Unemployment

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An Econometric Analysis of Unemployment In Great Britain, 1952-75

by

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Comments Welcome

AN ECONOMETRIC ANALYSIS OF UNEMPLOYMENT IN GREAT BRITAIN, 1952-75[1]

Section 1

Introduction

In this paper we analyse the reasons for increasing unemployment in Britain since the middle sixties. We shall argue that the main causes of high unemployment are the level and composition of aggregate demand. We shall argue that structural changes in the economy that have led to a change in the composition of output (from the industrial sector to the services sector) are an important explanation of the high levels of unemployment. Further, we shall argue that the increased unemployment benefits since 1966 do not have a significant effect on the level of unemployment. Our econometric results suggest that although we can highlight the main determinants of unemployment, the relationship is inherently unstable suggesting the need for a more completely specified model of the labour market.

The paper begins by outlining a simplified model of the labour market and deriving some implications for unemployment. The model is then

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1. I should like to thank Ms. Rachel Britton and Mr. V. Rapanos for computing assistance. Professor Gordon Fisher gave much of his time discussing some of the econometric problems discussed in the paper, and also brought to my notice the Brown, Durbin, and Evans (1975) paper, for which I am very grateful. The paper was completed at Queen's while on leave from Essex. Earlier versions of this paper were presented at McMaster University, University of British Columbia, and Simon Fraser University and the comments received have helped to improve this paper. None of the above is responsible for remaining errors or the prejudices expressed.

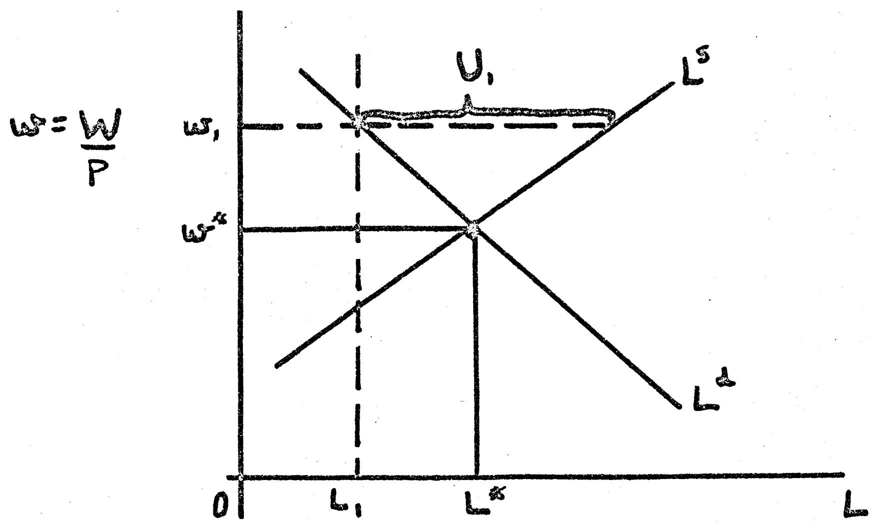
tested using annual data, 1952-75. Specific attention is paid to the specification of the "replacement ratio" (the unemployment benefits to net income ratio) and tests of structural stability are presented. The paper concludes with some suggestions for further work. An appendix outlines the data sources and lists the definitions of variables used in the estimation.

Section 2

A Model

In this Section we shall outline a simple model of the labour market. Assume a classical labour market with labour demand (L^d) a decreasing function, and labour supply (L^s) an increasing function of real wage rates. Competitive equilibrium would give an equilibrium real wage rate w* and equilibrium employment L*. By definition, unemployment is zero at that wage rate.

Diagram 1



If anyone from the working age population is unemployed at w* it is because they are voluntarily choosing to be unemployed because they want to "buy" leisure. (As there are no frictions or imperfections in a competitive model, the only unemployment that can exist is voluntary, which by definition is not unemployment!)

Now let us amend this classical model: assume that real wage rates adjust very slowly in response to excess demands or supplies. We assume that if for some reason the output market is in disequilibrium (*à la* Barro and Grossman (1969)) the *effective* labour demand curve (L_e^d) becomes vertical. In this disequilibrium framework we assume that the short-side of the market determines employment. In Diagram 1 if the real wage rate is w_1, employment is L_1 and *un*employment is U_1. Note, however, that this is a *flow* of unemployment (because labour demand and supply are *flows*) whereas measured unemployment is usually a *stock*. Now, anything which shifts the labour supply curve to the right increases unemployment, and anything that shifts the labour demand curve to the right decreases unemployment.

Let

$$L^d = f(\frac{w}{p}, z_1) \qquad (1)$$

$$f_1 < 0, \; f_2 > 0$$

$$L^s = g(\frac{w}{p}, z_2) \qquad (2)$$

$$g_1 > 0, \; g_2 > 0$$

$$L = \min \{L^d, L^s\}$$

$$U = L^s - L^d$$

$$\text{or } U = f(\frac{w}{p}, z_1) - g(\frac{w}{p}, z_2) \qquad (3)$$

$$\text{or } U = \phi(\frac{w}{p}, z_1, z_2) \qquad (4)$$

$$\phi_1 > 0, \; \phi_2 < 0, \; \phi_3 > 0$$

where L^d is labour demand, L^s is labour supply, U is *flow* of unemployment,

$\frac{w}{p}$ is the real wage rate, z_1 and z_2 are vectors of exogenous variables. Equation 4 is a quasi reduced form.

Let aggregate demand be one of the elements of the z_1 vector. If aggregate demand increases the labour demand curve shifts to the right. (In a classical model the labour demand curve can shift if and only if the production function shifts. In a Barro-Grossman type model, the *effective* labour demand can shift due to increases in aggregate demand). If the labour supply curve is independent of aggregate demand, then unemployment would decrease. Due to social or demographic changes the labour supply curve shifts to the right, and given a labour demand curve, unemployment increases. (Social/demographic variables are contained in the vector z_2).

Let us turn to how the introduction of unemployment benefits affects this labour market. Let us assume away any effects on aggregate demand due to higher incomes of the unemployed, and how the Government finances the unemployment benefits; we assume that the labour demand curve is unaffected.[1] Our presumption is that, given w, an increase in unemployment benefits would decrease the '*real*' labour supply: more people would prefer not to work at any given real wage rate. However, labour supply would *apparently* increase (due to a greater participation rate?) as more people would 'pretend' to be in the labour force. Thus, it is argued, unemployment would rise. In this *static* framework, unemployment rises because *real* supply decreases which leads to voluntary quits from employment. These workers then 'pretend' to be unemployed. Alternatively, the participation

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1. See Spindler & Maki (1979)

rate increases by new entrants 'pretending' to join the labour force.[1] To bring in a little bit of realism, however, voluntary quitters are not eligible for unemployment benefits for up to six weeks, and new entrants are not eligible. Thus neither reason would lead us to expect unemployment to rise. The only theoretical reason (taking account of the practical rules underlying unemployment benefits) which *may* lead to an increase in unemployment is in a *dynamic* framework with imperfect information: in a search theory context. Here an increase in benefits *may* lead to potential workers searching for a longer period because their search costs have been lowered. However, in a recent paper Mortenson (1977) has shown that an increase in unemployment benefits has an *ambiguous* effect on unemployment because you trade off being employed now against being unemployed in the future. If you accept a job quickly now you 'qualify' for benefits in the future. With earnings related benefits it is preferable to achieve a higher level of earnings before taking leisure in the form of unemployment at higher benefits in the future. Although it is common to generalize from the micro search theory predictions to macro relationships, we feel this is an invalid procedure. Search theory assumes *given* a wage distribution an increase in benefits may increase the duration of unemployment. Very little is said about what determines this wage distribution nor how it would be affected

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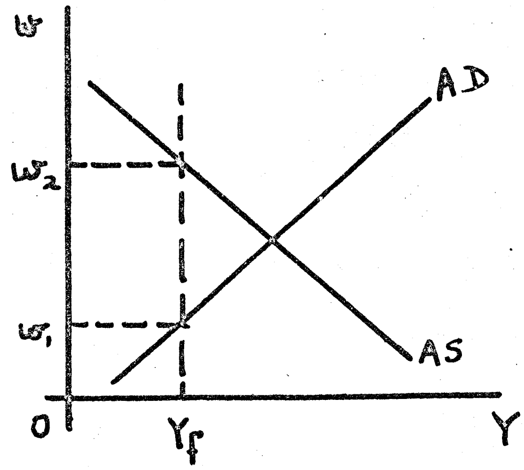
1. A good example of scientific, positive, non-pejorative language is in Horowitz (1977). (italics added). "The higher the compensation for *pretending* to be in the labor force while drawing UI benefits, the more individuals are likely to indulge in the *pretense*. *Bogus* labor-force participation can be of two types. First, unemployed workers can delay searching for a new job. This behavior will not alter measured labor-force participation, although it will increase unemployment at the expense of employment. Alternatively, people who would otherwise withdraw from the labor force can *feign* unemployment in order to qualify for UI benefits."

in response to labour supply changes in aggregate. The higher unemployment benefits may simply *select* who remains unemployed without affecting the total unemployment. The aggregation problem has yet to be solved!

To return to the simple static classical model discussed above, a decrease in the real wage rate leads to a decrease in unemployment. (In the search theory context a decrease in the (mean) wage rate would lead to an *increase* in the 'transitional' unemployment because searchers mistakenly believe that they are finding *relatively* poor wage offers.) It is possible to construct a Keynesian model, *à la* Malinvaud (1977), where a fall in the real wage rate increases unemployment.[1] Assuming an inelastic supply of labour, an aggregate demand curve as an increasing function and an aggregate supply curve as a decreasing function of the real wage rate, and the short-side market clearing we get both Keynesian and classical 'regimes' depending on the value of the real wage rate.[2]

This is illustrated below in Diagram 2.

Diagram 2



1. See Solow (1978)

2. For details see Solow (1978)

In the above diagram Y_f is full employment level of income (output) given an inelastic supply of labour. For real wage rates below w_1, a fall in w decreases aggregate demand (AD) and hence increases unemployment. This is Malinvaud/Solow's representation of Keynesian unemployment. For real wage rates above w_2, a fall in w increases aggregate supply (AS) and employment increases (unemployment decreases).

Having outlined an alternative framework simply to show some of the analytical problems we shall, in the next Section, formulate the simple classical model in an estimable form.

Section 3

Tests

In this Section we shall test the unemployment equation written in general form as equation (4). We shall use annual data for 1952-75 for Great Britain.[1] First we shall use the Spindler & Maki estimating equation paying particular attention to the replacement ratio (the Benefit-income ratio). The Spindler-Maki equation is:

$$\ln U_t = \beta_0 + \beta_1 R_t + \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_4 S_t + e_t \qquad (5)$$

where U_t is the unemployment *rate*, R_t is the replacement ratio, D_t and D_{t-1} are indexes of aggregate demand, S_t is a labour supply measure, and e_t is an error term assumed to satisfy classical least squares properties. To relate this to the "model", R_t is the variable that implies that labour supply would *apparently* shift to the right with an increase in the benefits, *given* the real wage rate. Implicit in the formulation is a restriction that

1. The data are taken from Spindler and Maki (1979).

it is only the *ratio* which is important. The variables D_t and D_{t-1} are to represent shifts in the labour demand curve due to changes in effective aggregate demand. They are measured as a ratio of actual GDP to trend GDP (see Appendix for details). S_t is a variable to account for changes in labour supply due to demographic reasons *and* changes in productivity/ efficiency. It is worth noting that the dependent variable is not the flow of unemployment but an average *stock* of unemployment. To relate it to the model we have to assume a proportionality between stocks and flows which remains *constant over time*.[1]

As there is no logical reason for taking a logarithmic form of estimating equation except for R_t we estimated the equation in both forms. In Table 1 we have estimated by Ordinary Least Squares using the definition of R used by Spindler-Maki (which is a weighted average of R_t and R_{t-1}) which we have called BENCN and re-estimated by using only R_t, which we have called BRSY. The results suggest that however defined (logs or not) the replacement ratio is a significant variable, and the other parameters are "more-or-less" unchanged in the process. This suggests that the unemployment rate goes up with the replacement ratio. The demand variables suggest that as aggregate demand goes up the unemployment rate goes down, as expected. The labour supply variable is also of appropriate sign (although the significance varies with the definition of the replacement ratio) suggesting that

1. The unemployment rate may be misleading because "large numbers of people both join and leave the register in between two successive counts, and so are not included at all in the monthly unemployment totals." (DE *Gazette* February 1973, "Duration of Unemployment")

Unemployment in Great Britain 1952-75 (Dependent Variable is LURATE)

Table 1

Eq.	Constant	BENCN	LBENCN	BRSY	LBRSY	LCAPAC	LAGCAP	ILSET	R^2	DW
1	-0.800	1.809				-8.942	-5.953	0.00004	0.96	1.29
	(-8.971)	(5.631)				(-8.107)	(-4.224)	(1.841)		
2	0.931		1.036			-9.126	-5.771	0.00003	0.95	1.46
	(2.604)		(5.405)			(-8.061)	(-3.996)	(1.361)		
3	-0.893			1.447		-8.516	-7.702	0.00006	0.94	1.53
	(-9.018)			(4.393)		(-6.700)	(-4.573)	(3.145)		
4	0.411				0.786	-8.403	-7.633	0.00006	0.94	1.54
	(1.181)				(4.064)	(-6.357)	(-4.363)	(2.874)		

Note: All the equations were estimated by Ordinary Least Squares for the period 1952-75.

as labour supply increases in number and efficiency unemployment increases.[1]

As there is no logical reason for using R instead of ln R, we rewrite (5) as:

$$\ln U_t = \beta_0 + \beta_1 \ln R_t + \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_4 S_t + e_t \quad (6)$$

where $R \equiv$ Benefits/Income

which may now be re-written as

$$\ln U = \beta_0 + \beta_1 \ln (\text{Benefits})_t - \beta_1 \ln (\text{Income})_t$$

$$+ \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_4 S_t + e_t \quad (7)$$

We now estimate equation (7) by Ordinary Least Squares and then by Restricted Least Squares to test the restriction that the parameter estimates on Benefits and Income are equal and opposite in sign. As there is some evidence (see Bowers, Cheshire, and Weeden (1970, 1972), Gujarati (1972)) to suggest that the labour market seems to have had a structural change in 1965-66 we have estimated equation (7) for different sub-samples: 1952-65, 1952-66, and 1952-75 and then carried out tests of structural stability (Chow tests). These results are presented in Table 2.

Re-writing equation (7) as

$$\ln U = \beta_0 + \beta_1 \ln (\text{Benefits})_t + b_1 (\text{Income})_t$$

$$+ \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_u S_t + e_t \quad (8)$$

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1. Note however that the DW is in the indeterminate range, although it improves if we use LBENCN, BRSY, or LBRSY.

We test the hypotheses:

H_{01}: $\hat{\beta}_1 = -\hat{b}_1$ (1952-65)

H_{02}: $\hat{\beta}_1 = -\hat{b}_1$ (1952-66)

H_{03}: $\hat{\beta}_1 = -\hat{b}_1$ (1952-75)

and H_{04}: $\hat{\beta}(1952\text{-}65) = \hat{\beta}(1952\text{-}75)$

H_{05}: $\hat{\beta}(1952\text{-}66) = \hat{\beta}(1952\text{-}75)$

Looking at equations (1) and (3) we find that the (nominal) benefits variable (LBENERS) has the 'wrong' sign and is even significant for the period 1952-66. For equation (5), 1952-75 the benefits variable has a 'correct' sign but is not significant. Other variables have 'correct' signs and are significant. When we carry out an F test on the restrictions of equality of parameters, we reject H_{01} and H_{02} but cannot reject H_{03}.[1] When we test for structural stability of parameters we reject the null hypotheses H_{04} and H_{05}. Thus if we carried out a test of the joint hypothesis H_{01}, H_{03}, and H_{04} we would reject it, as we have already rejected H_{01} and H_{04}. Similarly we would reject the joint hypothesis H_{02}, H_{03}, and H_{05} as we have already rejected H_{02} and H_{05}.

It therefore appears that the replacement ratio turns out to be significant because in some sense the income variable is "doing all the work." When we separate out the variable into its component parts the benefits variable 'collapses'. Specifically, we reject that the variable should be specified as a *ratio* of benefits to income.

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1. Note that collinearity is likely to lead to a non-rejection of the restriction.

Unemployment in Great Britain 1952-75 (Dependent Variable is LURATE)

Table 2

Eq.	Estimation Method	Sample	Constant	LBENERS	LINC	LCAPAC	LAGCAP	ILSET	R^2	F	DW	F for Restrictions
1	OLS	52-66	1.666	-0.447	-2.277	-16.231	-4.187	0.0006	0.97	49.69	1.89	
			(3.348)	(-2.179)	(-4.968)	(-9.075)	(-3.599)	(5.511)				
2	ROLS	52-66	-0.308	0.215	-0.215	-9.624	-6.632	0.00009	0.88		0.90	F(1,9)
			(-0.628)	(0.800)	(-0.800)	(-4.784)	(-3.657)	(2.673)				=22.70
3	OLS	52-65	1.687	-0.357	-2.273	-15.871	-4.265	0.0006	0.97	44.55	1.79	
			(3.175)	(-0.894)	(-4.693)	(-6.818)	(-3.376)	(4.154)				
4	ROLS	52-65	0.413	0.757	-0.757	-8.529	-6.582	0.00006	0.90		1.56	F(1,8)
			(0.643)	(1.794)	(-1.794)	(-4.277)	(-3.802)	(1.728)				=14.17
5	OLS	52-75	0.632	0.364	-1.317	-12.982	-6.009	0.0003	0.95	65.77	1.55	
			(1.852)	(1.322)	(-4.137)	(-5.037)	(-3.317)	(2.572)				
6	ROLS	52-75	0.411	0.786	-0.786	-8.404	-7.633	0.00006	0.94		1.54	F(1,18)
			(1.181)	(4.064)	(-4.064)	(-6.357)	(-4.363)	(2.874)				=4.08

1. NB R^2s are unadjusted.
2. LBENERS has the wrong sign for the earlier period.
3. The Restrictions are rejected at 1% for equations 2 and 4.
4. A "Chow test" rejects structural stability of the parameters for equations 1 and 5 (and for equations 3 and 5).

Let us look at this matter in more detail. When we use the replacement *ratio* as a variable, it does not matter whether we divide *nominal* benefits by *nominal* net income, or whether we divide *real* benefits by *real* income, since the price term cancels out. When we separated the replacement ratio into its components in the above Table 2 we used nominal quantities. We repeated the above exercise using log of *real* benefits and log of *real* net income (LRBEN and LRINC). The results are presented in Table 3.

Looking at the ordinary least squares results first, we note that LRBEN (the log of *real* benefits) is not significant for any of the sub-periods[1], but is significant (and positive) for the whole period. For each of the sub-periods an F-test rejects the restriction of equality of parameters (and opposite in sign) for the log of real benefits and log of real income. For the entire period we cannot reject the restriction. Again, since we reject structural stability of the $\hat{\beta}$ vector over the period, 1952-70 and 1952-75 we must treat the results of the overall period with some caution. To carry out formal tests of "money illusion" we re-write equation (6) as

$$\ln U_t = \beta_0 + \beta_1 \ln(\frac{B/P}{Y/P}) + \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_4 S_t + e_t$$

and then separating out the components of R_t (where B is nominal benefits, Y is nominal income, and P is the price level) as:

$$\ln U_t = \beta_0 + \beta_1 \ln B + b_1 \ln Y + \gamma_1 \ln P + \beta_2 \ln D_t + \beta_3 \ln D_{t-1} + \beta_4 S_t + e_t$$

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1. The break in 1970/71 was suggested by the different method for collection of Unemployment statistics. See Section 4.

Unemployment in Great Britain, 1952-75 (Dependent Variable is LURATE)

Table 3

Eq.	Estimation Method	Sample	Constant	LRBEN	LRINC	LCAPAC	LAGCAP	ILSET	$\bar{R}^2$	F	DW	F Value For Restrictions
1	OLS	52-65	-7.072 (-2.194)	0.072 (0.160)	-3.040 (-2.954)	-9.986 (-5.740)	-6.073 (-4.254)	0.0003 (2.846)	0.91	26.6	1.86	
2	ROLS	52-65	0.413 (0.643)	0.757 (1.794)	-0.757 (-1.794)	-8.529 (-4.277)	-6.582 (-3.803)	0.00006 (1.728)				F(1,8) =5.54*
3	OLS	52-66	-8.588 (-2.801)	-0.355 (-1.199)	-3.040 (-2.871)	-10.860 (-6.644)	-6.030 (-4.107)	0.0003 (3.522)	0.89	24.9	1.67	
4	ROLS	52-66	-0.308 (-0.628)	0.215 (0.800)	-0.215 (0.800)	-9.624 (-4.784)	-6.632 (-3.567)	0.0008 (2.673)				F(1,9) =7.41*
5	OLS	52-70	-7.587 (-3.194)	0.008 (0.031)	-3.172 (-3.875)	-9.967 (-6.000)	-6.669 (-4.327)	0.0003 (4.197)	0.92	40.1	2.08	
6	ROLS	52-70	0.333 (0.068)	0.579 (2.453)	-0.579 (-2.453)	-9.081 (-4.273)	-6.975 (-3.496)	0.00009 (2.524)				F(1,13) =10.55**
7	OLS	52-75	-2.188 (-0.913)	0.639 (2.725)	-1.774 (-1.924)	-8.196 (-6.169)	-7.652 (-4.396)	0.0001 (1.958)	0.94	56.7	1.70	
8	ROLS	52-75	0.411 (1.181)	0.786 (4.064)	-0.786 (-4.064)	-8.404 (-6.357)	-7.633 (-4.363)	0.00006 (2.874)				F(1,18) =1.20

Notes

1. * The Restrictions are rejected at 5%.
2. ** The Restrictions are rejected at 1%.
3. A Chow test rejects at the 5% level stability of the parameters for 1952-70 and 1952-75, but does not reject stability for either of the other sub-periods.

We now test the hypotheses:

$$H_{01}: \hat{\beta}_1 = -\hat{b}_1$$

$$H_{02}: \hat{\gamma}_1 = 0$$

$$H_{03}: \hat{\beta}_1 = -b_1 \textit{ and } \hat{\gamma}_1 = 0$$

Table 4 presents results of these tests of hypotheses, without giving the detailed results.[1] What we find is that for all the sub-periods the *joint* hypothesis (H_{03}) is rejected. However, it is not rejected for the entire period. But, tests of structural stability (Chow tests) reject stability of the $\hat{\beta}$ vector over the sub periods. For each sample we find that the OLS estimate of the benefits variable is insignificant. Once again we are led to the conclusion that the benefits variable is not significant and that there is structural instability of the parameter vector. However, in all versions we find that aggregate demand is an important explanatory variable.

Thus far we had defined all our variables (except the replacement ratio) in the same way as Spindler-Maki so as to make our results comparable. We now postulate (unlike Spindler-Maki) that the changing structure of the British economy has led to increasing unemployment. Specifically, we argue that the reason for increasing unemployment since the mid-60's (in addition to a lack of aggregate demand) was due to a shift in demand from industrial goods to the service sector. Since the industrial sector was cutting back on employment[2] (and most of them were men) we assumed that they would register as unemployed. The service sector which was expanding was hiring *female*

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1. These are available on request from the author.

2. See the DE Report (1976). Total employment, however, actually fell over this period.

Unemployment in Great Britain, 1952-75

Table 4

Eq.	Sample	H_{01}	H_{02}	H_{03}
1	52-65	F(1,7)=1.56	F(1,7)=2.21	F(2,7)=9.26*
2	52-66	F(1,8)=2.01	F(1,8)=2.19	F(2,8)=13.94**
3	52-70	F(1,12)=7.61*	F(1,12)=0.03	F(2,12)=8.04**
4	52-75	F(1,17)=2.99	F(1.17)=0.82	F(2,17)=2.43

$$\text{LURATE} = \beta_0 + \beta_1 \text{ LBENERS} + b_1 \text{ LINC} + \gamma_1 \text{ LPRICE} + \beta_2 \text{ LCAPAC} + \beta_3 \text{ LAGCAP} + \beta_4 \text{ ILSET}$$

Notes

1. * Reject at 5%
2. ** Reject at 1%
3. Chow Tests rejected structural stability for equations 1 and 4; 2 and 4; and 3 and 4.

labour, especially part time female labour. Because of an increasing participation rate this increase in employment did not show up as a decrease in unemployment. We used as an explanatory variable the log of the ratio of industrial output to the services sector (for an exact definition of this variable, LMIX, see the Appendix). In addition, we decided to use as our index of technological change the log of output per employed person (LOPE) instead of the composite ILSET variable used by Spindler-Maki. These results are presented in Table 5.

As before we note that the nominal benefits variable does poorly while the aggregate demand variables do well. Our composition of output variable (LMIX) turns up with a significant and negative sign: a decreasing proportion of industrial production has led to increasing unemployment. The technological change variable also turns up significant and with a positive sign, suggesting that a higher output per man increases unemployment. These generalizations are valid for either sub-period and for the whole period. However, a Chow test still rejects structural stability of the parameters. Thus we are still unable to explain the structural change using this framework of analysis. We can, however, argue that changing composition of output and technological change do seem to help in explaining unemployment. (Note, in passing that the Durbin-Watson statistics are higher with this specification than with the Spindler-Maki specification, although still in the indeterminate range for equations 2 and 3.)

Section 4

Further Analysis of Stability

Brown, Durbin, and Evans (1975) in a paper suggest an interesting method to analyse the stability of a regression equation over time. Given

UNEMPLOYMENT IN GREAT BRITAIN, 1952-75

(Dependent Variable is LURATE)

Table 5

Eq	Sample	Constant	LBENERS	LINC	LCAPAC	LAGCAP	LMIX	LOPE	$\bar{R}^2$	DW
1	1952-65	-58.267 (-5.703)	-0.559 -1.535	-0.753 (-0.919)	-10.525 (-3.256)	-2.484 (-1.643)	-5.861 (-4.106)	5.607 (2.812)	0.96	2.71
2	1952-70	-47.090 (-4.622)	-0.276 (-1.260)	-2.631 (-4.734)	-14.952 (-6.297)	-1.834 (-1.195)	-3.055 (-2.383)	7.932 (5.561)	0.95	1.68
3	1952-75	-48.919 (-5.682)	-0.158 (-0.781)	-1.807 (-8.149)	-13.195 (-8.096)	-1.890 (-1.321)	-4.104 (-4.516)	6.389 (6.409)	0.97	1.88

Notes 1. A Chow Test Rejects (at 1%) the stability of the parameters over either period.

a regression equation

$$Y = X\beta + u$$

The equation may be unstable over time for any one (or all) of the following reasons:

(1) The parameter vector β may have changed over time;

(2) The functional form may have changed: say, from a linear to a non-linear relationship;

(3) The error structure may have changed.

Their analytical method is based on looking at the residual sums of squares of recursive regressions and of moving regressions. A BDE computer program (TIMVAR) presents a useful graphical output in addition to the econometric results.

We define recursive residuals (w_r) as

$$w_r = \frac{y_r - x_r' b_{r-1}}{(1+x_r'(X_{r-1}'X_{r-1})^{-1}x_r)^{\frac{1}{2}}} \quad , r = k+1, \ldots T$$

where $X_{r-1}' = [x_1, \ldots x_{r-1}]$ and $Y_r' = [y_1, \ldots, y_r]$. x_t is a column vector of observations on k variables and b_r is the ordinary least squares estimate of β for the first r observations. BDE show that under the null hypothesis (unchanging parameters, and constant variance σ_u^2 that the w's are independent, normally distributed with mean zero and variance σ^2.

Constancy of the β vector can be examined by looking at the w_r's: if β is constant until $t=t_0$ and then changes, the recursive residuals will have a zero mean until t_0 and then diverge as t increases. Standardizing the recursive residuals by the estimated standard derivation, we define a CUSUM

$$W_r = \sigma^{-1} \sum_{k+1}^{r} w_j$$

which is plotted against time. BDE provide an approximate test of the hypothesis $E(W_r) = 0$.

Another test BDE suggest especially when the β's departure from constancy is haphazard, rather than systematic, is to look at the CUSUM SQUARES

$$CUSQ = \sum_{k+1}^{r} w_j^2 / \sum_{k+1}^{T} w_j^2 = \frac{S_r}{S_T}, \quad r = k+1, \ldots T$$

(where S_t is the sum of squared residuals)

On the null hypothesis this follows a beta distribution with mean (r-k)/(T-k). Again an approximate test can be carried out and confidence interval bands drawn in on the time series of the cusum squares. Along with the time series of the Cusum and Cusum Squares we get a time series of parameter estimates. These recursive regressions can be forward or backward recursive. Finally, we can do moving regressions to study the stability of the β vector by fitting regressions to n consecutive observations and then moving the time segment one observation at a time.

We applied this method to the Spindler-Maki regressions with the replacement ratio as defined by them, separated out into its nominal components, and into its real components, respectively. As the output of this computer program is voluminous we summarize the results and illustrate with a complete set of results for one of the regression equations, and a sample from some alternative regressions.

For the regression equation (1952-75)

$$\text{LURATE} = \underset{(1.853)}{0.632} - \underset{(-4.137)}{1.317}\ \text{LINC} + \underset{(1.322)}{0.364}\ \text{LBENERS} - \underset{(-5.037}{12.982}\ \text{LCAPAC}$$

$$- \underset{(-3.317)}{6.009}\ \text{LAGCAP} + \underset{(2.572)}{0.0003}\ \text{ILSET}$$

Diagrams 3 to 8 reproduce the results for the forward recursive regressions. Without carrying out tests of significance, it is apparent that there is a significant break in 1966/67 and in 1970/71.[1] The plot of the Cusum Squares has distinct jumps (and changes in slope) at these points. For the null hypothesis of constancy the plots should have followed the diagonal from 0 to 1. A formal test also rejects (at 5%) the null hypothesis of stability using the Cusum Squares. The Cusum test is not rejected at 5%. A look at the parameter plots also suggests that the instability is quite marked. It is worth noting the parameter for LBENERS is especially unstable. Thus these results confirm the Chow test results reported in the previous section. The data did not reject a test of the null hypothesis of homoscedastic errors.

When we repeated the above exercise using LRBEN and LRINC (ie. the benefits and income variables in real terms) the graphs (Diagrams 9, 10) suggested instability of the regression and of the parameter on LRBEN. However, the Cusum test and the Cusum Squares test for forward recursion was not rejected.[2] This is surprising in the light of the F-test (Chow test) rejecting structural stability. Perhaps this is due to the rather small sample, and the approximate nature of the tests. Similarly, when we repeated

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1. The only explanation we have for a break in 1970/71 is due to a change in the correction of unemployment statistics. This needs further investigation.

2. For backward recursive regressions the Cusum Squares test rejected Structural Stability.

LURATE C LINC LBENERS LCAPAC LAGCAP ILSET (1952-75)

FORWARD RECURSIVE REGRESSION, CUSUM SQUARED RESIDUALS NORMALISED

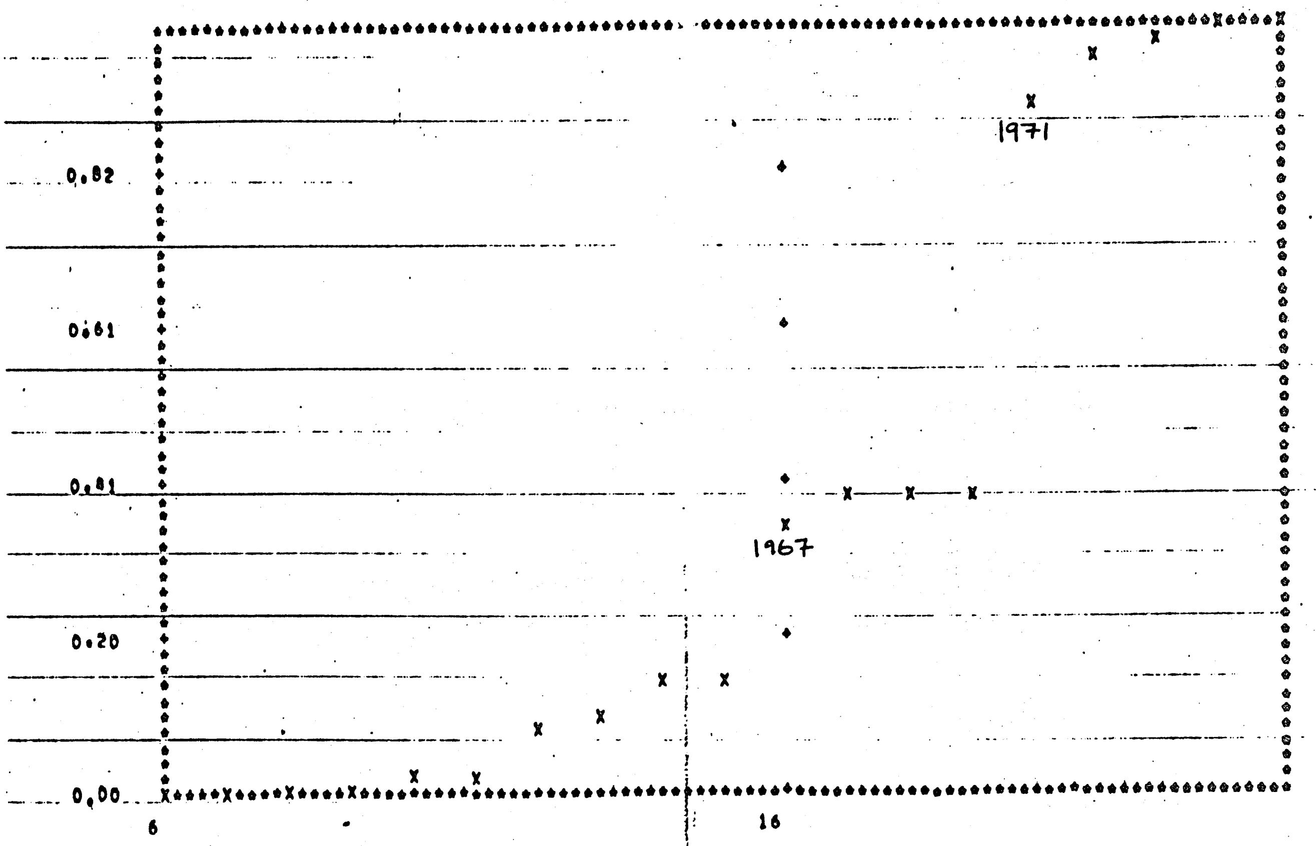

Diagram 3

FORWARD RECURSIVE REGRESSION, COEFFICIENT B- 2 (LINC)

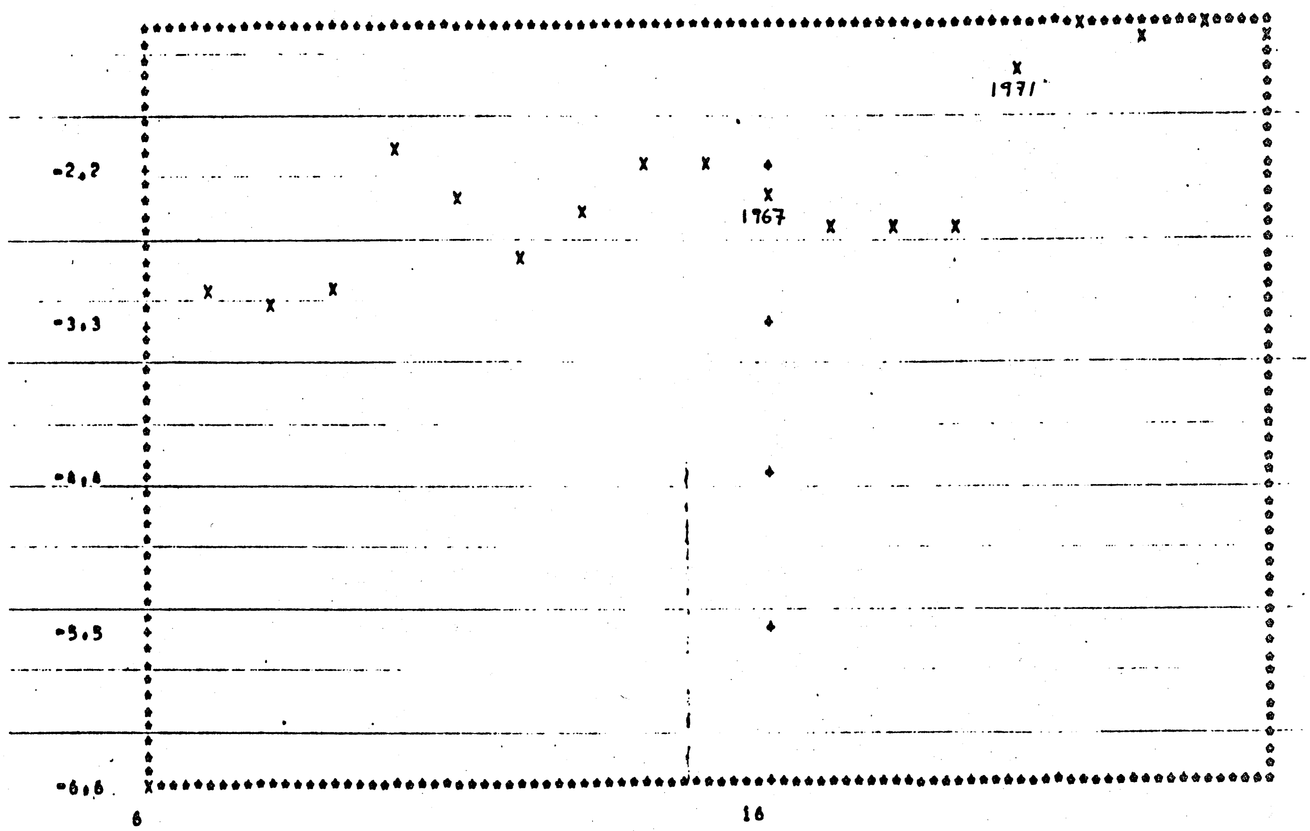

Diagram 4

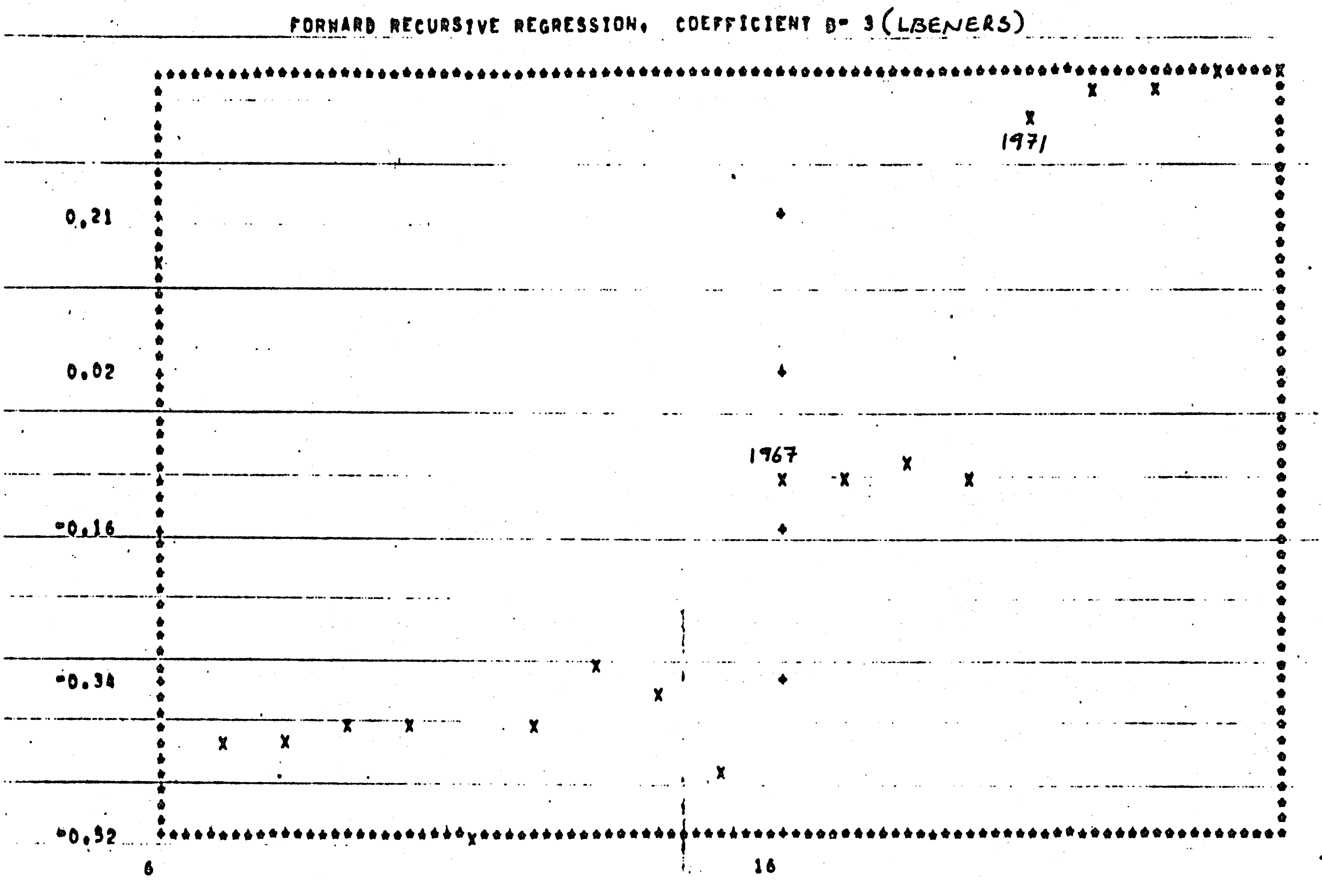

Diagram 5

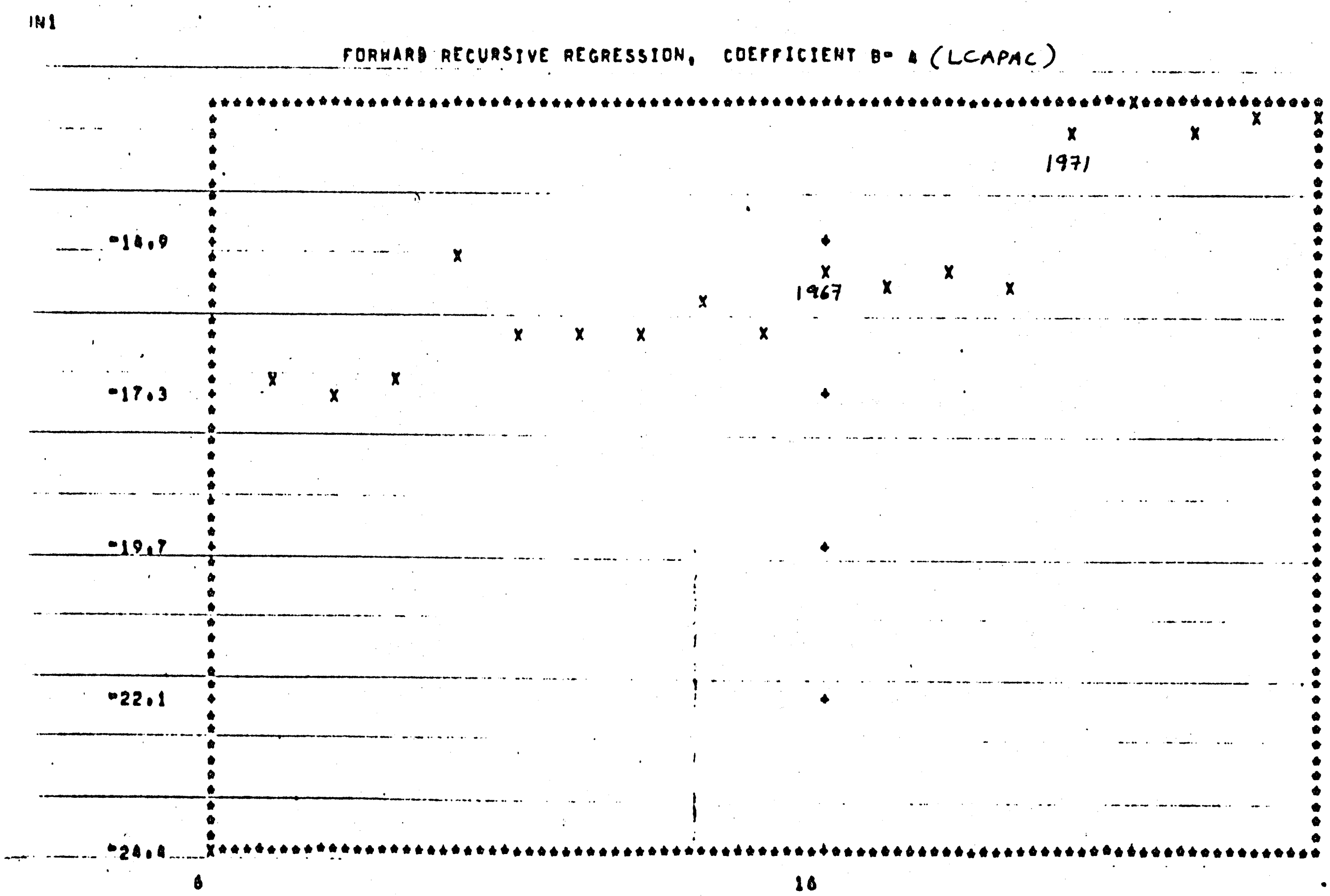

Diagram 6

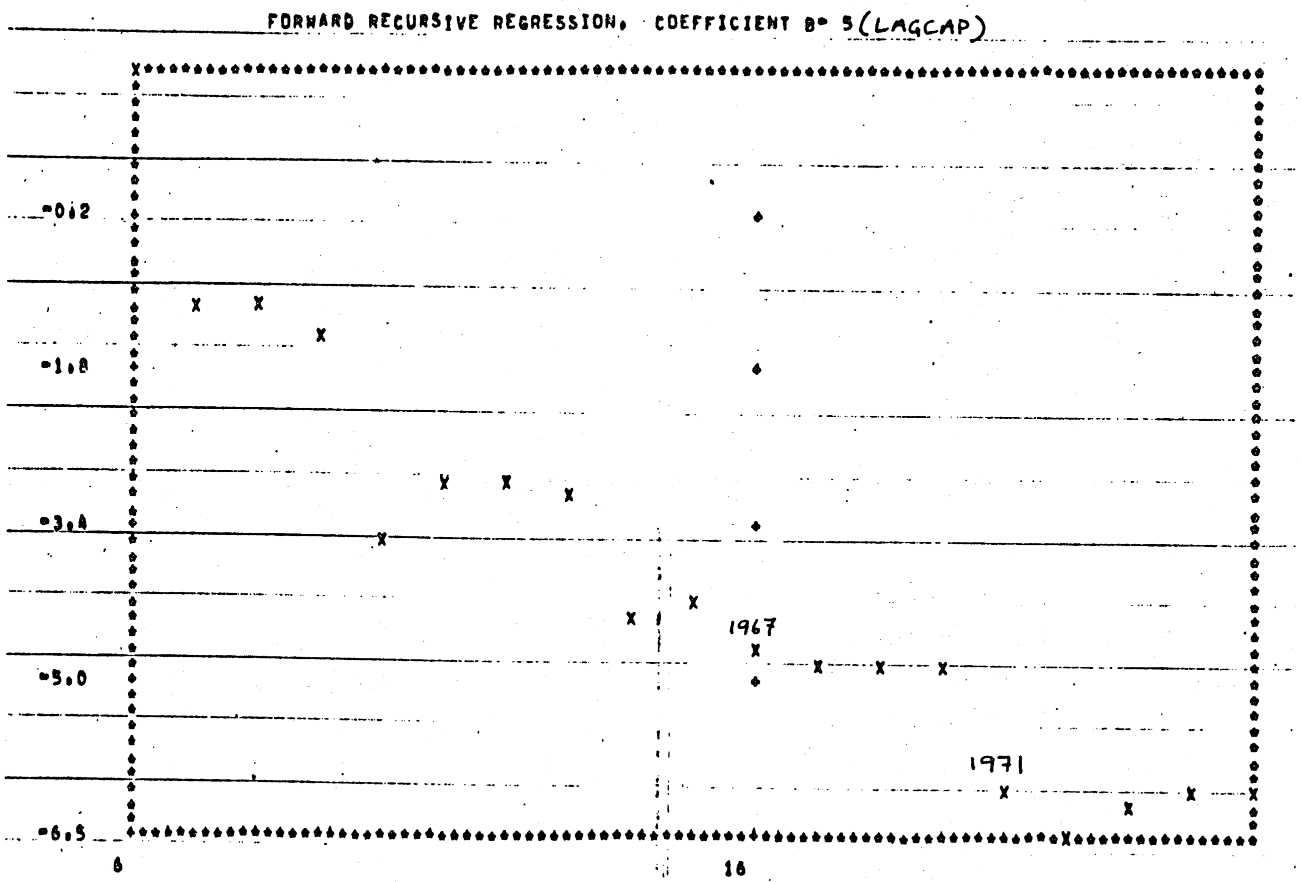

Diagram 7

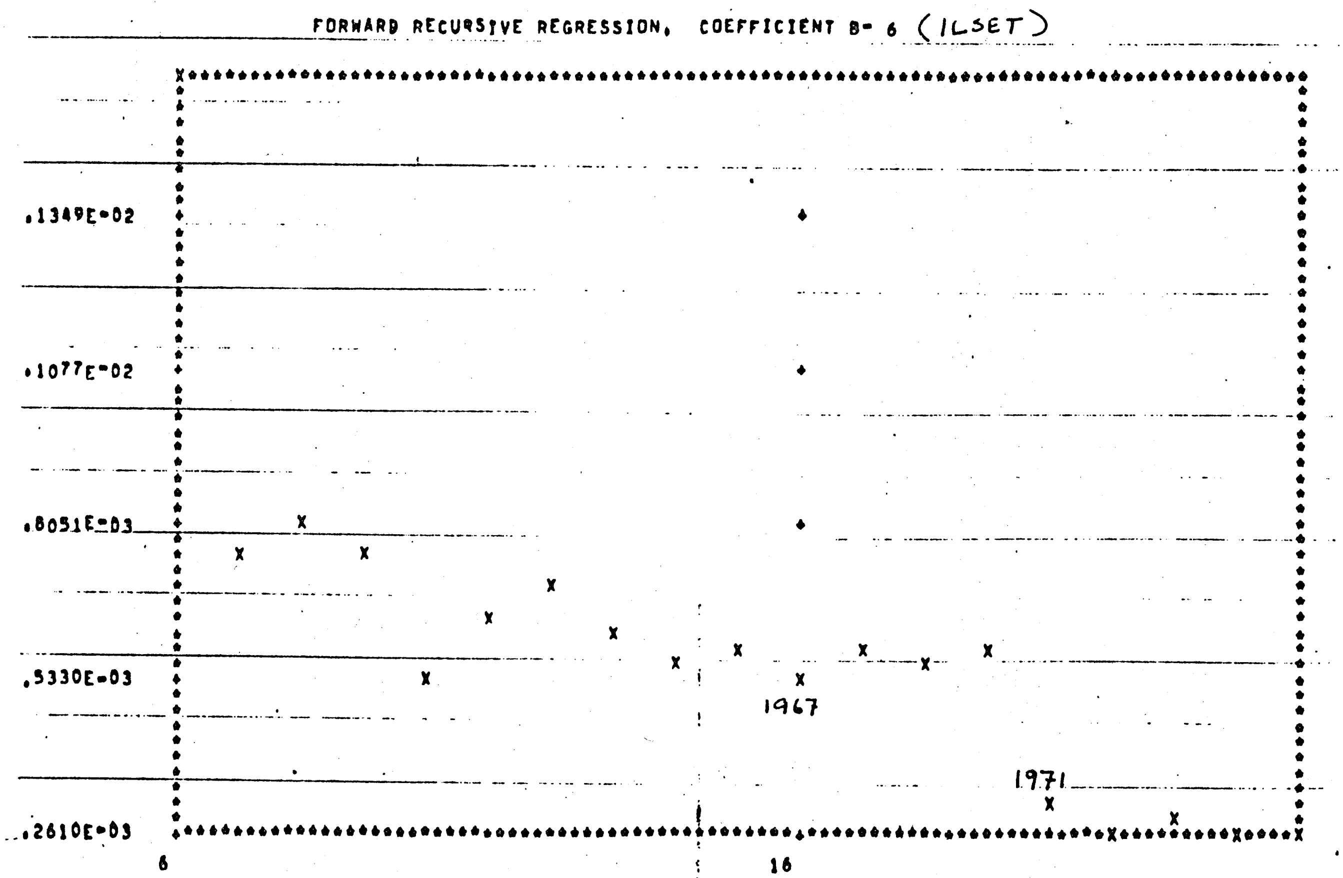

Diagram 8

FORWARD RECURSIVE REGRESSION, CUSUM SQUARED RESIDUALS NORMALISED
LURATE C BENCN LCAPAC LAGCAP ILSET

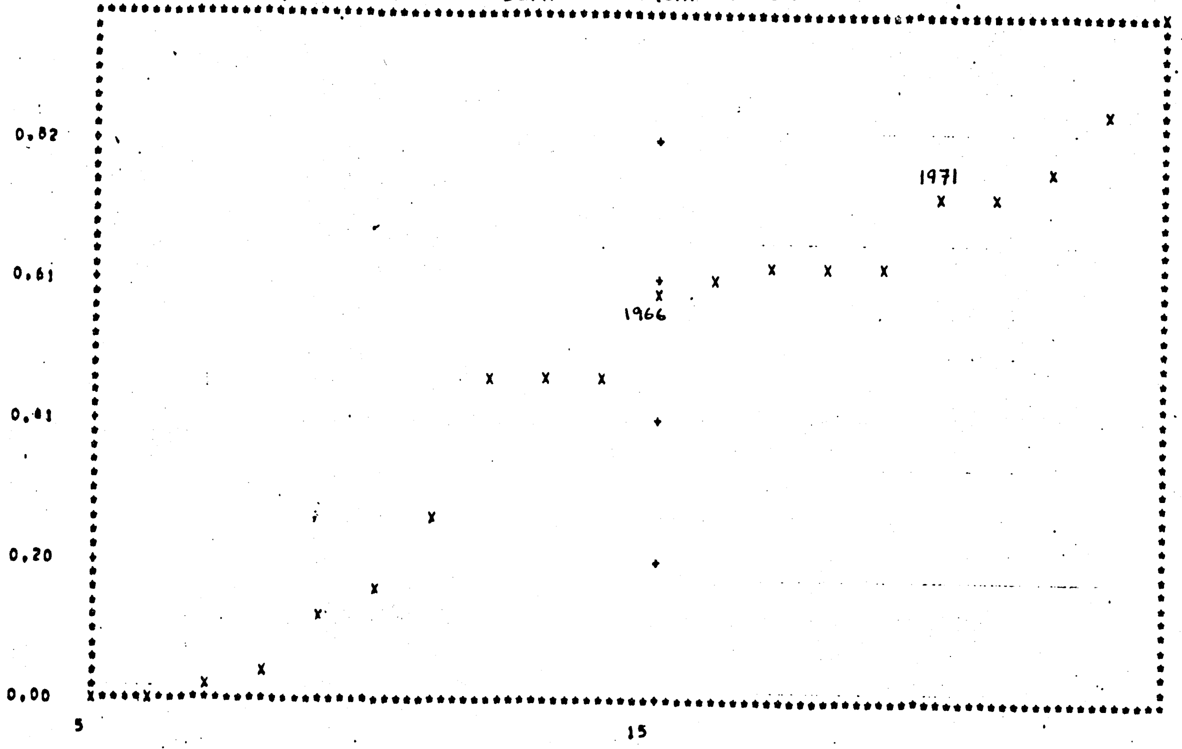

Diagram 9

FORWARD RECURSIVE REGRESSION, COEFFICIENT B= 2 (BENCN)

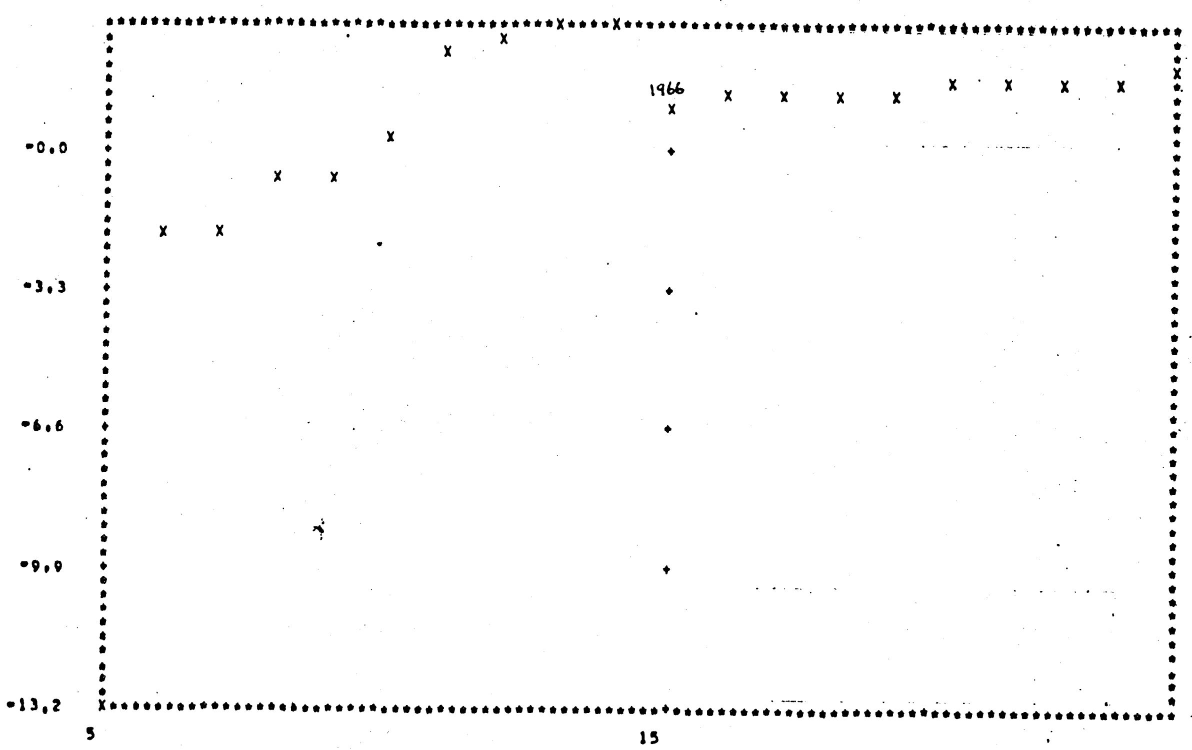

Diagram 10

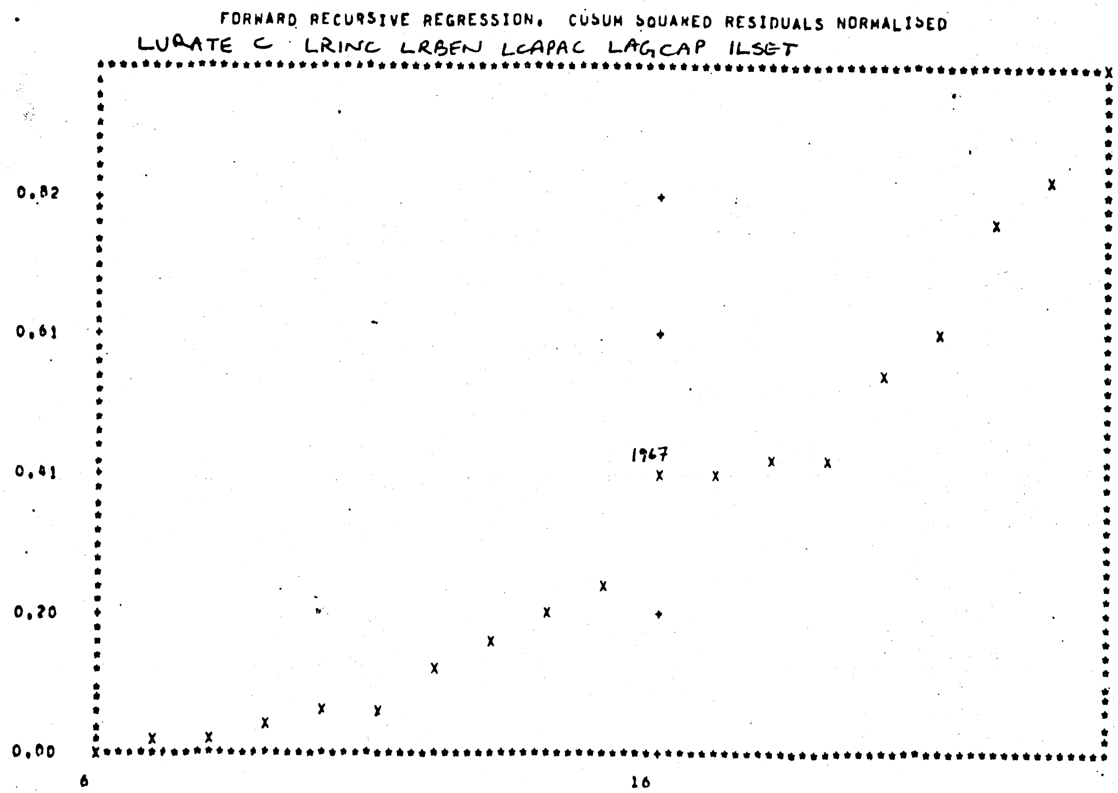

Diagram 11

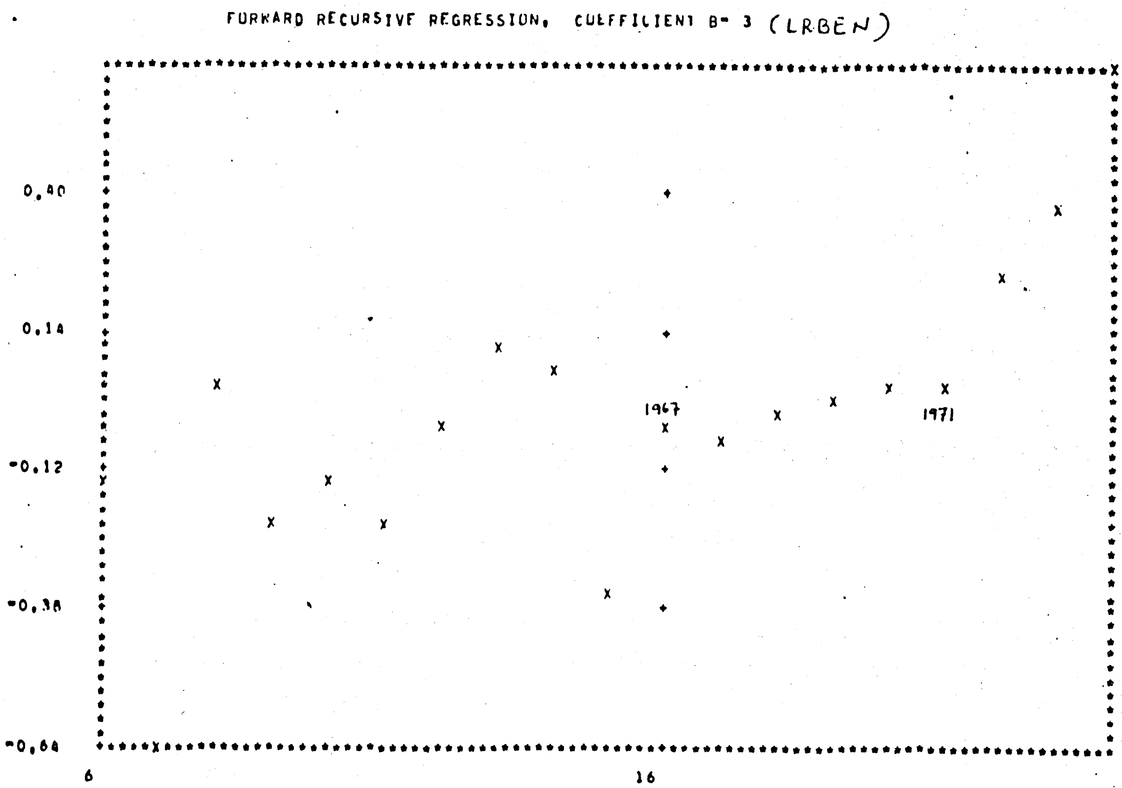

Diagram 12

the exercise using BENCN (i.e. the replacement ratio as defined by Spindler-Maki) we observe similar instability of the regression and of the parameter on BENCN. (Diagrams 11, 12). Again, formal tests do not reject the null hypothesis.

Thus the results of this Section confirm our findings of the instability of the regression equation but especially the instability of the parameter on the benefits variable. Changing the functional form by taking logs of BENCN or ILSET did not help to remove the instability. We therefore conclude this Section by arguing that the relation between unemployment benefits and the unemployment rate is not supported by the data. Any policy prescriptions based on such an unstable relation are purely fallacious. Even Spindler-Maki agree that their parameter estimate on the replacement ratio is unbelievably large given the number of people receiving unemployment benefits (especially the earnings related supplement).[1]

Section 5

Further Complications

In the paper so far we have followed the Spindler-Maki approach fairly closely and even used their data for most of the econometric work. In this Section we turn to look at some problems involved in using some of these variables. First, we turn to the unemployment variable.

The unemployment rate in Britain is a measure of those people who *register* as unemployed. Any changes that take place in the *proportion* of unemployed registering would lead to a changed relationship between unemployment and the explanatory variables. In Britain it is estimated that

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1. "We confess that we do not have any concrete suggestions on how to reliably estimate the size of that [replacement ratio] effect." Spindler and Maki (1979) p. 19. They are convinced, however, that the replacement ratio "does matter."

about 20% of the unemployed do not register: they are the hidden unemployed.[1] Another problem with using the unemployment rate is that it is a *stock* measure (or rather an average of a monthly stock figure): there are large flows in and out of the unemployment register *between* two unemployment counts. Besides this problem, what happens to the unemployment rate depends on what determines the inflows *and* outflows. It is possible for an explanatory variable to affect both the inflows and the outflows such that the net inflows are zero (and hence the unemployment stock may be unchanged). A proper analysis should therefore look at these *flows*. Some preliminary work done by the author supports our earlier findings that the replacement ratio does not affect these flows.

When we look at the replacement ratio more closely we find that the variable used in our econometric work may not be a good measure. The variable we used was the benefits which a married man with two children was *eligible* for. When we look at the data carefully, as Atkinson & Flemming (1978) emphasize, we find that over half of the unemployed did not receive *any* unemployment benefits. Of the men receiving unemployment benefits a large proportion had *no* dependents. The big increase in the replacement ratio in 1966 (which coincided with an increase in unemployment) was due to the introduction of the earnings related supplement. But a very small proportion were receiving this supplement. Thus the idea of using a replacement ratio for a 'typical' unemployed person is a vacuous one. (Atkinson and Flemming comment on the recent *fall* in the replacement ratio being associated with a *rise* in unemployment throwing doubt on a simple relation between

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1. See DE Gazette (Dec. 1976) and Atkinson and Flemming (1978).

benefits and unemployment.) As mentioned earlier, the unemployment benefits may simply *select* who is unemployed, without affecting the total. Cross-section results, for instance Nickell (1979), cannot be generalized to a time series context without some supplementary hypotheses.

We have argued that we need to specify a model of the labour market which looks at the *flows* in and out of unemployment. Unfortunately, some data are available only from 1967 but they do not distinguish whether the inflows are from the labour force or from outside the labour force. Similarly, they do not distinguish the outflows into categories who have joined the employed labour force and those who have left the labour force. An interesting paper for the U.S. by Clark and Summers (1978) discusses the large movements from outside the labour force into employment/unemployment, and from employment to out of the labour force. These movements do not get picked up by simply looking at the unemployed stock. There is a need for a better data base for labour market flows in Britain.

Conclusions

Our econometric work suggests that the increase in unemployment benefits did not cause the increase in unemployment in Britain since the mid-sixties. Specifically, we find the parameter estimates on the replacement ratio, or on benefits is either insignificant or very unstable. Hence we cannot derive any policy conclusions about whether to raise or lower benefits. More importantly, unemployment *is* a problem: the unemployed are not voluntarily searching for a (non-existent!) better job. We should try to reduce the unusually high levels of unemployment by appropriate fiscal and monetary policies. Our results suggest that the level and composition of aggregate demand is an important explanation of increasing unemployment.

Unlike many other areas, we can clearly say more work needs to be done in this area, especially in a modelling and estimating labour market flows.

Appendix

Most of the data used are taken from Spindler-Maki (1979) for purposes of comparability. We reproduce below their description of data sources:

Data Sources:

U Rate: Calculated as *average of quarterly unemployment* counts for calendar year as per cent of civilian labour force similarly averaged. Data for 1952-1968 from Department of Employment and Productivity, *British Labour Statistics, Historical Abstract: 1886-1968*, p. 223; 1969-1972 from *Labour Statistics Yearbook*, 1973, p. 120; 1973-1975 from Department of Employment, *Gazette*, Dec. 1976, p. 1372. All figures refer to Total male and females, Great Britain. Prior to June 1971 figures estimated on national insurance card count basis, subsequently on census of employment basis.

GDP Index: Gross Domestic Product at constant factor cost, from Central Statistical Office, *Annual Abstract of Statistics*, various issues. Part of the original series was reported on a 1948 base, part on a 1958 base, part on a 1963 base, and 1965-1975 on a 1970 base. We converted everything to a 1970 base using the average adjustment factor derived from the 4 or 5 year overlaps available.

Ben/Inc: Standard rate of sickness or unemployment benefit plus ERS divided by net income after deducting tax and NI contributions, for a married couple with two children, from Department of Health and Social Security, *Social Security Statistics*, various issues. *Data refer to Oct. 1 of each year, and were converted to annual basis by making* $(Ben/Inc)_t = .25(Ben/Inc)_{Oct\ 1,t} + .75(Ben/Inc)_{Oct\ 1,t-1}$

O/PE: Index of output per head - all production industries. Data for 1952-1968 from Department of Employment and Productivity, *British Labour Statistics, Historical Abstract, 1886-1968*; for 1962-1970 from Central Statistical Office, *Monthly Digest of Statistics*, June 1971, p. 46; and for 1969-1976 from *Monthly Digest of Statistics*, June 1977, p. 55. Data for 1969-1975 available to 1970 base, for 1952-1970 to 1963 base. We converted 1971-1975 to a 1963 base using the average adjustment factor derived from the 1969-70 overlap.

LFI: Constructed by converting civilian labour force as discussed above under *U Rate* to an index number, 1963 = 100.

In addition to the above data we used

Price: An index of the General Index of Retail Prices (All Items), 1970 = 100. Source *Economic Trends: Annual Supplement*, 1977. (C.S.O.) (page 96)

Industrial Production: Index of Industrial Production, 1970 = 100. Source: as above. (page 70).

Trades: Index of Distributive Trades, 1970 = 100. Source: as above. (page 70).

Services: Index of Other Services, 1970 = 100. Source: as above. (page 70).

LIST OF VARIABLES USED

1. LURATE = Log (U Rate)
2. BENCN = Ben/Inc (see above)
3. LBENCN = Log (BENCN)
4. BRSY = $(\text{Benefits})_t/(\text{Net Income})_t$
5. LBRSY = Log (BRSY)
6. LBENERS = Log $(\text{Benefits})_t$
7. LINC = Log (Net Income)
8. LRBEN = Log $(\text{Benefits/Price})_t$
9. LRINC = Log (Net Income/Price)
10. LCAPAC = Log (GDP/Trend GDP)

    (The Trend GDP was estimated by fitting Log GDP = $\alpha + \beta$ TIME.)
11. LAGCAP = $(\text{LCAPAC})_{t-1}$
12. ILSET = (O/PE)(LFI)
13. LOPE = Log (O/PE)
14. LMIX = Log {(Industrial Production)/(104 · TRADES + 343 · SERVICES)}

    where 104 and 343 are the weights in the GDP.
15. LPRICE = Log (PRICE)

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