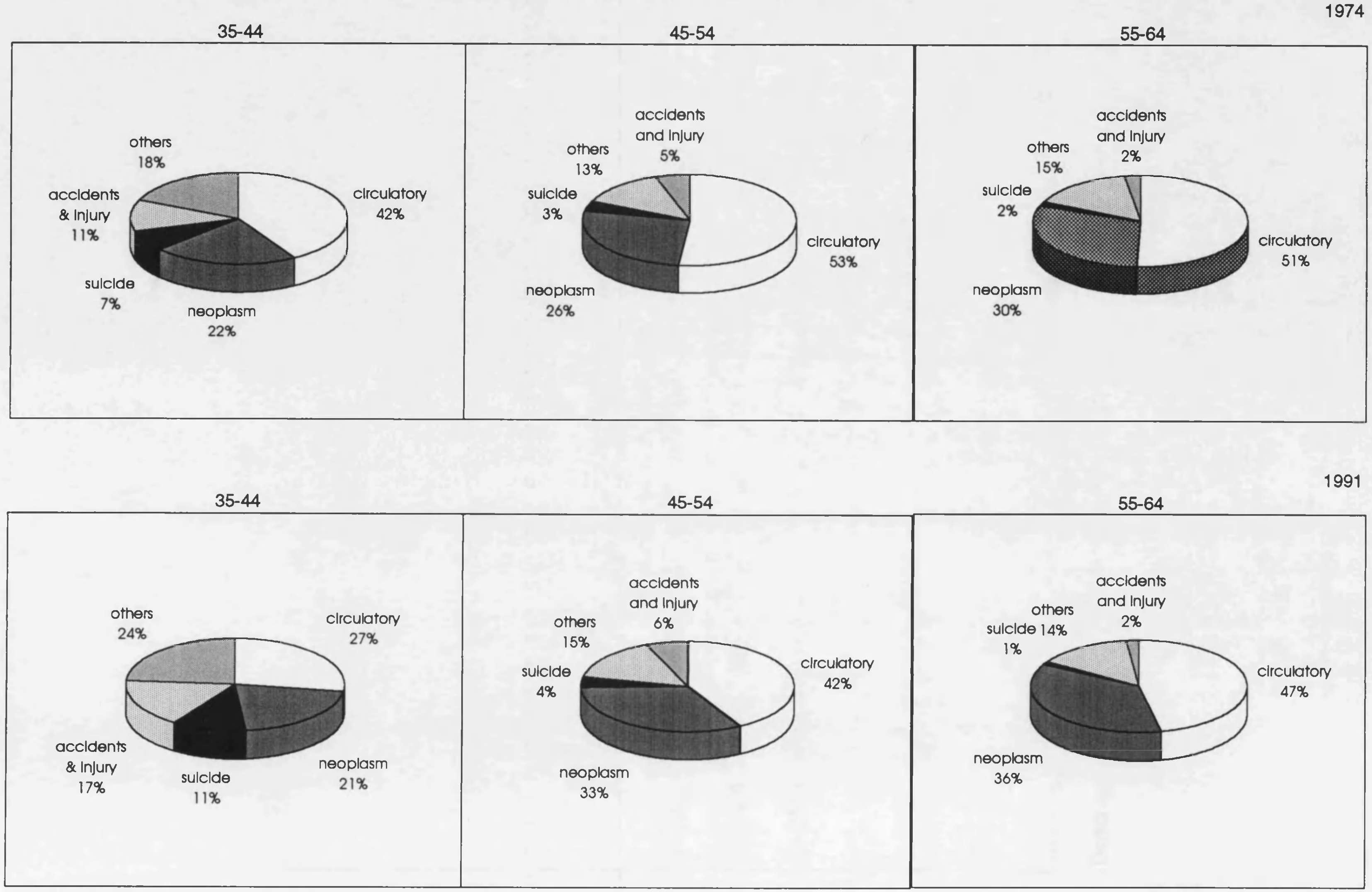
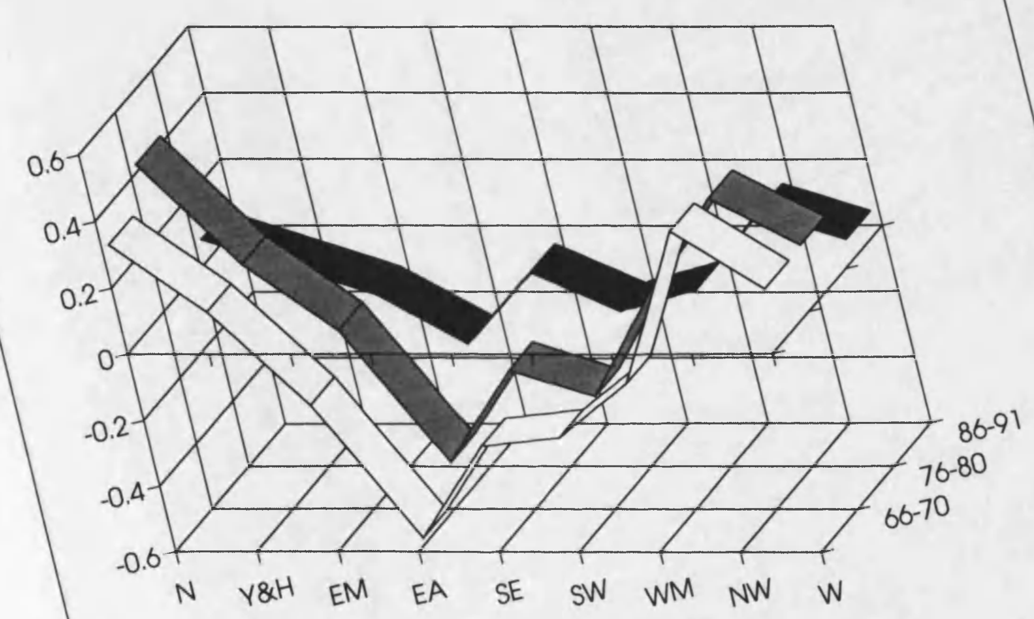


Figure 3.

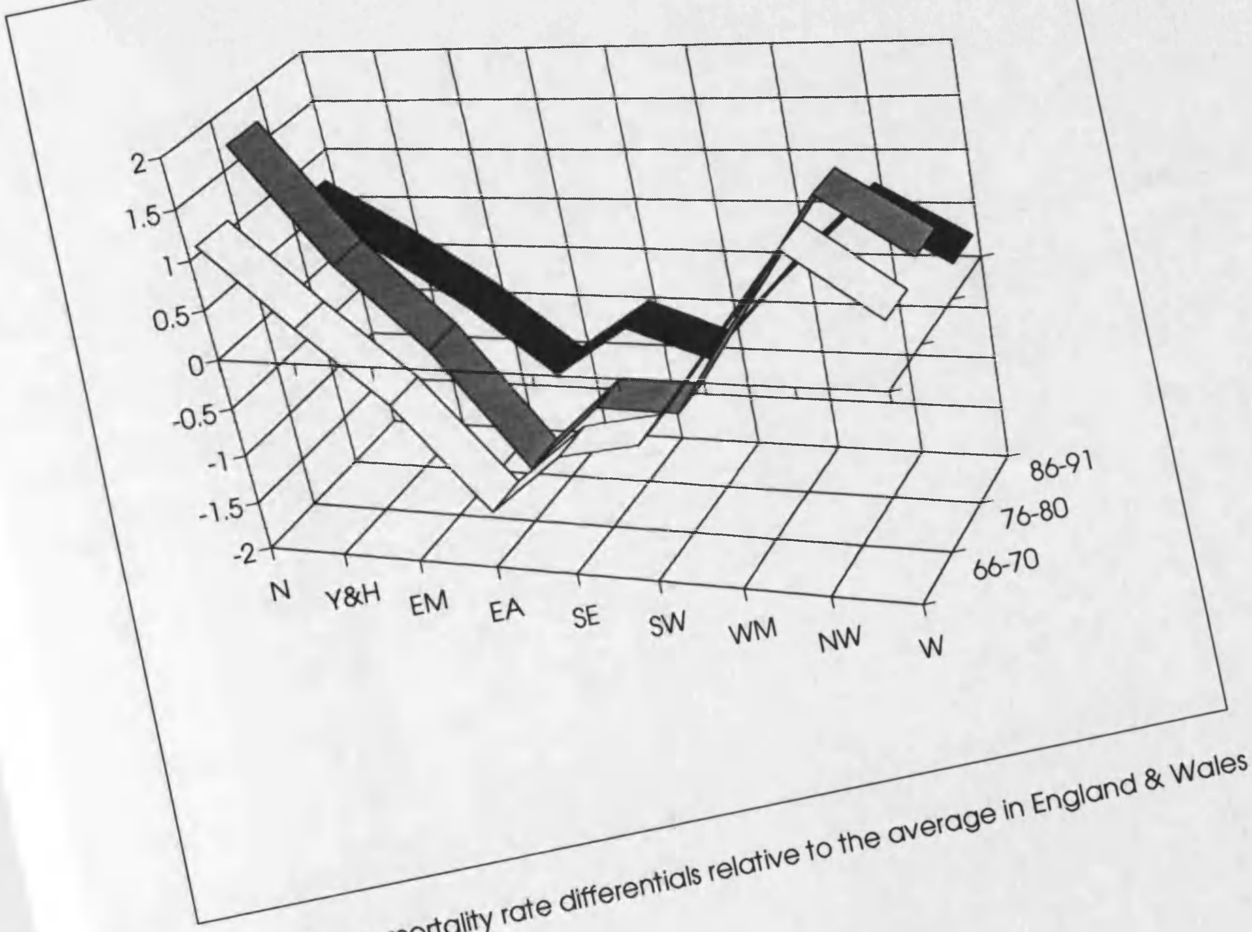
REGIONAL DISTRIBUTION OF MORTALITY OVER TIME: MALE 35-44.



Data refer to mortality rate differentials relative to the average in England & Wales

Figure 4.

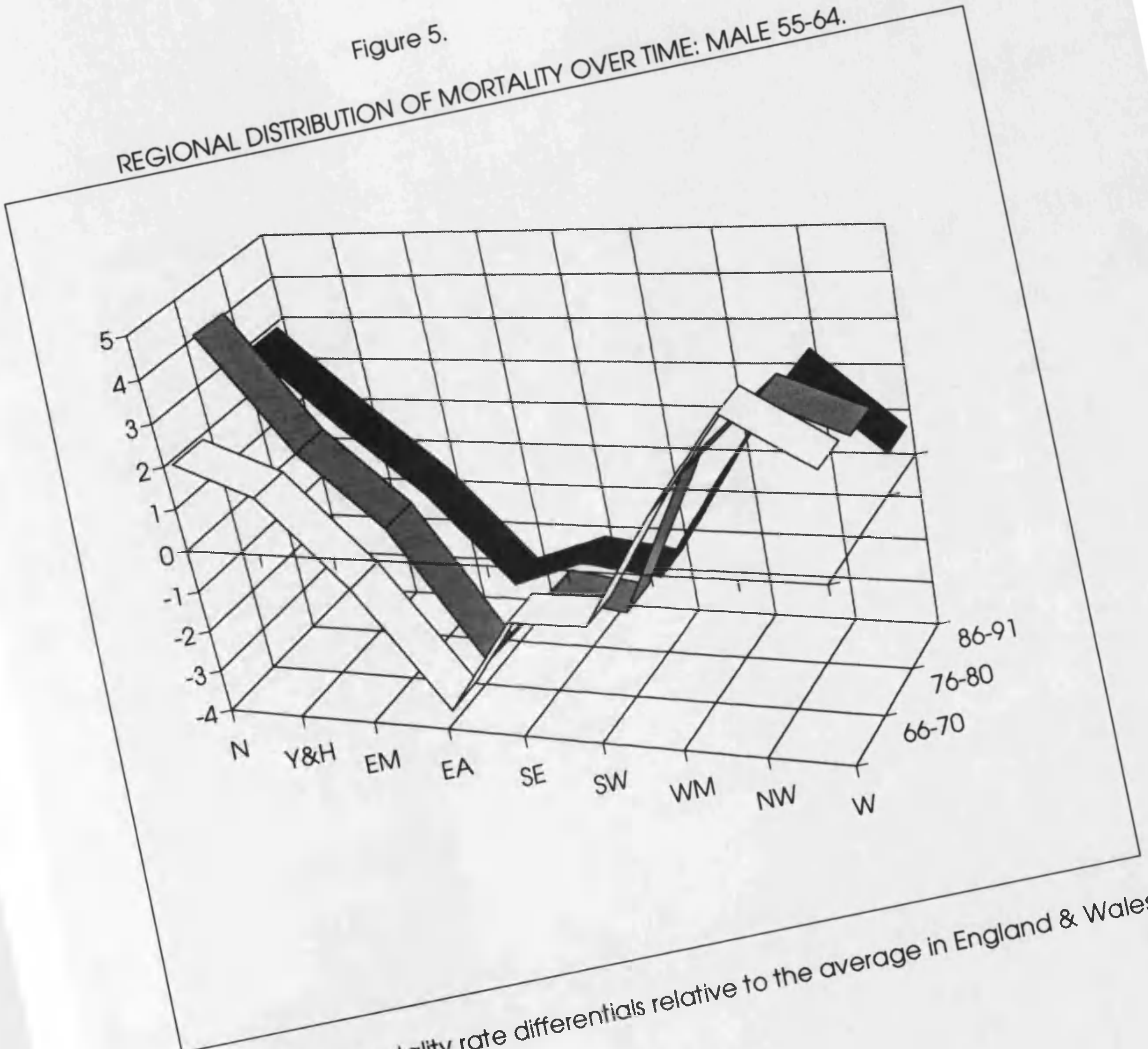
REGIONAL DISTRIBUTION OF MORTALITY OVER TIME: MALE 45-54.



Data refer to mortality rate differentials relative to the average in England & Wales

Figure 5.

REGIONAL DISTRIBUTION OF MORTALITY OVER TIME: MALE 55-64.



Data refer to mortality rate differentials relative to the average in England & Wales

CHAPTER 6. CONCLUSION.

We have attempted to shed light on the causes of employment changes in British industries and to investigate their health consequences.

The particular causes we have focused on are technical progress and shifts in the demand function. Of particular concern to us is the decline of British industrial employment relative to both the domestic economy and other industrialised countries. Clearly, this decline cannot be explained by a global substitution away from manufacturing products.

Examinations of various possible causes suggest that demand in manufacturing, a traded sector, is particularly sensitive to competitive forces; and this may have been seriously affected by certain characteristics of Britain's industrial structure, her labour market conditions, and her pace of innovations.[1] To fully assess these forces, it is thus important to study the employment consequences of changes in demand.

Now there is a view that technical progress in production efficiency can cost jobs, and this has sometimes led to resistance in the implementation of new technologies. While this has detrimental effects on industrial demand in the long term, the concern of workers and trade unions are likely to have shorter horizons. It is therefore interesting to see what are the employment implications of technical progress in production, at a given level of industrial demand. And this is the second question we address.

In chapter 2, we set out an industry model with imperfect competition which

[1]It may be possible for the exchange rates to adjust to eliminate divergence in competitiveness. Unfortunately, exchange rates are mainly driven by financial and speculative forces rather than trade flows, and can deviate from purchasing power parity for prolonged periods.

determines wages, prices, employment and output. In particular, we distinguish between secular demand changes and cyclical demand considerations. The model allows for the price mark-up to respond to cyclical demand, and insider effects to influence wage setting behaviour. These factors generate rent-seeking activities inducing increases in industrial prices and potentially offsetting the initial increase in demand. Also, in the short term, plant and machinery are not flexible and therefore creating another source of price rise due to rising marginal cost of production. (This factor also brings about a beneficial effect on employment since more labour is required to produce additional products at fixed capital stock levels than if the capital stocks had adjusted).

The total impact of these effects means that the industry cannot benefit fully from an increase in cyclical demand, although conversely, it also means that the industry need not suffer the full impact of adverse demand changes. However, this advantage is probably illusory. In an international context, increases in industry demand could also be satisfied by foreign producers. Therefore, any short term rent creation may damage competitiveness and final demand in the first place.

The employment effects of secular demand changes arising from changes in taste or differential income elasticities are not expected to lead to increases in pricing mark-ups or abnormal profits, essentially because such changes are considered part and parcel of the industry which firms, workers and potential entrants to the industry can and do plan for. In the long run, therefore, such demand changes are met one for one by industry output. In the short run, once again trailing levels of plant and machinery may mean that marginal cost of production will rise. The total impact on employment then depends on the balance between the consequent offset in output and the increased need for labour due to their less efficient employment. The output offset which will be caused by any upward movement of prices obviously depends on the demand elasticities, which we estimated in chapter 3.

Improvements in product design and quality will obviously increase industry demand. Technical progress which improves labour productivity will tend to do the same. This is, however, only true if the resultant benefits are passed along in lower prices.[2] This in turn depends on the behaviour of firms and workers when they face increased productivity. Given adjustment lags, prices only respond partially to productivity gains. The abnormal profit which accrues will be subjected to exploitation by workers as well. The slice of their share depending on their "insider" power. Hence, consumer benefit is restricted by this rent-seeking behaviour plus rising marginal cost of production due to the fact that workers are no longer efficiently employed. Once again, the overall output effect, though undoubtedly positive, is of a magnitude that is determined by the demand elasticities.

In the long run, abnormal profit margins cannot be maintained due to the threat of new entrants, as well as international competitiveness considerations, and mark-ups will return to their average level giving the full benefit of any productivity gain in the form of lower prices. (Consumers can benefit further if factor allocation efficiency is restored, lowering marginal costs to their former level). Demand and output undoubtedly rise, but the effect on employment is still ambiguous.

The overall assessment is that high demand elasticities are good, since that will generate larger output demand and labour demand for a given level of technical progress. In the case where capital stock is unchanged, the employment effect is also increasing in the elasticity of substitution. This second argument is intuitive because labour augmenting technical progress increases the amount of efficient units of labour,

[2]There is, of course, also the question of where such technical progress originated from. If these technologies have been discovered abroad and diffused into domestic industries, then demand will <u>recover</u> when prices have been fully lowered. This is analogous to the technological catching-up argument in development.

and a high degree of substitution will increase the ability of industry to absorb these extra labour units. Ultimately the employment consequences are an empirical matter although given reasonable values for elasticities of substitution, and partial elasticities of output to employment, demand elasticities around unity will ensure neutrality of this type of technical progress.

We then set about the empirical estimation of these parameters using three-digit level industry data and pooled time series-cross section techniques. This allowed us to achieve reasonable estimation results which would otherwise have been difficult. We found that demand elasticities are generally high enough to ensure employment. Indeed, the elasticities are often high enough to create extra employment. The only disappointing values are in Bricks and Glass, and the Textiles industry. However, the amount of employment decline in the Bricks and Glass industry is no bigger than average. And although the textile industry has seen one of the biggest employment falls, it is also one of the most competitive and traditional industries. Considerations of competition will therefore, suggest that technical progress is unlikely to have been responsible for its decline.

In terms of the employment effects of cyclical demand shifts, we found that Metal Manufacture and Miscellaneous Manufacturing have small demand effects because of high demand elasticities in the product market. We also found that Motors, Clothing, and the Food industries have small demand effects because of large pro-cyclicality pricing responses.[3] In the end, the impact of demand shocks on industry employment depend on the size of the shocks themselves. This is particularly true of secular demand changes which have a one to one employment impact.

There has been some evidence that British industries have indeed suffered large

[3]We find that Pricing mark-up are pro-cyclical in all our industries. This conforms with those found in Layard and Nickell(1986).

demand shocks. First, Layard and Nickell (1986) demonstrated significant declines in price competitiveness from the 1950s to the mid-1980s.[4] Second, in terms of trend demand, Thirwall (1978) presented income elasticities of demand for various British industries which he found to be generally lower than those in other industrialised countries.[5] Third, Gomulka (1979) noted that the number of technical innovations in Germany and Japan has overtaken their British counterparts since the early 1960s.[6] While the effects of these innovations are sometimes difficult to quantify, they would have increased quality and choice of foreign products relative to British ones. This would lead to a serious loss of demand. Thus, the size of these demand shocks are more likely to explain the fall in employment, especially in traditional sectors like metal manufacturing.

In the course of our theoretical development, we have used the concept of "insider" power in wage setting. This captures short run rent-seeking activities, for example. In chapter 4, we provided a rigorous derivation of these "insider" effects and asked what determines their magnitude. The "insiders" strive for a wage that, on average, will keep this group of workers employed, and within this context to maximise wages. Thus, when abnormal rents are available through productivity increases, wage demands are set so as to exploit these rents rather than allow higher employment. The actual size of these effects reflect how successful workers are in achieving this end. Noting that overall inter-industry wages do not significantly diverge despite secular differences in productivity, we suggest that such behaviour has mainly short-term implications. Empirically, we did find that "insider" effects are significant in the

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[4]See Layard, R. and S. Nickell, 1986, *The Rise in Unemployment*, pp 128-130.

[5]See Thirwall A., "The U.K.'s economic problems: A Balance of Payments Constraint?" in National Westminster Bank Quarterly Review, Feb. 1978.

[6]See Gomulka, S. (1979), "Increasing Inefficiency versus Slow Rate of Technological Change", p169, in "Slow Growth in Britain" edited by Beckerman (1979).

industries we studied, and that the magnitudes of such effects are correlated with Union power. That is, stronger unions ensure that workers are more successful in attaining their insider wage. "Insider" effects can sometimes produce unemployment hysteresis, because unemployment reduces the number of "insiders", thus allowing them to push for higher wages at the expense of lower employment. We did not find wide support for this in the data.

(Among the appendices in these chapters, we have included in chapter 3 an appendix on the matching of the 1968 and 1980 Standard Industrial Classifications. This facilitates the use of 3-digit level industry data covering the years before 1979 and after 1980.)

Having completed the analysis into the causes of employment decline in British industries, we turn to an investigation of the mortality impact of the consequent rise in unemployment.

Given how important this topic is, there is remarkably little consensus over whether there exist mortality effects of unemployment. Among the sources of contention is the difficulty in controlling for various factors. How do we separate out the secular developments in mortality from cyclical movements, for example? And how do we distinguish between the unemployment effect on sickness and mortality, and the fact that illness causes unemployment? Another area of disagreement is that even among those who believe in such effects, there is a debate over whether unemployment causes illness through material deprivation or psychological channels.

In chapter 5, we built an empirical model which controlled for age, sex, duration of unemployment, regional characteristics, macro-economic and secular factors. Using male unemployment and mortality data for the standard regions of England and Wales over the last thirty years, we found that unemployment does impact on mortality. However, the pattern of such impacts is rather complex. First, we found that in the determination of mortality, it is changes in unemployment (shocks) and unemployment duration that matter, and that the level of unemployment rate itself has negligible effects. Second, the pattern of these effects varies according to age group. Mortality in younger age groups (35-44) reacts strongly to unemployment shocks and a lengthening of unemployment durations. The durations effect decreases with age so that in the 55-64 age group, unemployment duration affects mortality only through its changes, but not its level.

Compared to the interwar years when unemployment was at a comparable level, the general provision of social welfare has made it more difficult to argue that mortality among the unemployed is caused by material deprivation. Work is, nonetheless, a source of self-esteem and provides rhythm and meaning to life. Hence, a more popular view is that the dis-orientation of job-loss is responsible for higher mortality, through such things as drastic changes in dietary and living habits. Our results tend to confirm this view. In our empirical work, as well as finding that unemployment shocks are more important than unemployment levels, we also found relatively short lags in our mortality equations so that over half of the unemployment effects impact in the first year or so.

Accepting the view that psychological channels lead to mortality, we can interpret the duration effect by pointing out that in times of high unemployment, there is less stigma attached to short spells of unemployment. It is only when unemployment becomes prolonged that people become stressed. This would also explain why there is no level duration effect on the over 55s-- because once the shock of unemployment wears off, they are more easily assimilated into retirement.

Although we found no mortality effects coming from the level of unemployment, we cannot conclude that unemployment has no adverse implication for health. First, we found that unemployment duration or its rise is significantly associated with mortality.

Second, whether it is the level or the change in unemployment that matters, the end result is that more people die or they die prematurely.

Finally, the somewhat complex pattern by which unemployment affects mortality may explain why previous investigators have found conflicting results on this subject. Obviously, if we just correlate mortality with the level of unemployment, and the true model is as we discussed, then the observed correlation will very much depend on the sample correlation of unemployment with the change in unemployment and unemployment durations.

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An investigation into the power of insiders in wage determination

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This paper is concerned with the role of insider forces in wage determination. Various union and non-union models of wage behaviour are considered and they imply that wages are a convex combination of internal and external factors. Certain union models also imply a degree of hysteresis. Data on fourteen British production industries reveal that: (i) insider forces are important; (ii) their importance is directly related to both union power and the degree of monopoly in the product market; (iii) the state of the aggregate labour market is also important; and (iv) hysteresis effects arising from insider power are only significant in a small minority of sectors.

1. Introduction

When managers are asked how wage increases are determined, a common response is to state that 'productivity plus inflation' is the basis for negotiation. Thus, for example, managers questioned in the British 1984 Workplace Industrial Relations Survey put forward profitability/productivity and increases in the cost of living as by far the most important influences on pay settlements, with the external pay structure coming a poor third [see Blanchflower and Oswald (1988, table 3) for example].

The fact that increases in worker productivity *within the firm* are thought of as being a prime determinant of wage rises, irrespective of what is happening to pay elsewhere, suggests that 'insider' factors must play an important role in wage bargaining. If the labour market were competitive, 'outside' factors, particularly wages paid elsewhere and possibly the overall state of the labour market, would be the key determinants of pay within the firm.

If insiders are important in pay bargaining this may have profound implications for the behaviour of the macroeconomy. Under certain circum-

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stances insider wage setting leads to a high level of hysteresis in the economy which implies that the impact of shocks may persist for very long periods even under rational expectations [see Blanchard and Summers (1986) for example]. It may also lead to asymmetric behaviour and ratchetting, whereby employment responds less, and wages more, to demand increases than to demand falls [see Lindbeck and Snower (1986), for example].

In the light of this, it is our purpose to investigate the importance of insider forces in pay determination in the British industrial sector. In order to do this we set up a model of union pay bargaining where unions and firms bargain over wages but firms set employment unilaterally. We utilise this framework because this is the predominant form of pay determination in British industry [see Oswald and Turnbull (1985)]. The general idea is that unions are concerned with the wage and long term employment prospects of a fixed group of workers, the insiders, and firms are concerned with longer term profitability. Long term here is taken to mean the situation which arises when employment has been fully adjusted to the wage bargain. The resulting model of wage determination, a generalisation of that presented in Blanchard and Summers (1986), is one where wages are a weighted sum of the wage which would, on average, induce the firm to employ all the insiders and the wage that would rule if only outside opportunities were significant.

This model is then confronted with data from a number of 2 digit industrial sectors and several hypotheses are investigated. First, are insider factors important? Second, is the importance of insider factors related to union power as our model, in fact, predicts? Third, does the state of play in the external labour market influence wages and is the importance of this factor inversely related to union power? Finally, if insider factors are important, are the insiders a restricted group of workers such as the existing employees or do they extend into the unemployed who last worked in the industry? Only in the former case does insider wage setting translate into hysteresis. Having set out the questions we may now proceed towards the answers.

2. A model of industry wage determination

Suppose that each industry consists of price setting firms. Since we shall assume that the firms have a constant returns technology and that prices and wages are uniform across the industry, we may take it that factor input/output ratios are also uniform. We thus have an industry production function which we assume, for expositional simplicity, to have the Cobb–Douglas form[1]

[1]This assumption is not carried over to the empirical work.

$$Y = BN^a, \tag{1}$$

where Y = value added, N = employment, B = capital plus technical progress coefficient. To avoid clutter, we drop industry subscripts. Note that the term B has the form

$$B = K^{1-a}A^a, \tag{2}$$

where K = capital and A = technical progress (written as labour augmenting).

The industry faces a demand for its product of the form

$$Y = \omega(P/\bar{P}^e)^{-\eta}\tilde{\theta}, \quad \eta > 1, \tag{3}$$

where ω reflects long-run secular movements in demand due to changes in tastes, P = price of industry value added, $\bar{P}^e$ = expected price of aggregate value added and $\tilde{\theta}$ is a random variable reflecting short-run demand shifts. We suppose that decisions are taken in the following sequence. Wages are determined via bargaining between firms and unions before $\tilde{\theta}$ is revealed. Prices, employment and output are then fixed after $\tilde{\theta}$ is revealed but before the aggregate price level is known. These precise assumptions about timing have no substantive consequences and are not carried over to the empirical section.

Although we suppose that there are employment adjustment costs of the standard type, it is convenient at this stage to analyse the static equilibrium employment behaviour of the industry. In order to do this, we begin with the pricing decision. If the industry behaved as a single monopoly, the resulting monopoly price, P_M, would satisfy

$$P_M = \frac{W}{a\varepsilon} Y^{(1-a)/a} B^{-1/a}, \tag{4}$$

where W is the pre-determined wage and $1/\varepsilon = \eta/(\eta - 1)$, the standard monopoly mark-up on marginal cost. The fundamental question is the relationship between the joint monopoly price and that which is actually set. In a Cournot–Nash industry, the actual price is a fixed proportion of the monopoly price.[2] However, other theories indicate that deviations of industry prices from the joint monopoly level are sensitive to short-run demand fluctuations [see Stiglitz (1984), Rotemberg and Saloner (1986), or Bils (1987) for example]. The general view appears to be that industries

[2] In fact the mark-up is given by $\eta/(\eta - H)$ where H is the Herfindahl Index, $\sum_j (Y_{ij}/Y_i)^2$. See Cowling and Waterson (1976), for example.

behave more competitively when demand is high, indicating a pricing equation of the form

$$P=\frac{Wf(\tilde{\theta})}{a\varepsilon}Y^{(1-a)/a}B^{-1/a}, \tag{5}$$

with $f \leqq 1$, $f' \leqq 0$. Corresponding to this price–marginal cost relationship is the standard marginal revenue product condition obtained by using the product function to eliminate Y from (5). This may be written as

$$N^*=\left(\frac{f(\tilde{\theta})}{a\varepsilon}\frac{W}{PB}\right)^{-1/(1-a)}, \tag{6}$$

where N^* is the equilibrium level of employment. Recall that under static expectations, convex adjustment costs imply that actual employment follows an approximate partial adjustment process of the form

$$n=\varphi n_{-1}+(1-\varphi)n^*, \tag{7}$$

where lower case letters indicate logs. This equation, which along with (6) yields a dynamic version of the marginal revenue product condition, forms the basis of our empirical analysis of employment.[3]

However, our key purpose in this section is to lay the foundations for the wage bargaining model. As we have already noted, we suppose that when firms and unions bargain about wages, they concern themselves with the long run consequences of any choices. That is, the union is concerned with the employment consequences when the firm has fully adjusted to the new wage. Similarly the firm is concerned with the long run impact on profitability. Furthermore, since wages are determined prior to the revelation of the demand index $\tilde{\theta}$, unions and firms are interested in the expectations of the relevant variables.

By making use of (1), (3), (5), we can express ex-post employment and

[3]The use of (6) as a basis for the empirical analysis of employment may be questioned in the sense that it is arguably preferable to use an expression for N^* which contains variables which are either pre-determined or exogenous to the firm [e.g., (8) on the following page] rather than one which contains the endogenous output price of the firm, P. However, alternatives will inevitably contain the variable ω which captures long run changes in tastes. Since these are both unobservable and hard to proxy, we may utilise the marginal revenue product condition, (6), which, in effect, makes use of the output price in order to capture these long run taste changes. Concerning the dynamic structure of (7) we make no attempt here to go beyond this simple dynamic formulation by allowing for non-static expectations, for example. Our justification for this is first that it will make the empirical analysis overly complex in a direction away from the main point at issue and second that given that real wages approximately follow a random walk with drift, the assumption of static expectations is unlikely seriously to violate the data.

profit in terms of wages and variables exogenous to the industry. For employment we obtain

$$N^* = \tilde{\phi} B_1 (W/\bar{P}^e)^{-(1+\gamma)},$$

where

$$\tilde{\phi} = [\tilde{\theta}^{1/\eta}/f(\tilde{\theta})]^{(1+\gamma)}, \quad B_1 = (a\varepsilon)^{1+\gamma}\omega^{(1+\gamma)/\eta} B^{\varepsilon(1+\gamma)}, \quad 1+\gamma = (1-a\varepsilon)^{-1}. \tag{8}$$

Real profit $\pi = (P/\bar{P}^e)Y - (W/\bar{P}^e)N - F$, where F are fixed costs, is given by

$$\pi = B_2 (W/\bar{P}^e)^{-\gamma} - F,$$

where

$$B_2 = B_1^{a\varepsilon} B^{\varepsilon} \tilde{\phi}^{a\varepsilon} (\omega\tilde{\theta})^{1/\eta} - \tilde{\phi} B_1. \tag{9}$$

As a basis for bargaining ex-ante, therefore, unions and firms are concerned with expectations of (8), (9).

2.1. A bargaining model of wage determination

The foundation of wage determination we take to be the Nash bargaining model,[4] the strategic justification for which is given by Binmore et al. (1986). In order to make it operational we first consider the union objective. We suppose that unions are concerned only with the welfare of a group of members, N^1 in number. At this stage we make no assumptions as to who they are. They could, for example, range from a small subset of existing employees to a wide group including all existing employees and recently unemployed union members who are potential employees. We now suppose that the union objective is the expected utility of a representative member of this group. If we suppose that L is the probability that a member of the group does not obtain employment in the industry, U is the member's utility if he does obtain employment and $\tilde{U}$ his expected utility if he does not, then the union's objective, Z, is

$$Z = (1-L)U + L\tilde{U}. \tag{10}$$

[4]The model developed here is essentially static and therefore misses out on some potentially interesting phenomena. For example, agents will recognize that the higher the wages that are set today, the lower will be employment and the fewer the number of insiders for tomorrow's wage bargain. Unfortunately, there exists no satisfactory sequential bargaining model which is rich enough to cover all the basic issues dealt with here and yet simple enough to be suitable as a foundation for empirical analysis. We would also contend that the static model which we use here is adequate for analysing the data in the sense that the interpretations placed on the results would not be very different were a sequential bargaining model to be used to provide the underlying theoretical framework.

The status quo point, $\bar{Z}$, for the Nash bargain refers to the utility that the representative member can obtain while bargaining proceeds if immediate agreement is not forthcoming. This we suppose to be $\tilde{U}$ since, for the duration of any conflict, existing employees can obtain this elsewhere and any other members of the group can obtain this in any event. So the union's contribution to the Nash bargain is

$$Z-\bar{Z}=(1-L)(U-\tilde{U}). \tag{11}$$

On the firm's side, the concern is with expected profit $\mathrm{E}(\pi)$ and the status quo point, $\bar{\pi}$, is simply given by $-F$ since the firm has to pay out its fixed costs for the duration of the conflict. So the firms' contribution to the Nash bargain is

$$\mathrm{E}(\pi)-\bar{\pi}=\bar{B}_2(W/\bar{P}^{\mathrm{e}})^{-\gamma},$$

from (9), where $\bar{B}_2$ is the mean of B_2. The generalised Nash objective is, therefore,

$$\Omega=(1-L)(U-\tilde{U})\bar{B}_2(W/\bar{P}^{\mathrm{e}})^{-\gamma\beta}, \tag{12}$$

where β is a measure of firms' bargaining power. The wage outcome is obtained simply by maximizing Ω with respect to W but before this can be analysed we must discuss the precise form of the L and U functions.

The L function measures the probability of a union member not obtaining work within the industry and is given by

$$L=\mathrm{P}(N^*\leqq N^{\mathrm{I}})\left(1-\frac{\mathrm{E}(N^*\,|\,N^*\leqq N^{\mathrm{I}})}{N^{\mathrm{I}}}\right). \tag{13}$$

So if the random variable $\tilde{\phi}$ has a mean $\bar{\phi}$ and a distribution function $G(\cdot)$, then it may be shown, using (8), that[5]

$$L(W/\bar{P}^{\mathrm{e}},N^{\mathrm{I}})=\frac{1}{\mu}\int_0^{\mu}G(\tilde{\phi})\,\mathrm{d}\tilde{\phi},$$

[5] $\mathrm{P}(N^*\leqq N^{\mathrm{I}})=\mathrm{P}(\tilde{\phi}B_1(W/\bar{P}^{\mathrm{e}})^{-(1-\gamma)}\leqq N^{\mathrm{I}})=G(\mu)$, where $\mu=N^{\mathrm{I}}(W/\bar{P}^{\mathrm{e}})^{(1+\gamma)}B_1^{-1}$. So

$$L=G(\mu)-\frac{G(\mu)}{N^{\mathrm{I}}}\int_0^{\mu}B_1(W/\bar{P}^{\mathrm{e}})^{-(1+\gamma)}\frac{\tilde{\phi}}{G(\mu)}\,\mathrm{d}G(\tilde{\phi})=G(\mu)-\frac{1}{\mu}\int_0^{\mu}\tilde{\phi}\,\mathrm{d}G(\tilde{\phi})=\frac{1}{\mu}\int_0^{\mu}G(\tilde{\phi})\,\mathrm{d}\tilde{\phi}$$

using integration by parts.

where

$$\mu = N^{1}(W/\bar{P}^{e})^{(1+\gamma)}B_1^{-1}. \tag{14}$$

The utility function of the representative worker, U, we specify as

$$U = V_1(W(1-v)/\bar{P}^{e}) + V_2(W/\bar{W} - (W/\bar{W})_{-1}], \quad V_1', V_2' > 0, \; V_1'', V_2'' < 0, \tag{15}$$

where v is the factor which transforms the real product wage into the post-tax real consumption wage and $\bar{W}$ is the average wage in the economy. The term v, commonly referred to as the wedge, includes taxes on labour and consumption as well as the real price of imports. Note that utility is allowed to depend not only on the level of real disposable income but also on the gain in wages relative to the economy wide average. This latter term allows for the possibility that individual utility is influenced not only by the level of real income but also by changes in the individual's relative position. While this is not standard in economics, it is both a commonplace observation that individuals are particularly motivated both by relativities and by deviations from the habitual state of affairs, as well as being an aspect of human behaviour which is well known to social psychologists [see Argyle (1987), for example]. Finally we express expected utility outside the industry as

$$\begin{aligned}\tilde{U} = {} & (1-\bar{u})[V_1[\bar{W}(1-v)/\bar{P}^{e}) + V_2(1-(W/\bar{W})_{-1})] \\ & + \bar{u}[V_1(\rho\bar{W}(1-v)/\bar{P}^{e}) + V_2(\rho - (W/\bar{W})_{-1})],\end{aligned} \tag{16}$$

where ρ is the benefit replacement ratio and $\bar{u}$ is the aggregate unemployment rate; $\tilde{U}$ is thus the weighted sum of utility in alternative employment and utility while unemployed.

We may now maximise the Nash objective Ω with respect to W to obtain the first-order conditions[6]

[6]From (12) we have

$$\frac{\partial \Omega}{\partial W} = \left(\frac{W}{\bar{P}^{e}}\right)^{-\gamma\beta}\left\{-\frac{\partial L}{\partial W}(U-\tilde{U}) + (1-L)\frac{\partial U}{\partial W} - \gamma\beta\frac{(1-L)(U-\tilde{U})}{W}\right\}$$

Noting from (14) that $W(\partial L/\partial W) = (1+\gamma)(G(\mu) - L(\mu))$ then yields the first-order condition (17) in the text.

$$1-\frac{U-\tilde{U}}{W(\partial U/\partial W)}\left[(1+\gamma)\frac{G(\mu)-L(\mu)}{1-L(\mu)}+\beta\gamma\right]=0, \tag{17}$$

which serves as the basis of our wage equation. Before we log-linearise, there is one problem which must be dealt with in preparation for the empirical implementation of this model. As we have already noted in footnote 3, it is convenient to exclude the long-run taste variable ω [see eq. (3)] from our empirical model. Recalling from (14) that μ is given by

$$\mu=N^{\mathrm{I}}(W/\bar{P}^{\mathrm{e}})^{(1+\gamma)}B_1^{-1}, \tag{18}$$

we see from eq. (8) that B_1 is a function of ω. However, note that (8) implies

$$\mu=N^{\mathrm{I}}\bar{\Phi}/\mathrm{E}(N^*),$$

and we can utilise the marginal revenue product condition (6) to generate an alternative expression for $\mathrm{E}(N^*)$, namely

$$\mathrm{E}(N^*)=\left(\frac{f(\hat{\theta})W}{a\varepsilon P^{\mathrm{e}}B}\right)^{1/(1-a)}, \tag{19}$$

where P^{e} is the price which the firm expects to set and $\hat{\theta}$ is the value of $\tilde{\theta}$ corresponding to $\bar{\Phi}$. Thus we can make use of the fact that we observe the industry output price, P, in order to eliminate the unobserved taste variable ω. Noting the definition of B in eq. (2), we are now able to write μ as

$$\mu=\left(\frac{W}{P^{\mathrm{e}}}\right)^{1/(1-a)}\frac{N^{\mathrm{I}}}{KA^{a/1-a}}B_3,$$

where

$$B_3=\bar{\Phi}\left(\frac{f(\hat{\theta})}{a\varepsilon}\right)^{1/(1-a)},\quad \text{a constant} \tag{20}$$

Returning to the first-order condition (17), it is easy to show that, to a high degree of approximation, the term $(U-\tilde{U})/W(\partial U/\partial W)$ is homogeneous of degree zero[7] in $W/\bar{P}^e$, $\bar{W}/\bar{P}^e$ and so it can be written as

$$\frac{U-\tilde{U}}{W(\partial U/\partial W)}=\chi_1(W/\bar{W},(W/\bar{W})_{-1},v,\rho,\bar{u}). \tag{21}$$

Writing $(G-F)/(1-L)$ as $\chi_2(\mu)$, then (17) reduces to

$$1-\chi_1(W/\bar{W},(W/\bar{W})_{-1},v,\rho,u][(1+\gamma)\chi_2(\mu)+\beta\gamma]=0, \tag{22}$$

with μ given by (20). If we log-linearise, we obtain a wage equation of the form[8]

7
$$\frac{\partial}{\partial[W/\bar{P}^e)}\left[\frac{U-\tilde{U}}{W(\partial U/\partial W)}\right]=\frac{1}{W(\partial U/\partial W)}\left\{vV_1'-\frac{(U-\tilde{U})}{W(\partial U/\partial W)}\left(vV_1'+vV''\frac{Wv}{\bar{P}^e}\right)\right\},$$

where

$$V_1'=\frac{\partial V_1}{\partial[\gamma W/\bar{P}^e)},\quad V_1''=\frac{\partial^2 V_1}{\partial(vW/\bar{P}^e)^2}.$$

Omitting second-order terms, we may approximate $(U-\tilde{U})/W(\partial U/\partial W)$ by $(W-\bar{W})/W+[u\bar{W}/W](1-\rho)$. Making use of this and omitting all terms containing $\bar{u}V_1''$ as second order, we find that

$$\frac{\partial}{\partial(W/\bar{P}^e)}\left[\frac{U-\tilde{U}}{W(\partial U/\partial W)}\right]\simeq\frac{\bar{W}vV_1'}{W^2(\partial U/\partial W)}\left\{1-\bar{u}(1-\rho)-\frac{v(W-\bar{W})}{\bar{P}^e}\frac{V_1''}{V_1'}\right\}.$$

Consider next

$$\frac{\partial}{\partial(\bar{W}/P^e)}\left[\frac{U-\tilde{U}}{W(\partial U/\partial W)}\right]=-\frac{((1-\bar{u})vV_1'\bar{W}+\bar{u}\rho vV_1'\rho)}{W(\partial U/\partial W)}$$

where $V_1'\bar{W}=V_1'$ evaluated at $\bar{W}$. $V_1'\rho$ is defined similarly. Using Taylor expansions we find that

$$\frac{\partial}{\partial(\bar{W}/\bar{P}^e)}\left[\frac{U-\tilde{U}}{W(\partial U/\partial W)}\right]\simeq\frac{1}{W(\partial U/\partial W)}\left((1-\bar{u})v\left(V_1'+\frac{V_1''v}{\bar{P}^e}(\bar{W}-W)\right)+\bar{u}\rho vV_1'\right)$$

$$=\frac{-vV_1'}{W(\partial U/\partial W)}\left\{1-\bar{u}(1-\rho)-\frac{vV_1''}{\bar{P}^eV_1'}(W-\bar{W})\right\}$$

$$\simeq-\frac{W}{\bar{W}}\frac{\partial}{\partial(W/\bar{P}^e)}\left[\frac{U-\bar{U}}{W\,\partial U/\partial W}\right],$$

which is the result in the text. Note also that if V_1 is a constant elasticity function, this approximation is exact.

[8]Note that in our definition of μ in eq. (20) we have supposed the mean of the short-run demand shift $\bar{\phi}$ to be constant. We are assuming here that the long-run employment expectation induced at different wages is independent of any short-run fluctuations in the mean of the demand shift term. We, in fact, investigated this proposition by including current and/or lagged demand shift variable in the model reported in table 2. In not one industry was a demand term positive and significant at the 5% level so we did not pursue this any further and remain satisfied with our implicit assumption.

$$w = c_0 + \lambda(p^e + (1-a)(k - n^I) + a\log A) + (1-\lambda)(w - c_1\bar{u} + c_2 \log v + c_3 \log \rho) + c_4(w - \bar{w})_{-1}, \tag{23}$$

where it is possible to show that $\lambda < 1$; c_1, c_2, $c_3 > 0$. Unfortunately we are unable to demonstrate that λ is positive for a general distribution G although it is positive for a uniform distribution, for example.[9] However, it is clear that if λ is negative we have a potentially unstable situation since the industry wage would respond to the average wage level, $\bar{w}$, with a greater than unit elasticity, so we shall ignore this possibility in what follows.

This type of industry wage model has a very appealing interpretation. If we log-linearise our expression for the expectation of equilibrium unemployment [eq. (19)], we obtain [using (2)]

$$\log \mathrm{E}(N^*) = -\frac{1}{1-a}(w - p^e) + k + \frac{a}{1-a}\log A + \text{constant}, \tag{24}$$

so the expression in the first bracket of the wage equation can be interpreted as the wage that would be required in order to induce the industry, on average, to employ all N^I insiders. To see this, simply replace $\log \mathrm{E}(N^*)$ by n^I in (24) and solve for w. If we deem this to be the 'insider' wage, then it seems natural to call the term in the second bracket of the wage equation the 'outsider' wage since it reflects the alternative opportunities available to the workers. The actual wage is thus a weighted sum of the insider and outsider wages and is, therefore, a natural generalisation of the Blanchard and Summers (1986) model which involves only the insider wage, with N^I set equal to last period's employment. Furthermore, it is easy to show that the weight on the insider wage, λ, is a decreasing function of β, the firm's bargaining power [see eq. (12)].[10] So the more powerful is the union in the bargain, the higher is the weight on the insider wage. This hypothesis we investigate in due course.

[9] λ has the form

$$\frac{(1+\gamma)\chi_2'\mu}{1-a}\left[\frac{W}{\bar{W}}\frac{\chi_{11}}{\chi_1^2} + \frac{(1+\gamma)\chi_2'\mu}{1-a}\right]^{-1}.$$

It is easy to show that $\chi_{11} > 0$ but it is not possible to sign χ_2' for a general distribution function. We can, however, demonstrate that the denominator is positive.

[10] From footnote 9 we see that λ has the form

$$\lambda = \frac{(1+\gamma)\chi_2'\mu}{1-a}\left[\frac{W}{\bar{W}}\frac{\chi_{11}}{\chi_1^2} + \frac{(1+\gamma)\chi_2'\mu}{1-a}\right]^{-1} = \frac{(1+\gamma)\chi_2'\mu}{1-a}\left[\frac{W}{\bar{W}}\chi_{11}(\beta\gamma + (1+\gamma)\chi_2)^2 + \frac{(1+\gamma)\chi_2'\mu}{1-a}\right]^{-1},$$

from the definition of χ_1 in (22). This expression is clearly diminishing in β.

2.2. Industry wage behaviour in the long run

It is clear from the above analysis that if insider forces are important in wage determination, then wage rises in an industry are influenced by productivity growth within the industry. Suppose, then, that we have two industries, one of which has a rate of productivity growth which is consistently faster than the other. Does this mean that wages in the two industries will continuously diverge? If this were so, it would be an extremely worrying implication of the model since it would imply that the fundamental force of competition was being permanently overridden. In fact, however, this is not an implication of the model because, in the long run, as productivity grows, competition exerts a downward pressure on the industry price and hence on the industry wage.

To see how this operates, consider the log-linear version of the marginal revenue product condition (6), (7) along with the wage equation where we have dropped the lagged dependent variables:

$$n-k=a_0+a_1\log\tilde{\theta}-\frac{1}{1-a}(w-p)+\frac{a}{1-a}\log A, \tag{25}$$

$$w=c_0+\lambda(p+(1-a)(k-n^{\mathrm{I}})+a\log A)+(1-\lambda)(w-c_1\bar{u}+z), \tag{26}$$

where $a_1\log\tilde{\theta}=-1/(1-a)\log f(\tilde{\theta})$ and $z=c_2\log v+c_3\log\rho$, the 'wage pressure' variables. Now suppose that in equilibrium, the number of insiders, n^{I}, is a fixed proportion of the employees. So

$$n^{\mathrm{I}}=n+\delta. \tag{27}$$

Then, if we further suppose that short-run demand shifts are set at their average level (since we are focussing on the long-run equilibrium), totally differentiating this system reveals that

$$\mathrm{d}w=\mathrm{d}\bar{w}-c_1\,\mathrm{d}\bar{u}+\mathrm{d}z-\frac{\lambda(1-a)}{(1-\lambda)}\mathrm{d}\delta. \tag{28}$$

Thus industry productivity growth, as captured by k and $\log A$, has no impact on wages which are influenced solely by outside opportunities and the proportion of employees who are insiders. This result indicates that while insiders can generate a wage 'mark-up' which is higher the lower the proportion of employees who are actually insiders ($\partial w/\partial\delta<0$), competitive forces ensure that industry productivity growth is transmitted into lower prices in the long run rather than higher wages.

3. The empirical model

In order to confront this model with the data, we must both generalise it and specify some of the unobserved variables such as the number of insiders. We start out from the wage equation (23) and the marginal revenue product condition (6), (7) which in full dynamic form is

$$n=\varphi n_{-1}+(1-\varphi)\left(a_0+a_1\log\tilde{\theta}+k\frac{1}{1-a}(w-p)+\frac{a}{1-a}\log A\right). \tag{29}$$

Our first problem is that we have no data on value-added prices by industry. If p_{f} is the final output price and p_{m} the price of material inputs, then we have the relation (ignoring constants)

$$p=p_{\mathrm{f}}-\frac{s}{1-s}(p_{\mathrm{m}}-p_{\mathrm{f}}), \tag{30}$$

where s is the share of materials in final output. Second, we see no strong reason to impose the Cobb–Douglas assumption on the data and thus we simply write

$$1/(1-a)=a_2. \tag{31}$$

In general a_2 need not be greater than unity since it is the elasticity of substitution divided by the share of capital. Inserting these into the basic model yields

$$n=\varphi n_{-1}+(1-\varphi)\left(a_0+a_1\log\tilde{\theta}+k-a_2(w-p_{\mathrm{f}})\right.$$
$$\left.\times\frac{a_2 s}{1-s}(p_{\mathrm{m}}-p_{\mathrm{f}})+(a_2-1)\log A\right), \tag{32}$$

where

$$w=c_0+\lambda\left(p_{\mathrm{f}}^{\mathrm{e}}-\frac{s}{1-s}(p_{\mathrm{m}}^{\mathrm{e}}-p_{\mathrm{f}}^{\mathrm{e}})+\frac{1}{a_2}(k-n^{\mathrm{I}})+\frac{(a_2-1)}{a_2}\log A\right)$$
$$+(1-\lambda)(\bar{w}-c_1\bar{u}+c_2\log v+c_3\log\rho)+c_4(w-\bar{w})_{-1}. \tag{33}$$

The following terms must now be specified. First, short-run demand shifts are captured by aggregate competitiveness, *comp*, and deviations of industry specific world production from trend, *wt*. Thus we have

$$a_1 \log \tilde{\theta} = a_{11} comp + a_{12} wt + \varepsilon_1, \tag{34}$$

where ε_1 is some random error. Second, technical progress is captured by a residual based measure $\hat{a}$ described in the data appendix combined with a time trend. This yields

$$\log A = \hat{a} + \gamma t + \varepsilon_2, \tag{35}$$

where ε_2 is a further random error reflecting productivity shocks.

The number of insiders, N^{I}, we capture by

$$N^{\mathrm{I}} = \omega_1 U_{-1} + \omega_2 N_{-1},$$

where ω_2 is the exogenous proportion of previous employees who count as insiders, ω_1 is the exogenous proportion of the unemployed who count as insiders and U_{-1} refers to those unemployed who recently worked in the industry. The insiders therefore reflect some proportion of the existing employees plus some proportion of the relevant group of unemployed workers. If we define the labour force 'attached' to the industry as

$$L = U + N,$$

then

$$N^{\mathrm{I}} = \omega_1 U_{-1} + \omega_2 (L_{-1} - U_{-1}) = \omega_2 L_{-1} \left(1 - \left(1 - \frac{\omega_1}{\omega_2}\right) u_{-1}\right),$$

where $u = U/L$, the industry specific unemployment rate. This yields

$$n^{\mathrm{I}} = l_{-1} - \left(1 - \frac{\omega_1}{\omega_2}\right) u_{-1} + \text{constant}. \tag{36}$$

Note that this formulation generates of a positive impact of lagged unemployment on wages so long as the proportion of unemployed who count as insiders is lower than the proportion of existing employees who do so ($\omega_1 < \omega_2$). This, is the foundation of the hysteresis element in the insider model.

Finally we deal with the price expectation terms in the wage equation by the standard measurement error method [see Wickens (1982) for example] replacing p_f^e, p_m^e by the actual values p_f, p_m and incorporating the innovations $\varepsilon_3 = p_f - p_f^e$, $\varepsilon_4 = p_m - p_m^e$ into the equation error.

Substituting (34), (35), (36) into our basic eqs. (32), (33) yields

$$n = \varphi n_{-1} + (1-\varphi)\left[a_0 + a_{11}comp + a_{12}wt + k - a_2(w - p_f) - \frac{a_2 s}{1-s}(p_m - p_f)\right]$$

$$+ (a_2 - 1)(\hat{a} + \gamma t) + (1-\varphi)[\varepsilon_1 + (a_2 - 1)\varepsilon_2], \tag{37}$$

$$w = c_0 + \lambda\left(p_f - \frac{s}{1-s}(p_m - p_f) + \frac{1}{a_2}(k - l_{-1}) + \frac{(a_2 - 1)}{a_2}(\hat{a} + \gamma t)\right)$$

$$+ (1-\lambda)\bar{w} - (1-\lambda)c_1\bar{u} + \frac{\lambda}{a_2}\left(1 - \frac{\omega_1}{\omega_2}\right)u_{-1} + (1-\lambda)c_2 \log v$$

$$+ (1-\lambda)c_3 \log \rho + c_4(w - \bar{w})_{-1} + \lambda\left[\frac{(a_2 - 1)}{a_1}\varepsilon_2 - \frac{(\varepsilon_3 - s\varepsilon_4)}{1-s}\right]. \tag{38}$$

For the purpose of estimation we suppose that $k, \hat{a}$ are known in advance and hence predetermined whereas it is clear that w, p_f, p_m may all be influenced by productivity shocks and must, therefore, be treated as endogenous. We also treat *comp* and *wt* as endogenous as a precautionary measure. In the wage equation, the price innovations in the error may be correlated with any current dated variables except for $k, \hat{a}$ which are known in advance and so all such variables must be instrumented by lagged values.

In the light of these remarks, we therefore investigate the following structural model based on (37), (38).

Marginal revenue product condition

$$n - k = \alpha_0 - \alpha_1(1-\alpha_5)(w - p_f) - \alpha_2(1-\alpha_5)(p_m - p_f) + \alpha_{31}comp$$

$$+ \alpha_{32}wt + \alpha_4(1-\alpha_5)\hat{a} + \alpha_4(1-\alpha_5)\gamma t + \alpha_5(n_{-1} - k), \tag{39}$$

n = employment, w = hourly labour cost*, p_m = material input price*, p_f = final output price*, $comp$ = aggregate competitiveness*, wt = industry world activity*, k = capital stock, $\hat{a}$ = residual based measure of technical progress; *variables are treated as endogenous. In (37) it has been assumed that the value-added restriction holds. If this is not the case, then the coefficient on the materials price, α_2, can take either sign. Furthermore, (37) also contains the restriction that technical progress is labour augmenting. In terms of (39) this restriction has the form

$$\text{labour augmenting technical progress (LATP) restriction: } \alpha_4 = \alpha_1 - 1. \quad (40)$$

Wage equation

$$w - \bar{w} = \gamma_0 + \lambda[(p_f - \bar{w}) + \gamma_1(k - l_{-1}) - \gamma_2(p_m - p_f) + \gamma_3\hat{a} + \gamma_4 t]$$
$$+ \gamma_5\bar{u} + \gamma_6 u_{-1} + \gamma_7 \log v + \gamma_8(w - \bar{w})_{-1}, \quad (41)$$

$\bar{w}$ = wages expected to rule elsewhere in the economy, $\bar{u}$ = aggregate unemployment rate, u = industry specific unemployment rate, $\log v$ = wedge between employers' real wage and the real consumption wage. This is $t_1 + t_2 + t_3 + s(\bar{p}_m - \bar{p}_f)$ where t_1 is the employer's labour tax rate, t_2 is the income tax rate, t_3 is the excise tax rate, $\bar{p}_m - \bar{p}_f$ is the aggregate real price of inports and s is the appropriate share. All current dated variables except $\hat{a}, k$ are treated as endogenous. The model restrictions implied by (37), (38) are $\gamma_1 = 1/\alpha_1$, $\gamma_2 = \alpha_2/\alpha_1$, $\gamma_3 = \alpha_4/\alpha_1$, $\gamma_4 = \alpha_4\gamma/\alpha_1$. The third of these is not required if the LATP restriction (40) is satisfied and the fourth does not appear if $\gamma = 0$, for then the time trend is omitted from the model entirely.

4. The empirical investigation

Our aim in this section is to investigate the four hypotheses set out in the introduction using 25 years of annual data for 14 two-digit industrial sectors in Britain. The data are described in the appendix.

The first stage is to investigate the overall importance of insider factors and we do this by fitting a very general unrestricted wage equation for each industry and testing for the joint significance of the insider variables. Thus, based on the wage equation (41), we simply regress $w - \bar{w}$ on two lags of itself and all the dependent variables except the productivity terms $(k - l_{-1})$, $\hat{a}$ which are so heavily trended that only one lag makes much sense. We also include a trend and constant. The F-tests for the joint significance of the insider variables $(p_f - \bar{w})$, $(k - l_{-1})$, $(p_m - p_f)$, $\hat{a}$, u_{-1} are presented in table 1 and indicate that in 11 of the 14 industries, this group is jointly significant at the 10% level (8 at the 5% level). Furthermore two of the remaining three industries have an F which rejects the null at the 15% level so overall these results indicate that insider factors are of considerable importance.

While such equations are useful for investigating overall effects, the degree of overfitting and the consequent shortage of degrees of freedom arising from a regression with 15 variables using 25 data points makes them all but useless for any intensive investigation of individual coefficients. However, to

Table 1

Wage equations[a] (VAR type): F tests for insider variables (dependent variable: $w-\bar{w}$, 1961–1985).[b]

Industry[c]	F statistic[d]	Industry[c]	F statistic[d]
FDT	1.99	OE	5.25*
CH	2.03	TX	4.98*
MM	4.32*	CL	7.36*
ME	3.50*	BG	1.20
IE	3.57*	TF	2.81**
EE	5.21*	PP	2.41**
VE	2.37**	CN	4.53*

[a]The equation includes two lags on $w-\bar{w}$, $p_f-\bar{w}$, p_m-p_f, $\bar{u}$, u, $\log v$; one lag on $\hat{a}$, $k-1_{-1}$ plus c and trend. The F tests the joint significance of the insider terms, namely two lags on $p_f-\bar{w}$, p_m-p_f, u and one lag on $\hat{a}$, $k-1_{-1}$.

[b]In order to specify the expected outside wage, $\bar{w}$, we proceed as follows. If wage bargainers are fully informed, then the expected outside wage would simply be, w_a, the aggregate wage. If, as seems more likely, they are less than fully informed about aggregate wages but have a good knowledge of aggregate prices, they would sensibly estimate aggregate wages by $w_{a_{-1}}+\Delta\bar{p}+g$ where $\Delta\bar{p}$ is the change in aggregate prices and g is trend real wage growth. So we define $\bar{w}$ as $\bar{\alpha}w_a+(1-\bar{\alpha})(w_{a_{-1}}+\Delta\bar{p})$, assuming g is a constant. In the analyses reported here, we set $\bar{\alpha}=0.5$. In fact, varying $\bar{\alpha}$ on the unit interval makes very little odds to the results.

[c]FDT = food, drink, tobacco; CH = chemicals; MM = metal manufacture; ME = mechanical engineering; IE = instrument engineering; EE = electrical engineering; VE = vehicles; OE = other engineering; TX = textiles; CL = clothing and footwear; BG = bricks and glass; TF = timber and furniture; PP = paper and printing; CN = construction.

[d]The relevant statistic is $F(8,10)$, $5\%=3.07$, $10\%=2.37$. So * represents a 5% rejection, ** a 10% rejection.

avoid charges of data mining and the like, we feel that it is worth presenting results from unrestricted estimates of the wage equation which are identical in form across all industries. So we regress $w-\bar{w}$ on the first lag of all the independent variables in (41) except aggregate unemployment where we use the current value in order to preserve the theoretically important temporal difference between this variable and the industry unemployment rate. Relevant statistics from these regressions are presented in table 2. The first important point is that for most of the industries λ is strongly positive and appears to be larger in those industries with strong unions (chemicals, engineering, vehicles, paper and printing) relative to those with weak unions (textiles, clothing, bricks and glass, construction). This impression will be confirmed more precisely when we have considered estimates of our structural model. The second point worth noting is that the unemployment terms do not give a very clear cut impression. Recall that aggregate unemployment

Table 2

Unrestricted wage equations[a] (single lag) (dependent variable: $w-\bar{w}$, 1961–1985).[a,b]

	Parameters				
Industry	$\lambda(p_f-\bar{w})_{-1}$	$\gamma_5(\bar{u})$	$\gamma_6(u_{-1})$	se	R^2
FDT	0.49 (3.8)	0.68 (1.8)	−0.27 (0.7)	0.013	0.93
CH	0.34 (2.6)	0.11 (0.2)	0.06 (0.1)	0.017	0.89
MM	0.38 (3.0)	−0.37 (1.0)	0.18 (1.2)	0.015	0.70
ME	0.36 (4.0)	−0.62 (2.0)	0.87 (2.1)	0.012	0.82
IE	0.26 (2.1)	−0.63 (1.7)	1.04 (1.1)	0.016	0.84
EE	0.26 (3.7)	−0.25 (1.1)	−0.29 (0.6)	0.011	0.72
VE	0.32 (1.5)	0.07 (0.1)	0.26 (0.4)	0.025	0.92
OE	0.22 (3.1)	−1.26 (5.6)	0.24 (1.7)	0.010	0.86
TX	0.13 (1.4)	−0.65 (1.8)	−0.27 (1.3)	0.012	0.94
CL	0.02 (0.2)	−1.26 (3.1)	0.46 (1.8)	0.015	0.92
BG	0.26 (2.3)	−0.53 (1.2)	−0.16 (0.4)	0.016	0.67
TF	0.39 (3.5)	−0.73 (2.1)	0.44 (1.4)	0.013	0.89
PP	0.50 (3.7)	0.93 (1.7)	−1.38 (1.5)	0.019	0.90
CN	−0.10 (0.1)	−0.68 (2.2)	−0.09 (0.5)	0.015	0.79

[a] t statistics in parentheses.

[b] The equation includes one lag on $w-\bar{w}$, $p_f-\bar{w}$, p_m-p_f, u, $\log v$, $\hat{a}$, $k-1_{-1}$, the current value of $\bar{u}$ plus c and trend. Notes [b] and [c] on table 1 also apply.

should be negative and since it is an outside factor we might expect it to be more important in those industries where λ is small and unions are weak [see eq. (38)]. Ten out of the fourteen industries have negative aggregate effects and these are indeed large where unions are weak (textiles, clothing, bricks and glass, construction). Again we shall firm up this impression in due course. However, only eight of the fourteen industries have positive industry unemployment effects and overall these unemployment effects are badly determined. This is, perhaps, not wholly surprising given the high degree of collinearity between the two unemployment variables (correlation coefficients are typically in the range 0.91–0.97) so we should not be too disappointed. However, there are clear instances of overall positive unemployment effects in some industries and this will make a contribution to hysteresis in the economy as a whole.

In table 3 we present estimates of the key wage parameters of the structural model set out in eqs. (39), (41). The remaining parameters may be found in table 3′ in the appendix. Our general strategy in estimating this model is as follows. We allow the equations to differ across industries by dropping material prices (p_m-p_f), the trend term and the wedge term ($\log v$) if their coefficients are small and insignificant. We impose the labour augmenting technical progress restriction if it is not rejected. Otherwise, the first equation for each industry is the same throughout, whereas in the

Table 3

Wage equations [structural model, eqs. (39, 40)].[a,b]

	Industry						
Parameters	FDT	CH	CH	MM	MM	ME	ME
λ	0.33 (4.4)	0.21 (2.8)	0.22 (2.8)	0.26 (2.8)	0.25 (3.1)	0.27 (4.6)	0.30 (5.3)
$\gamma_5(\bar{u})$	0.11 (0.4)	0.50 (1.5)	–	0.18 (0.5)	–	−0.20 (1.2)	−0.21 (2.7)
$\gamma_6(u_{-1})$	−0.068 (0.2)	−0.35 (0.8)	0.19 (0.9)	0.025 (0.2)	0.094 (2.6)	0.036 (0.2)	–
$\gamma_7(\log v)$	–	–	–	–	–	–	–
$\gamma_8(w-\bar{w})_{-1}$	0.59 (4.0)	0.29 (1.6)	0.39 (2.2)	0.14 (0.8)	0.14 (0.9)	0.21 (1.5)	0.18 (1.4)
se	0.0157	0.0182	0.0182	0.0201	0.0196	0.0136	0.0138
se (1st-order autoregression)	0.0200	0.0237	0.0237	0.0213	0.0213	0.0204	0.0204
Autocorrelation, LM, χ^2_2	3.30	1.58	3.18	7.11[c]	7.40[c]	3.48	2.08
Parameter stability '73/4 F(12, x)	1.27	0.83	1.10	1.17	0.96	0.92	0.97
Parameter stability '79/80 F(6, x) (x = 19, 20 or 21)	1.31	0.82	0.20	0.70	0.79	0.30	0.32
Cross equation restriction	1.52 (χ^2_2)	1.36 (χ^2_2)	0.82 (χ^2_2)	3.17 (χ^2_3)	5.06 (χ^2_3)	0.30 (χ^2_2)	0.30 (χ^2_2)

	Industry					
Parameters	IE	IE	EE	EE	VE	VE
λ	0.35 (5.1)	0.33 (5.3)	0.21 (3.3)	0.16 (2.7)	0.64 (3.7)	0.52 (3.2)
$\gamma_5(\bar{u})$	−0.07 (0.3)	−0.22 (2.0)	0.27 (1.1)	−0.19 (1.9)	0.96 (1.9)	–
$\gamma_6(u_{-1})$	−0.32 (0.6)	–	−0.82 (2.0)	–	0.35 (0.7)	0.86 (2.0)
$\gamma_7(\log v)$	–	–	0.054 (1.1)	0.069 (1.4)	–	–
$\gamma_8(w-\bar{w})_{-1}$	0.14 (0.9)	0.18 (1.2)	0.071 (0.4)	0.20 (1.1)	0.88 (4.3)	0.74 (3.9)
se	0.0122	0.0124	0.0123	0.0125	0.0204	0.0204
se (1st-order autoregression)	0.0192	0.0192	0.0153	0.0153	0.0278	0.0278
Autocorrelation, LM, χ^2_2	1.53	1.96	3.34	3.55	0.66	0.75
Parameter stability '73/4 F(12, x)	1.31	1.25	1.30	1.42	1.04	0.78
Parameter stability '79/80 F(6, x) (x = 19, 20 or 21)	1.01	0.39	1.24	0.84	1.17	0.57
Cross equation restriction	6.77 (χ^2_3)	6.50 (χ^2_3)	4.20 (χ^2_3)	3.35 (χ^2_2)	0.43 (χ^2_4)	0.26 (χ^2_4)

Parameters	Industry OE	OE	TX	TX	CL	BG	BG
λ	0.27(4.2)	0.24(3.9)	0.14(2.0)	0.12(1.9)	0.037(0.6)	0.17(1.8)	0.17(1.9)
$\gamma_5(\bar{u})$	0.23(0.7)	−0.33(2.9)	−0.49(1.6)	−0.79(4.7)	−1.40(4.7)	−0.76(0.2)	−0.14(1.0)
$\gamma_6(u_{-i})$	−0.40(1.8)	–	−0.23(1.2)	–	0.62(3.6)	−0.68(0.2)	–
γ_7(wedge)	0.10(1.9)	0.13(2.7)	0.25(4.0)	0.26(4.1)	0.18(2.4)	0.84(1.2)	0.087(1.3)
$\gamma_8(w-\bar{w})_{-1}$	−0.030(0.2)	0.11(0.7)	0.24(1.4)	0.37(2.7)	0.75(5.4)	0.31(1.5)	0.31(1.6)
se	0.0160	0.0141	0.0114	0.0114	0.0137	0.0163	0.0163
se (1st-order autoregression)	0.0194	0.0194	0.0199	0.0199	0.0213	0.0190	0.0190
Autocorrelation, LM, χ^2_2	0.92	3.44	1.98	0.12	0.24	0.34	3.95
Parameter stability '73/4 $F(12,x)$	1.36	1.23	1.19	1.25	1.58	1.33	1.19
Parameter stability '79/80 $F(6,x)$ ($x=19$, 20 or 21)	0.43	0.49	1.87	1.24	3.14[c]	0.37	0.23
Cross equation restriction	2.84(χ^2_2)	1.51(χ^2_2)	0.02(χ^2_2)	0.79(χ^2_2)	3.78(χ^2_3)	6.58(χ^2_3)	5.26(χ^2_3)

Parameters	Industry TF	TF	PP	PP	CN	CN
λ	0.26(1.9)	0.24(2.2)	0.29(1.8)	0.42(2.3)	0.12(1.2)	0.12(1.2)
$\gamma_5(\bar{u})$	−0.28(0.7)	−0.43(2.5)	−0.15(0.3)	−0.17(0.6)	−0.09(0.1)	−0.54(1.7)
$\gamma_6(u_{-i})$	−0.17(0.4)	–	0.23(0.3)	–	−0.14(0.4)	–
γ_7(wedge)	–	–	–	–	0.02(0.2)	0.05(0.6)
$\gamma_8(w-\bar{w})_{-1}$	0.046(0.2)	0.075(0.3)	0.82(3.6)	0.81(3.6)	−0.42(2.0)	−0.40(2.0)
se	0.0145	0.0142	0.0221	0.0229	0.0148	0.0142
se (1st-order autoregression)	0.0205	0.0205	0.0258	0.0258	0.0278	0.0278
Autocorrelation, LM, χ^2_2	3.17	2.04	0.83	0.63	3.98	4.01
Parameter stability '73/4 $F(12,x)$	0.70	0.85	1.17	1.22	0.95	0.99
Parameter stability '79/80 $F(6,x)$ ($x=19$, 20 or 21)	0.84	0.86	1.16	1.23	0.88	0.52
Cross equation restriction	5.10(χ^2_3)	4.71(χ^2_3)	2.81(χ^2_2)	2.08(χ^2_2)	0.35(χ^2_3)	0.58(χ^2_3)

[a]For reference purposes the model estimated is

Wage: $w-\bar{w}=\gamma_0+\lambda[p_f-\bar{w}+\gamma_1(k-1_{-1})-\gamma_2(p_m-p_f)+\gamma_3\hat{a}+\gamma_4 t]+\gamma_5\bar{u}+\gamma_6 u_{-1}+\gamma_7\log v+\gamma_8(w-\bar{w})_{-1}$.

Marginal revenue product condition:

$n-k=a_0-\alpha_1(1-\alpha_5)(w-p_f)-\alpha_2(1-\alpha_5)(p_m-p_f)+\alpha_{31}comp+\alpha_{32}wt+\alpha_4(1-\alpha_5)\hat{a}+\alpha_4(1-\alpha_5)\gamma t+\alpha_5(n_{-1}-k)$.

LATP restrictions: $\alpha_4=\alpha_1-1$.

Cross equation restrictions: $\gamma_1=1/\alpha_1$, $\gamma_2=\alpha_2/\alpha_1$, $\gamma_3=\alpha_4/\alpha_1$, $\gamma_4=\alpha_4\gamma/\alpha_1$.

The third of these is omitted if LATP is satisfied and the fourth if $\gamma=0$. In table 3 we report the key parameters of the wage equation. The values of γ_1, γ_2, γ_3, γ_4 may be found by consulting the estimates of the marginal revenue product condition in the appendix and using the cross equations restrictions. Table 1 notes [b] and [c], table 2 note [a] also apply.

[b]For reasons explained in the text, all the current terms except $\hat{a}$ and k are treated as endogenous – the first lags on all these variables are used as instruments. The equation was estimated by non-linear 3SLS on TSP (4.1A).

[c]Rejection of the null hypothesis.

second equation we drop one of the unemployment terms if this seems sensible.

Overall, the wage equations are fairly satisfactory in the sense that they always have considerably lower standard errors than a simple first order autoregression, they exhibit stable parameters over the two episodes of greatest 'structural change' in the economy, 1973–1974, 1979–1980 and they generally have serially uncorrelated errors. The cross equation restrictions implied by the theoretical structure are never rejected.

The insider effects, λ, are well determined and differ quite systematically between industries as we might expect. Furthermore, since they are all significantly below unity and typically below one half, this implies that the outside wage is a very important factor in wage determination. Other features worth noting include the fact that the lagged dependent variable, which typically covers a multitude of sins in time series models, usually has a gratifyingly small coefficient. This is consistent with the variables in the wage equation being cointegrated, which in all bar a couple of cases they are. A discussion of the implications of non-stationarity for these equations is provided in an appendix.

Unfortunately the unemployment terms, tend not to be well determined, partly as a consequence of their lack of independent variation. If their overall effect seems to be negative we drop the lagged industry term and if positive, we drop the aggregate unemployment rate. Once we do this, then in most cases we obtain a significant effect. This is not, however, a wholly satisfactory procedure.

We are now in a position to present tentative answers to the four questions posed in the introduction. First, are insider forces important? The results reported in all three tables indicate a resounding yes. Industry wages do not simply track aggregate wages modified by the situation in the aggregate labour market but are strongly influenced in the short run by industry price and productivity terms. The second and third questions refer to the relationship between insider/outsider effects and union power. Recall our theoretical framework indicates that the 'insider weight', λ, should be increasing in union power (see fn. 10) and this implies that the coefficient on aggregate unemployment should also be increasing in union power [see eq. (38)]. Note that an increase in the unemployment coefficient implies that the unemployment effect on wages becomes *less* important, since it is generally negative. To investigate these issues we analyze the cross industry variation in the λ coefficient and that on aggregate unemployment in relation to union power. Our measure of union power in each industry, which we consider to be relatively stable through time, is the mark-up of union on non-union manual male wages in 1976 as reported in Stewart (1983). As a measure of union power this is superior to union density in the British context, since, for a variety of reasons, several heavily unionised industries have rather weak

Table 4

The relationship between union power, insider and unemployment effects.

Industry	Union power (Up)	5 firm concentration[a] ratio ($C5$)	Coefficients λ (table 2)[b]	λ (table 3)[b]	$\bar{u}$ (table 2)[b]	$\bar{u}$ (table 3)[b]
FDT	0.161	0.618	0.49	0.33	0.68	0.11
CH	0.241	0.602	0.34	0.22	0.11	0
MM	0.116	0.642	0.38	0.25	−0.37	0
ME	0.122	0.351	0.36	0.30	−0.62	−0.21
IE	0.167	0.322	0.26	0.33	−0.63	−0.22
EE	0.108	0.635	0.26	0.16	−0.25	−0.19
VE	0.272	0.677	0.32	0.52	0.07	0
OE	0.198	0.275	0.22	0.24	−1.26	−0.33
TX	0.111	0.476	0.13	0.12	−0.65	−0.79
CL	0.127	0.254	0.02	0.04	−1.26	−1.40
BG	0.101	0.489	0.26	0.17	−0.53	−0.14
TF	0.269	0.279	0.39	0.24	−0.73	−0.43
PP	0.312	0.323	0.50	0.42	0.93	−0.17

OLS regressions

$$\underset{}{\lambda 2 = -0.0038} + \underset{(2.1)}{0.98Up} + \underset{(1.4)}{0.29C5} \qquad R^2 = 0.36 \qquad \bar{u}2 = -2.3 + \underset{(2.4)}{4.8Up} + \underset{(2.6)}{2.3C5} \qquad R^2 = 0.53$$

$$\lambda 3 = -0.064 + \underset{(3.0)}{1.17Up} + \underset{(1.4)}{0.25C5} \qquad R^2 = 0.51 \qquad \bar{u}3 = -1.3 + \underset{(1.5)}{1.9Up} + \underset{(2.7)}{1.6C5} \qquad R^2 = 0.45$$

[a]The 5 firm concentration ratio is based on net output and refers to the weighted average across all the 3-digit industries within each 2-digit industry. Union power is taken directly from Stewart (1983), table 3 and corresponding to the raw differential.

[b]λ (table 2), λ (table 3) are the λ coefficients taken from tables 2 and 3. $\bar{u}$ (table 2), $\bar{u}$ (table 3) are the coefficients on aggregate unemployment taken from the same tables. In the regressions, these coefficients are written as $\lambda 2$, $\lambda 3$, $\bar{u}2$, $\bar{u}3$, respectively.

unions. However this measure does have the drawback that it reflects not only union power but the rents which are available to be captured.[11] To deal with this, we also control for the 1976 industry 5-Firm Concentration Ratio, C_5, when examining the relationships. In table 4, we tabulate Union Power, the 5-Firm Concentration Ratio and the values of λ and the aggregate unemployment coefficients from both table 2 and table 3. We also present some relevant regressions in order to summarise the overall picture. The results here indicate that there is a significant positive correlation across industries between the insider effect, λ, and our measure of union power. This is consistent with the theoretical framework set out in section 2. Furthermore, there is evidence of a positive cross industry correlation between the aggregate unemployment effect and union power. This is the correct sign because larger negative unemployment effects should be associated with weaker unions. Finally, the positive concentration ratio effects are of

[11]I am grateful to Mark Stewart for pointing this out.

independent interest. There is evidence of some association between strong insider or weak outsider effects and high levels of concentration within the industry, holding union power constant. This is consistent with the evidence on efficiency wage models presented in Katz (1986), for example. However we do not wish to speculate further at this stage but simply leave it as an interesting result.

The last question posed in the introduction concerns the extent to which insiders are a restricted group of workers such as the existing employees, as opposed to a wider group including the recently unemployed. In this case, we should observe positive lagged industry unemployment effects generating hysteresis in the economy. The evidence here is rather mixed. It is clear from tables 2 and 3 that there are such effects in a minority of industries, in particular CH, MM, VE and CL. Overall, however, we do not find any strong evidence that hysteresis generated by insiders[12] is a pervasive phenomenon.

5. Summary and conclusions

The purpose of this exercise has been to investigate the importance of insider factors in wage determination. We have developed a theoretical framework based on union bargaining which indicates that the wage outcome is a weighted sum of that wage which will just ensure the employment of the 'insiders' and the wage which will attract and retain workers in the face of outside competition for their services. The weight attached to the former is found to be an increasing function of the power of the union.

When confronted with the data, this model in both unrestricted and tightly specified form reveals insider factors to be important and indicates that insider forces are stronger and outsider forces weaker when unions are powerful. However, the insider group does not, in general, appear to be restricted to the current encumbents and, as a consequence, hysteresis arising from insider behaviour does not seem to be a pervasive phenomenon. These results based on industry data are generally consistent with those derived using firm data which are reported in Nickell and Wadhwani (1990).

[12]Hysteresis can arise for other reasons. For example, if the long-term unemployed have only a weak impact on wage determination this will generate hysteresis via the dynamics of the relationship between the unemployment rate and the proportion of long term unemployed [see Nickell (1987) for example].

Appendix A. Non-stationarity in the wage model

The variables used in the wage model (see table 3) are $(w-\bar{w})$, $\bar{u}$, u, $\log v$ and $[p_f-\bar{w}+\hat{\gamma}_1(k-l_{-1})-\hat{\gamma}_2(p_m-p_f)+\hat{\gamma}_3\hat{a}+\hat{\gamma}_4 t]=\hat{z}$, say. The $\hat{\gamma}$ coefficients used to define $\hat{z}$ for the purposes of this analysis are taken from appendix table 3′. $\bar{u}$, $\log v$ are aggregate variables and the rest are industry specific. In table A.1, we present Augmented Dickey–Fuller (ADF) tests of the null hypotheses that the series are I(1) and I(2). If the ADF statistics are less than around -3.5 (5%) or -3.2 (10%), then we may reject the null and suppose that the series are I(0) or I(1), respectively.

The general impression given by table A.1 is that the variables are I(1) although in some industries $(w-\bar{w})$ and z may be I(0). We should, however, be highly sceptical about results of this kind based on 25 observations since discriminating between a unit root and one which takes the value 0.9, say, is very difficult with so little data.

Were we to have observations for 125 years as opposed to 25 years, it could well be a very different story. Just as a simple example, in the case of aggregate unemployment we do, in fact, have observations from 1850. Over the period 1859–1985, aggregate unemployment fluctuates a great deal, but strictly between the bounds 0–14% (on current definitions). Furthermore, the unemployment series crosses 3% no less than 22 times and 8% no less than 12 times. The probability that such a series is generated by an autoregression with a unit root is more or less negligible. Nevertheless, many short stretches of the series look like a random walk.

However, if we proceed in the standard fashion and suppose the variables to be I(1), we must next check to see if the wage equation variables are cointegrated. In table A.2, we present the appropriate ADF tests and these reveal that aside from one or two exceptions, the variables are indeed cointegrated. The coefficients and t ratios reported in table 3 are thus generally reliable and although we could, perhaps, gain some extra efficiency by using the Johansen (1988) multivariate procedure, the potential rewards would be minimal given the short length of the time series.

These are standard Augmented Dickey–Fuller statistics, using one lag on the differenced residual in the equation generating the statistic.

Table A.1
ADF statistics (1961–1985).

	$(w-\bar{w})$		u		z		$\bar{u}$		$\log v$	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
FDT	−3.8	−4.8	−1.4	−5.7	−3.5	−4.4	−0.2	−4.5	−3.0	−3.2
CH	−5.0	−7.0	−1.8	−5.0	−3.0	−3.7				
MM	−2.9	−5.8	−0.9	−3.3	−2.6	−3.7				
ME	−3.4	−5.0	−1.7	−4.4	−3.3	−3.2				
IE	−2.3	−4.0	−1.9	−5.0	−2.5	−3.6				
EE	−3.1	−5.0	−1.9	−4.8	−2.3	−3.4				
VE	−1.8	−3.8	−1.6	−4.2	−2.9	−3.6				
OE	−2.9	−4.3	−1.4	−4.0	−2.8	−4.0				
TX	−1.6	−4.3	−0.9	−4.1	−3.6	−4.9				
CL	−2.5	−3.3	−0.5	−4.2	−3.3	−4.2				
BG	−4.1	−5.2	−2.0	−4.5	−2.5	−3.3				
TF	−3.2	−4.7	−1.7	−5.2	−2.6	−5.6				
PP	−1.8	−3.7	−2.3	−4.4	−2.3	−3.9				
CN	−2.9	−6.6	−2.6	−5.0	−2.0	−3.0				

Table A.2
ADF tests of cointegration for the wage equations of table 3.

FDT	−3.5	EE	−5.8	BG	−3.9
CH	−5.0	EE	−6.0	BG	−3.9
CH	−5.2	VE	−2.4	TF	−3.9
MM	−4.3	VE	−2.5	TF	−4.0
MM	−4.4	OE	−4.1	PP	−4.1
ME	−5.5	OE	−4.1	PP	−4.1
ME	−5.4	TX	−4.9	CN	−5.1
IE	−3.0	TX	−5.1	CN	−6.7
IE	−3.0	CL	−1.5		

Table 3′[a]

Marginal revenue product condition [table 3, eq. (39)].

	Industry						
Parameters	FDT	CH	CH	MM	MM	ME	ME
α_1	1.62(11.9)	1.05(7.5)	0.93(6.5)	3.13(5.3)	2.96(7.4)	2.16(8.7)	2.08(10.1)
α_2	–	–	–	–	–	–	–
α_{31}	0.14(3.4)	0.20(2.7)	0.24(4.1)	0.53(4.3)	0.55(4.4)	0.25(3.3)	0.30(3.7)
α_{32}	1.20(3.2)	0.30(1.8)	0.40(2.2)	0.32(1.6)	0.32(1.6)	0.51(2.6)	0.82(3.6)
α_4	α_1-1	α_1-1	α_1-1	0.69(1.6)	0.55(2.2)	α_1-1	α_1-1
$\alpha_4\gamma$	–	–	–	–	–	–	–
α_5	0.93(20.6)	0.86(8.3)	0.91(9.5)	0.89(14.5)	0.86(16.0)	0.81(13.0)	0.76(11.3)
se	0.0131	0.0203	0.0206	0.0412	0.0426	0.0263	0.0285

	Industry					
Parameters	IE	IE	EE	EE	VE	VE
α_1	1.13(12.9)	1.12(12.5)	1.29(7.3)	1.24(6.9)	1.92(2.80)	1.66(2.6)
α_2	–	–	–	–	–	–
α_{31}	0.12(1.8)	0.13(1.8)	0.20(3.8)	0.20(3.7)	0.31(5.9)	0.33(6.1)
α_{32}	0.26(1.2)	0.25(1.2)	0.69(5.2)	0.68(5.1)	0.33(2.6)	0.33(2.5)
α_4	α_1-1	α_1-1	−0.13(0.4)	−0.23(0.8)	2.22(2.7)	1.86(2.6)
$\alpha_4\gamma$	−0.023(9.2)	−0.023(8.9)	–	–	−0.041(4.0)	−0.036(3.7)
α_5	0.76(9.9)	0.76(9.9)	0.80(15.7)	0.80(15.2)	0.95(29.1)	0.93(21.0)
se	0.0258	0.0257	0.0174	0.0174	0.0193	0.0192

	Industry						
Parameters	OE	OE	TX	TX	CL	BG	BG
α_1	1.57(9.2)	1.55(9.5)	1.46(7.6)	1.41(7.7)	1.16(2.7)	3.58(10.4)	3.57(10.7)
α_2	–	–	0.94(1.9)	1.06(2.2)	–	–	–
α_{31}	0.28(3.7)	0.30(3.9)	0.49(6.2)	0.51(6.3)	0.37(7.0)	0.31(4.7)	0.31(4.8)
α_{32}	0.81(2.7)	0.92(3.1)	0.73(3.5)	0.76(3.7)	0.64(2.6)	0.86(6.2)	0.86(6.3)
α_4	α_1-1	α_1-1	α_1-1	α_1-1	α_1-1	0.90(4.2)	0.90(4.3)
$\alpha_4\gamma$	–	–	–	–	–	–	–
α_5	0.81(14.1)	0.80(13.9)	0.81(20.8)	0.80(20.5)	0.84(19.9)	0.90(26.3)	0.90(26.3)
se	0.0266	0.0268	0.0198	0.0199	0.0190	0.0187	0.187

	Industry					
Parameters	TF	TF	PP	PP	CN	CN
α_1	2.24(5.5)	2.18(5.9)	2.11(5.1)	2.01(11.9)	1.60(0.7)	2.78(0.7)
α_2	–	–	–	–	–	–
α_{31}	0.23(2.7)	0.24(2.9)	–	–AD	2.03(2.9)	2.21(3.2)
α_{32}	0.71(3.6)	0.71(3.7)	0.26(2.0)	0.40(3.0)	–	–
α_4	−0.01(0.0)	−0.05(0.1)	α_1-1	α_1-1	−1.19(1.3)	−1.89(0.7)
$\alpha_4\gamma$	–	–	–	–	−0.053(2.1)	−0.038(0.8)
α_5	0.91(18.7)	0.91(18.2)	0.93(21.4)	0.84(15.9)	0.90(8.3)	0.95(10.6)
se	0.0264	0.0265	0.0178	0.0170	0.0315	0.0318

[a]Notes as in table 3 of main text. For industry CN we use the adjusted budget deficit (AD) as the demand variable since it is more relevant for this industry than the international variables used elsewhere.

Appendix B

Table B.1

Data.

1.	N_i	Employees in employment in industry i, male and females, G.B., mid-year. Source: *Employment Gazette.*
2.	K_i	Gross capital stock (plant and machinery) in industry i. Between 1963 and 1977, data taken from Panic (1978). Before 1963 and after 1977, annual gross capital stock (plant and machinery) from the *Blue Book* were used.
3.	W_i	Real labour cost in industry i. First we compute male hourly wage rate, W^i_{m} and female hourly wage rate, W^i_{f} by the expressions $\mathrm{E}^i_{\mathrm{m}}=W^i_{\mathrm{m}}\times \mathrm{NH}+W^i_{\mathrm{m}}\times 1.3\times(H^i_{\mathrm{m}}-\mathrm{NH})$, $\mathrm{E}^i_{\mathrm{f}}=W^i_{\mathrm{f}}\times H^i_{\mathrm{f}}$, where $\mathrm{E}^i_{\mathrm{m}}$, $\mathrm{E}^i_{\mathrm{f}}$ are male and female average weekly earnings in industry i. H^i_{m}, H^i_{f} are male and female average weekly hours in industry i. Then we calculate $W_i=\left[\frac{N^i_{\mathrm{m}}}{N_i}\times W^i_{\mathrm{m}}+\frac{N^i_{\mathrm{f}}}{N_i}\times W^i_{\mathrm{f}}\right]\times(1+t_1)$, where $N^i_{\mathrm{m}}, N^i_{\mathrm{f}}$ are male and female employment in industry i. Sources: Earnings and hours are October figures in the *Employment Gazette.* Employment are mid-year figures from the *Employment Gazette.* Employment Tax (t_1). See Layard and Nickell (1986).
4.	P_i	Output price in industry i. Up to 1977, data taken from the Cambridge Growth Model data bank via the Macroeconomic Modelling Bureau, Warwick University. After 1977, these are the wholesale price indices in *British Business.*
5.	P_{mi}	Price of raw materials purchased by industry i. Source: *British Business.*
6.	A_i	Five-year moving averages of technical progress in industry i. (TP_i). Using a constant returns to scale production function, $Y^i_{\mathrm{G}}=f_i(M^i,K_i,N_i,TP_i)$, where Y^i_{G}=gross output in industry i at constant prices, M^i=raw materials input of industry i at constant prices; TP_i was calculated with the technique described in Layard and Nickell (1986). Source: Y^i_{G}, M_i at current prices from the *Census of Production* are deflated by the respective price indices.
7.	*comp*	Competitiveness series described in Layard and Nickell (1986).
8.	wt_i	Index of world production (market economies), detrended by a quintic in time. Source: *UN monthly statistics.*
9.	u	Male unemployment rate, mid-year, G.B. Source: Layard and Nickell (1986).
10.	u_i	Industry unemployment rate, male and female, mid-year, G.B., defined as $UR_i/(N_i+UR_i)$. Source for UR_i: *Employment Gazette.* After 1982, when these are no longer published, they are estimated from several proxy indicators; lagged UR_i, UR, deviation of N_i from a moving average. The weights used to combine these proxy indicators result from a regression with UR_i as the dependent variable.
11.	Y_i	Index of industrial production. Source: *Blue Book.*
12.	$\bar{Y}$	Potential output of the economy. Source: Layard and Nickell (1986).
13.	W	Average aggregate hourly wages, male, October. Source: Layard and Nickell (1986).
14.	P	Output price index (TFE deflator at factor cost) described in Layard and Nickell, NIER (1985). Sources: *Blue Book.*
15.	AD	Adjusted fiscal stance. Source: Layard and Nickell (1986).
16.	Up	Union power. Unadjusted union mark-up. Source: Stewart (1983).
17.	*Wedge*	Taxes plus relative price of imports weighted by the share of imports in final expenditure. See: Layard and Nickell (1986).
18.	t_1	'Tax' rate on labour paid by employers. Source: Layard and Nickell (1986).
19.	$C5$	Five-firm concentration ratio. This is based on net output and is averaged over the three-digit industries within each two-digit one. Source: *Census of Production.*

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