The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862—1957: A Further Analysis[1]

By RICHARD G. LIPSEY

In an earlier paper in this journal, Professor Phillips[2] has advanced the hypothesis that the percentage rate of change of money wage rates in the United Kingdom ($\dot{W}$) can be explained to a very large extent by: (i) the percentage of the labour force unemployed (U), and (ii) the *rate of change* of unemployment ($\dot{U}$). After an inspection of the data, Phillips concluded not only that there is a clearly observable relationship between these variables, but that the form of the relationship has been remarkably stable over a period of almost one hundred years. The purpose of the present paper is to reconsider Phillips' work in some detail. In particular it seemed necessary: (i) to consider the general theoretical model that is being tested; (ii) to quantify Phillips' results, determining, if possible, the proportion of the variance in money wage rates that is associated with the two variables, level of unemployment (U) and rate of change of unemployment ($\dot{U}$); (iii) to provide systematic tests of the various subsidiary hypotheses framed by Phillips during the course of his analysis; and (iv) to test hypotheses that follow from possible alternative models. The logical order in which to deal with these topics, in the absence of Phillips' paper, would be, first, to outline the phenomena which require explanation, then to develop a model which will explain the phenomena, and, finally, to test further implications of the model. Given Phillips' paper, however, a slight change of approach seems to be desirable. In the first section of this paper a report is given of the statistical analysis carried out on data for the period 1862–1913. Although the main purpose is to discover what phenomena require explanation, a rather elaborate treatment is required in order to test the hypotheses about these phenomena framed by Phillips. This is

[1] The present paper, like Professor Phillips', is a part of a wider research project financed by the Ford Foundation. The writer was assisted by Mr. Peter Lantos and Mrs. June Wickins. This paper was the subject of extended discussion at the LSE Staff Seminar on Methodology and Testing in Economics and I am indebted to all the members for many comments and suggestions; I also benefited from the discussion at the University of Manchester Advanced Economics Seminar where some of the material embodied in this paper was first presented. Mr. F. Brechling and Dr. S. F. Kaliski have given valuable criticisms and I am particularly indebted to Professor Phillips for his constant aid and encouragement.

[2] A. W. Phillips, " The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861–1957 ", *Economica*, Nov. 1958.

necessary in order to build up a clear picture of our explicanda. Although many of Phillips' subsidiary hypotheses are rejected, the data are shown to support Phillips' main contention that there is a significant relation between the rate of change of money wage rates and the level and the rate of change of unemployment. Having established the evidence for these relations, the second section is devoted to the construction of a theoretical model which adequately accounts for them. Phillips had given very little indication of the sort of model of market behaviour which would produce his postulated relations. The third section is devoted to an analysis of the data for the post–1918 period. The theory developed in Section II is particularly useful in interpreting the differences which occur between the relations existing in the nineteenth century and in the twentieth century.

I

The Period 1862–1913

1. *The relation between the rate of change of money wage rates* ($\dot{W}$) *and the level of unemployment* (U)[1]

The unemployment figures used by Phillips showed the percentage of the unionized labour force unemployed, while the figures for the rate of change of wage rates were calculated[2] from the Phelps Brown-Hopkins index.[3]

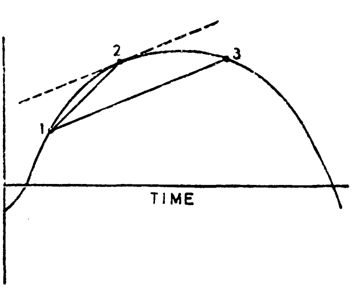

Fig. 1.

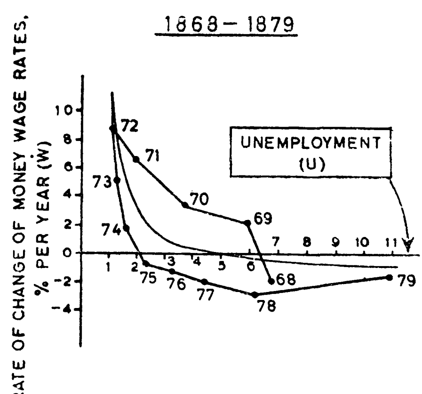

Fig. 2.

[1] Since the *level* of unemployment is uncorrelated with the *rate of change* of unemployment, as is any trend-free variable with its own rate of change, the relation between the rate of change of money wages and each of the independent variables, U and $\dot{U}$, can be considered separately. The actual r^2 for U and $\dot{U}$ is ·0002.

[2] Phillips, *ibid.*, p. 290, n. 1, took half the first central differences ($W_{t+1} - W_{t-1} \div 2$) as the best approximation to the absolute rate of change of wages. The argument for approximating a continuous derivative by this method rather than by the more intuitively plausible method of taking the difference between this year's wage index and last year's ($W_t - W_{t-1}$) can best be explained by reference to the diagram. Fig. 1 shows a continuous time series (say one for the rate of change of wages). Only a discrete number of regularly-spaced observations are available, say those at 1, 2, and 3, and it is desired to approximate the derivative at 2 (the true value being given

Fig. 3 shows the data for $\dot{W}$ and U for the period under consideration.

Phillips elected to describe the data by a curve of the type

$$\dot{W} = \alpha + \beta U^{\gamma} \qquad \text{(1a)}$$

$$\text{or} \quad \log(\dot{W} - \alpha) = \log \beta + \gamma \log U \qquad \text{(1b)}$$

where $\dot{W}$ is the rate of change of money wage rates $\left(\dot{W}_t \equiv \frac{W_{t+1} - W_{t-1}}{2W_t} \right)$, and U is the percentage of the labour force unemployed. This curve could not be fitted to all 52 observations because points below the asymptote ($\dot{W} < \alpha$) would require negative logarithms. Hence Phillips grouped his observations into six class intervals based on the level of unemployment[1] and found the mean values of $\dot{W}$ and U for each of the six groups. Having thus compressed his data into six points, he fitted his curve to these points, using a trial-and-error procedure, and obtained the following equation:

$$\dot{W} = -0.9 + 9.638\, U^{-1.394}, \qquad (2)$$

which is plotted as curve (2) in Fig. 3.

Since, for purposes of the present study, it seemed desirable to treat the data by standard statistical methods if at all possible, a new

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by the slope of the broken line tangent to the curve at 2). Taking the rate of change to be equal to the difference between the values of the function at 2 and at 1 is equivalent to estimating the derivative at 2 to be equal to the slope of the line joining 1 and 2. But the slope of this line is typical of the value of the derivative somewhere *between* 1 and 2, so that this method gives the derivative somewhere *between* the two points of time and is thus equivalent to introducing a time lag of approximately six months into the rate-of-change series. On the other hand, taking half the first central difference is equivalent to estimating the derivative to be equal to the slope of the line joining 1 and 3. In a regular curve this latter value is likely to be closer to the true value of the derivative at 2 than is the former value. In a recent article criticising Phillips' work, Mr. Routh has argued that the actual wage rate series is too crude to make the difference between the two methods of calculating $\dot{W}$ significant. (Guy Routh, " The Relation Between Unemployment and the Rate of Change of Money Wage Rates : A Comment ", *Economica*, November, 1959.)

[3] E. H. Phelps Brown and Sheila Hopkins, " The Course of Wage Rates in Five Countries, 1860–1939 ", *Oxford Economic Papers*, June 1950. Mr. Routh (*loc. cit.*, pp. 299–305) gives a detailed study of the coverage of the wage rate and the unemployment series and argues that " . . . in the two series used by Professor Phillips, neither the weights, occupations nor the industries are a good match (p. 303) ". Routh argues, for example, that any fixed weighted index of rates will not allow for movements between areas and occupations. This is undoubtedly correct. It is, however, always possible to show that any set of statistics are not perfect or even, by some absolute standard, that they are downright bad. The relevant question is not whether the figures are perfect, but whether they are good enough for the purposes at hand. The question of whether or not the postulated relation is strong enough to show up in spite of imperfections in the data, can only be answered by the empirical results: in this case the postulated relation is strong enough. Another criticism of Phillips' article is to be found in K. G. J. C. Knowles and C. B. Winsten, " Can the Level of Unemployment Explain Changes in Wages ? ", *Bulletin of the Oxford Institute of Statistics*, May 1959.

[1] The class intervals (percentage unemployment) with the number of items contained in each class given in parentheses are: 0—2 (6), 2—3 (10), 3—4 (12), 4—5 (5), 5—7 (11), 7—11 (9) (the upper limit is included in each class).

equation was adopted which could be fitted to all the 52 original observations:[1]

$$\dot{W}=a+bU^{-1}+cU^{-2}. \qquad (3)$$

It was found that, by suitable choice of the constants b and c, this curve could be made to take up a position virtually indistinguishable

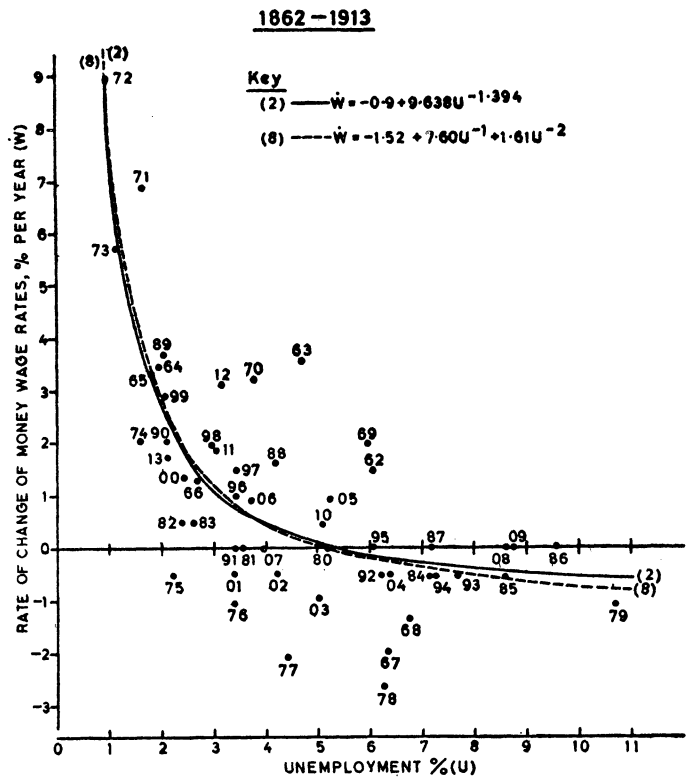

Fig. 3.

from that taken up by curve (1) for any value of γ between -1 and -2. Thus choosing between the two curves does not necessitate choosing between different hypotheses about the nature of the relation between $\dot{W}$ and U.[2]

The curve was first fitted to Phillips' six points of averages and gave the equation

$$\dot{W}=-0.44+0.023U^{-1}+12.52U^{-2}. \qquad (4)$$

[1] For purposes of the present section the shape of the relation assumed by Phillips is accepted so that the problem is merely to find an equation which takes the same shape as equation (1) but which can be fitted by least squares. In Section II the general form of the relationship between $\dot{W}$ and U is considered in some detail.

[2] When (1) and (3) are fitted to the same data, normal least squares fitting does, however, result in slightly different shapes to the two curves because in one case the sum of the squares of the residuals expressed in logarithms is minimised while, in the second case, it is the sum of the squared residuals expressed in natural numbers that is minimised.

The difference[1] between equations (2) and (4) results from the procedure of minimising the squares of the differences between the actual and the estimated values expressed in logarithms for (2) and in natural numbers for (4).[2] Next the curve was fitted to Phillips' original 52 observations for the years 1862–1913 which resulted in the following equation:

$$\dot{W} = -1.14 + 5.53U^{-1} + 3.68U^{-2}. \qquad (5)$$

The difference between (4) and (5) indicates the distorting effect caused by fitting to points of averages rather than to the original observations.[3]

Next the Phelps Brown-Hopkins series for wage rate changes in 1881 to 1885 was replaced by the Bowley series for the same years.[4] The fitted equation then became

$$\dot{W} = -1.42 + 7.06U^{-1} + 2.31U^{-2}. \qquad (6)$$

There is a noticeable shift in the relationship when equation (5) is replaced by equation (6) and there is room for debate as to which series for the disputed years, and thus which equation, should be used. The Bowley series conforms with the pattern seen in the other eight cycles which cover the period under consideration and thus seems to be the more plausible of the two. In the absence of any evidence favouring one series rather than the other, we cannot eliminate one merely because it does not conform with our hypothesis. Therefore, although the Bowley substitution for the years 1881–85 is used on the subjective grounds that it seems more plausible, all relations have been recalculated using the Phelps Brown-Hopkins series for the disputed years, the values for the latter being given in footnotes.

The relation specified in equation (6) gives an r^2 of 0.64, indicating that, over the period 1862–1913, 64 per cent. of the variance in money wage rates is associated with variations in the level of unemployment.[5]

2. *The relation between the rate of change of wages* ($\dot{W}$) *and the rate of change of unemployment* ($\dot{U}$)

After an inspection of his graphs Phillips noted that the relationship between $\dot{W}$ and $\dot{U}$ appeared to be important; he observed that,

[1] The different fitted relationships may be at least roughly compared by comparing the values of the asymptotes.

[2] Some of the difference is accounted for by the fact that Phillips did not fit to all six points by least squares but rather made his curve go as closely as possible to the two points representing the highest levels of unemployment and then minimised squares on the other four points.

[3] When fitting to points of averages each of the six points is given equal weight although there are considerable differences between the number of items within each class interval.

[4] The Phelps Brown-Hopkins series shows a suspicious stability in wage rates over the period 1881–85 in spite of wide variations in employment, while the Bowley series shows the usual relation with wage rates rising when unemployment falls and then falling as unemployment rises. See Phillips, *loc cit.*, pp. 287 and 291. Routh (*loc. cit.*, p. 313) has given reasons for the stability in the Phelps Brown-Hopkins index and has argued that this index should *not* be replaced by the Bowley series for these years.

[5] Equation (5) which shows the comparable relation determined without the substitution of Bowley's index for 1881–85 gives an $r^2 = 0{\cdot}64$.

compared to the value predicted by the relation between $\dot{W}$ and U, $\dot{W}$ tended to be high when unemployment was falling ($\dot{U}<O$) and low when unemployment was rising ($\dot{U}>O$). In other words, the change in money wage rates is greater than would otherwise be expected when unemployment is *falling* and less than would otherwise be expected when unemployment is *rising*. He did not, however, attempt to determine either the precise form of the relationship between $\dot{W}$ and $\dot{U}$ or its quantitative significance. Fig. 2 shows the relation between $\dot{W}$ and U for the years 1868–79 together with the curve described by equation (2). This general picture is typical of the nineteenth century cycles. The " loop " is clearly observable with the actual $\dot{W}$ being above the fitted curve when unemployment is falling and below the curve when it is rising.

It was now desired to measure this relationship which was very strongly suggested by inspection. Half the first central difference was taken as the best approximation to the rate of change of unemployment in any year.[1] Thus, a new variable was defined, $\dot{U}_t \equiv \frac{U_{t+1} - U_{t-1}}{2U_t} . 100$, and the new regression equation became

$$\dot{W} = a + bU^{-1} + cU^{-2} + d\dot{U} \quad \ldots\ldots\ldots\ldots \quad (7)$$

which, when fitted to the original observations, gave

$$\dot{W} = -1.52 + 7.60U^{-1} + 1.61U^{-2} - .023\dot{U} \quad \ldots\ldots \quad (8)$$

Curve (8) in Fig. 3 shows this relation when $\dot{U}=O$. R^2 for this relationship is 0.82 while the squared partial correlation coefficients are 0.78 for U and 0.50 for $\dot{U}$. This indicates that 82 per cent. of the variance in $\dot{W}$ can be associated with variations in U and $\dot{U}$, and that $\dot{U}$ can remove 50 per cent. of the variance not already associated with U while, if $\dot{U}$ is considered first, U is associated with 78 per cent. of the residual variation in $\dot{W}$.[2]

Now that the influence of $\dot{U}$ has been measured it is possible to check quantitatively on Phillips' observation that " . . . it appears that the width of the loops obtained in each trade cycle has tended to narrow, suggesting *a reduction in the dependence of the rate of change of wage rates on the rate of change of unemployment* ".[3] This statement is taken to mean that, throughout the period, any given rate of change of unemployment was associated with a progressively diminishing rate of change of money wages (i.e., that, if it were fitted separately for

[1] See p. 2, n. 2.

[2] The relations without the Bowley substitutions 1881–85 are as follows: $\dot{W} = -1{\cdot}23 + 6{\cdot}00U^{-1} + 3{\cdot}05U^{-2} - {\cdot}021\dot{U}$, $r^2 = 0{\cdot}79$. The squared partial correlation coefficient for $\dot{U}$ of 0·41 is smaller than the one quoted in the text. As would be expected the substitution of a series without a loop for a series with a loop results in a reduction of the explanatory power of $\dot{U}$.

[3] Phillips, *loc. cit.*, p. 292, italics added. After making this observation, Phillips offers two possible explanations to account for the supposed change.

each cycle, the parameter d in equation (7) would diminish from cycle to cycle). In order to check this statement equation (6) was used to predict values for $\dot{W}$ and the differences between these predicted values and the observed values were plotted on a scatter diagram against $\dot{U}$.[1] A separate diagram was drawn and a straight line (i.e. $R_{(6)}=a+b\dot{U}$) was fitted for each cycle. The slope of the line is an index of the width of Phillips' loops. The values in Table 1 show that, in the cycle of 1893–1904, for example, a 100 per cent. increase in the percentage of the working force unemployed (e.g. from 3 per cent. unemployment to 6 per cent.) was associated with an observed figure for the rate of change of wage rates 2.2 per cent. below the value predicted by equation (6). The value of the r^2 indicates the importance of $\dot{U}$ as an additional explanatory variable in each cycle. An inspection of Table 1 reveals that there is considerable variation in the value of the coefficient " b " from cycle to cycle but that there is no clear

TABLE 1

STRAIGHT LINES RELATING RESIDUALS FROM EQUATION (6) TO THE RATE OF CHANGE OF UNEMPLOYMENT

$R_6=a+b\dot{U}$

Period([2])	b	r^2
1862–68	·017	·25
1868–79	·046	·91
1879–86	·015	·56
1886–93	·016	·91
1893–1904	·022	·59
1904–09	·011	·49

[1] Since the units in which all the variables are expressed are percentage points there is the possibility of confusion when residuals are calculated. To avoid such confusion it may be worthwhile defining all the variables and the residuals at this point:

(i) the rate of change of money wage rates at time $t\equiv$

$$\dot{W}_t\equiv\frac{W_{t+1}-W_{t-1}}{2W_t}\,.\,100;$$

(ii) the percentage of the labour force unemployed at time $t\equiv U_t$;

(iii) the rate of change of unemployment at time $t\equiv$

$$\dot{U}_t\equiv\frac{U_{t+1}-U_{t-1}}{2U_t}\,.\,100;$$

where W_t is the index of money wage rates. Since lagged variables are not used in this section, the time subscript t is dropped from all the variables in the equations.

(iv) the deviation of the observed value of $\dot{W}$ from the value predicted from equation $n\equiv R_n\equiv\dot{W}_o-\dot{W}_{en}$ where o stands for observed, and en for estimated, from equation n. R_n is always expressed in original units which, in the case of $\dot{W}$, are percentage points. Thus a residual of $+1$ per cent. might mean that the actual $\dot{W}$ was 3 per cent. while the estimated value was 2 per cent. R_n is always used as defined above and *never* as a proportional residual (i.e. R_n per cent. $\equiv\frac{\dot{W}_o-\dot{W}_{en}}{\dot{W}_{en}}$ is never used).

[2] To make the figures comparable with those of Phillips, the last year of each cycle has also been included as the first year of the subsequent cycle. The years 1910–13 are excluded because they do not constitute a complete cycle.

evidence that it becomes progressively smaller cycle by cycle. The cycle 1868–79 is unusual in that the deviations of the observed from the predicted values of $\dot{W}$ associated with any given level of $\dot{U}$ are three times as large as those associated with most other cycles. At the 5 per cent. probability level there is a significant difference between the coefficient *b* for the cycle 1868–79 and those for all other cycles, while the coefficients for the other cycles do not differ significantly from one another. Thus there is some evidence that the loop for 1868–79 is significantly wider than all the other loops, while there is no evidence of significant variations in widths of loop between the other cycles. A hasty comparison of the loop for the period 1868–79 with those that came afterwards may have led Phillips to the erroneous conclusion that the loops were getting progressively narrower.[1]

We must conclude therefore that there is no clear evidence in favour of the hypothesis that $\dot{U}$ is a variable whose importance was diminishing over the period. There is thus no need to attempt the sort of explanation given by Phillips.

3. *Consideration of effects of changes in the cost of living as an additional explanatory variable*

Phillips advanced the hypothesis that cost of living adjustments affect money wage rates with a threshold effect. If wage rates would have risen by X per cent. in the absence of any changes in the cost of living, then an increase of up to X per cent. in the cost of living will have no effect on wages " . . . for employers will merely be giving under the name of cost of living adjustments part of the wage increases which *they would in any case have given as a result of their competitive bidding for labour* ".[2] If, however, the cost of living rises by *more than X per cent.*, then this will also cause wages to rise by more than X per cent., i.e., by more than they otherwise would have done. This implies that the outcome of the wage bargain is unaffected by any change in the cost of living unless it actually threatens to reduce real wages, so that active and at least partially successful attempts must be made to push up money wage rates in response to price level changes that actually threaten to lower real wages. It also implies, however, either that unions passively accept any change in the price level which threatens to take away anything less than 100 per cent. of the increase in real wages that could have resulted from a rise in money wages, or that any attempts to resist such losses are totally frustrated by employers. This behaviour may seem intuitively implausible but it is necessary to see if the data provide any evidence for it.

[1] The same experiment was made relating $\dot{U}$ to the residuals from Phillips' own equation ($R_{(2)}$) with similar results to those given in the text. Thus the rejection of Phillips' hypothesis is not the result of the adoption of a new equation.

[2] Phillips, *loc. cit.*, p. 284, italics added. Phillips gives no reason for believing that cost-of-living adjustments operate in this manner.

In order to test Phillips' hypothesis two series were computed. First, the residuals $R_{(8)}$ were calculated. This series showed whether actual money wage rates had risen by more or by less than the amount associated with the existing levels of U and $\dot{U}$. The second series was the change in the real wage rate which was computed by adjusting the change in the money wage rate for the change in the retail price index.[1] A scatter diagram was then drawn relating the residuals, $R_{(8)}$, to the change in the real wage rate. The Phillips hypothesis predicts that when the real wage actually fell, the observed rise in money wage rates would be greater than the predicted rise, but it says nothing about what happens when the real wage rate rises.

In the period under consideration there were fifteen years in which the real wage fell (i.e. when the cost of living increase from the previous year to the present one was more than the increase in money wage rates). In only five of these years was the increase in money wage rates more than that predicted from the equation relating $\dot{W}$ to U and $\dot{U}$, and in none of these years was the deviation more than one half of 1 per cent.[2] In other words, of those years in which the real wage fell there was not one in which the money wage rate rose by more than one half of 1 per cent. more than was predicted by equation (8). In ten of the years in which the real wage fell the rise in money wage rates was *less* than that predicted by equation (8). Thus we must conclude that the evidence does not support Phillips' hypothesis that the cost of living affects wage rates only with a threshold effect.[3]

The rejection of Phillips' hypothesis suggests that it may be desirable to consider a simpler cost of living hypothesis. This hypothesis is that the outcome of the wage bargain is affected simply by the *change* in the cost of living, that an increase in the cost of living makes trade unions more aggressive in demanding increases and employers and arbitrators more willing to grant them, while a decrease in the cost of living acts in the reverse direction. This hypothesis predicts simply that deviations of actual wage increases from those predicted by equation (8) would be associated with the change in the cost of living index, increases in the cost of living being associated with positive deviations and decreases with negative deviations.

As a first check on this hypothesis the residuals from equation (8) were plotted against the percentage change in the cost of living index. In 37 of the 52 years under consideration the residual, R_8, was not more than 1 per cent ($-1 < R_8 < +1$). Of the eight years in which

[1] The index used was the retail price index taken from Phelps Brown-Hopkins, *loc. cit.*

[2] The same experiment was made, using Phillips' equation (2), to estimate the values of $\dot{W}$, and the results were substantially the same as those reported in the text.

[3] One other possibility is that there might be a time lag in this process so that decreases in the real wage rate at year t would be followed by abnormally high increases in money wage rates in year $t+1$. The one year lag, however, produces results comparable to those quoted in the text.

there was a positive residual of more than 1 per cent ($R_8 > +1$), six were years in which the cost of living rose. Of the eight years in which there was a negative residual greater than 1 per cent ($R_{(8)} < -1$), seven were years in which the cost of living fell while only one was a year in which the cost of living rose. This suggested that, if there was any relation between cost of living changes and wage rate changes, it was a simple one, $\dot{W}$ being related in a straightforward manner to changes in the cost of living. The degree of scatter was, however, very large; there were, for example, eight years in which the cost of living changed by more than 2 per cent. while the actual wage rate change was within half of 1 per cent. of the value predicted by equation (8).

In order to check further on the quantitative significance of cost of living changes as an additional explanatory variable, equation (8) was amended by adding a term for the percentage change in the cost of living index. The equation then became

$$\dot{W}=a+bU^{-1}+cU^{-2}+d\dot{U}+e\dot{P} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (9)$$

where $\dot{P}$ is the percentage change in the cost of living index,[1] $\dot{P}_t \equiv \frac{P_{t+1}-P_{t-1}}{2P_t} \cdot 100$. When fitted to the data for the years 1862 to 1913 this becomes:

$$\dot{W}=-1.21+6.45U^{-1}+2.26U^{-2}-.019\ \dot{U}+.21\dot{P} \quad \ldots\ldots \quad (10)$$

A comparison of equations (8) and (10) shows that the addition of a cost of living variable causes the curve relating $\dot{W}$ to U (when $\dot{U}=\dot{P}=O$) to shift upwards for levels of U greater than 3 per cent. and less than 1 per cent., while, between 1 and 3 per cent., the curve shifts slightly downwards. The (small) coefficient of $\dot{P}$ indicates that an increase of almost 5 per cent. in the cost of living is associated with an increase in money wage rates of only 1 per cent. Finally, the R^2 for this relation is 0.85 while the squared partial correlation coefficient for $\dot{P}$ is 0.17, indicating that 17 per cent. of the variance in $\dot{W}$ which remains after allowing for U and $\dot{U}$ can be removed by associating $\dot{W}$ with $\dot{P}$.[2]

[1] $\dot{P}_t \equiv \frac{P_t - P_{t-1}}{\frac{1}{2}(P_t+P_{t-1})}$ was tried as an alternative cost of living variable thus introducing a six-months' time lag on cost of living adjustments. The results were broadly similar, but the correlations slightly lower.

[2] The standard error of estimate of $\dot{W}=\cdot 86$, while standard errors for the regression coefficients are $b=2\cdot 12$, $c=2\cdot 13$, $d=\cdot 004$, $e=\cdot 07$. All of the partial correlation coefficients are significant at the 5 per cent. level and there is no evidence of significant auto-correlation in the $\dot{W}$ residuals for time lags of one to four periods at the 5 per cent. probability level. The size of the standard errors for b and c may be misleading because quite large changes can be made in these coefficients without causing large shifts in the curve relating $\dot{W}$ to U.

The comparable relations without the Bowley substitution for 1881–85 are as follows:

$$\dot{W}=-0\cdot 94+4\cdot 92U^{-1}+3\cdot 66U^{-2}-\cdot 016\dot{U}+0\cdot 20\dot{P},$$

$r^2=0\cdot 82$.

Finally, it was desired to see if $\dot{P}$ could be an alternative explanatory variable to either U or $\dot{U}$. The most plausible hypothesis here seemed to be that $\dot{U}$ and $\dot{P}$ might be very highly correlated since retail prices would tend to rise on the upswing of a trade cycle and fall on the downswing. Thus the loops relating $\dot{W}$ to U might be merely a reflection of cost of living changes over the cycle. There is in fact very little relation between $\dot{U}$ and $\dot{P}$; the squared coefficient of correlation between $\dot{U}$ and $\dot{P}$ is only 0.19. In order to see which is the better explanatory variable, $\dot{U}$ or $\dot{P}$, equation (9) was amended by dropping the term for $\dot{U}$, thus producing:

$$\dot{W} = -.90 + 5.23U^{-1} + 3.20U^{-2} + .37\dot{P} \quad \ldots\ldots\ldots\ldots \quad (11)$$

R^2 for this relation is 0.76. The squared partial correlation coefficient for $\dot{P}$ is .33, which compares with .50 for $\dot{U}$ when the effect of U is already allowed for. This indicates that $\dot{P}$ has only about two-thirds the explanatory value of U when they are considered as alternative variables to be added to the effect of U. The other possible situation would be to use $\dot{P}$ as the sole explanatory variable so that $\dot{P}$ would be an alternative for U. A linear relation between $\dot{W}$ and $\dot{P}$ produced the equation $\dot{W} = 1.14 + .55\dot{P}$ and $r^2 = 0.27$.

4. *The special explanation of 1893–96*

Phillips singled these years out for a special *ad hoc* explanation, apparently believing that the residuals were especially large or particularly significant in these years. He suggested that this could be accounted for by the growth of employers' federations in the 1890's and resistance to trade union demands from 1895 to 1897. Whatever may have been the industrial history of the period, there is no empirical evidence of *exceptional* downward pressure on wages. Estimated values for the change in money wage rates were calculated from equation (10) for the period 1894–96. The wage rate change in 1894 was actually one-third of 1 per cent. higher than the change predicted from equation (10); in 1895 it was only one-third of 1 per cent. less than that predicted by the equation, while in 1896 the actual rise (1 per cent.) was only eight-tenths of 1 per cent. less than the predicted rise (1.87 per cent.). Such very small deviations of the actual from the predicted values can hardly be regarded as significant; larger deviations than that occurring in 1896 were observed in no less than 21 of the 52 years under consideration. We must conclude, therefore, that there is no need for a special explanation of the observed events of 1893–96 which in fact conformed quite closely to the general pattern of the whole period.

5. *Conclusions*

(i) There is a significant relation between the rate of change of money wage rates on the one hand and the level of unemployment and its rate of change on the other. Over 80 per cent. of the variance in money wage rates over the period 1862–1913 can be associated with these two variables, U and $\dot{U}$. (ii) The Phillips hypothesis that the influence of the rate of change of unemployment has diminished over the period is rejected. (iii) The Phillips hypothesis that the cost of living enters with a threshold effect is rejected. There seems to be some evidence in favour of a simple (but rather weak) relation between changes in the cost of living and changes in money wage rates. (iv) There is no evidence of a *need* for any special explanation of the years 1893–96.

II

THE MODEL[1]

The analysis reported in Section I shows that there is a significant relation between $\dot{W}$, U, and $\dot{U}$, and it is now necessary to construct a theoretical model that will satisfactorily account for the relationship. It is necessary to take this step for at least three reasons. First, the relation between $\dot{W}$, U, and $\dot{U}$ is open to serious misinterpretation, and such misinterpretations can be prevented only when the model which underlies the relation is fully specified. Second, if the relation ceases to hold, or changes, and we have no model to explain it, we can only say " the relation has ceased to hold " or " the relation has changed " and we will have learned nothing more than this. If we have a model explaining the relationship, we will know the conditions under which the relation is expected to remain unchanged. Then, if a change occurs, the model will predict *why* this has happened and this prediction will give rise to further tests from which we can learn. Third, unless it is a very *ad hoc* one, the model will give rise to further testable predictions in addition to the relation between the three variables $\dot{W}$, U, and $\dot{U}$, and from the testing of these we will gain further relevant information.[2]

1. *The relation between $\dot{W}$ and U*

We shall consider this relationship, first, for a single market, and then for the whole economy, using lower-case letters to refer to the single market variables and capitals to refer to the corresponding macro-variables.

We might analyse the market for any commodity since the argument at this stage is quite general. Since, however, the subject of the

[1] I am particularly indebted to Mr. G. C. Archibald whose persistent criticisms of measurement without adequate theory have been to a very great extent responsible for the whole of Section II. He should in fact be regarded as joint author of part (1) of this section.

[2] The relation between $\dot{W}$, U and $\dot{U}$ is already known and the model will be specifically constructed to account for it. Thus to *test* the model against the existing observations of these variables is to conduct a " sun-rise test ", that is, to test the theory by checking some prediction which has a zero chance of being found wrong.

present article is the labour market we shall use the terminology appropriate to that market. The usual argument merely states that when there is excess demand, for example *ij* in Fig. 4, wage rates will rise, while, when there is excess supply, for example *mn* in Fig. 4, wage rates will fall. Nothing is said about the speed at which the adjustment takes place. We now introduce the dynamic hypothesis that the rate at which *w* changes is related to the excess demand, and specifically, the greater is the proportionate disequilibrium, the more rapidly will wages be changing.[1] Thus the hypothesis is $\dot{w} = f\left(\frac{d-s}{s}\right)$ which says that the speed at which wages change depends on the excess demand as a proportion of the labour force.[2] Fig. 5 illustrates a simple form of this relation, $\dot{w} = \alpha\left(\frac{d-s}{s} \, . \, 100\right)$ according to which if we start with excess demand of, for example, $Oc\left(= \frac{gh}{w'g} \text{ in Fig. } 4\right)$, wages will be rising at the rate *cd*, but, if the excess demand increases to $Oa\left(= \frac{ij}{w''j} \text{ in Figure } 4\right)$, wages will be rising at the rate *ab*.[3]

There are a number of advantages in including the relations illustrated in Fig. 5 in one's theory rather than having only the ones illustrated in Fig. 4. If it is known that both of the curves of Fig. 4 are shifting continuously (e.g. the demand curve due to cyclical variations in income, and the supply curve due to exogenous changes in the labour force), then no two price-quantity observations will lie on the same curve. It will then be difficult to discover by observation the *ceteris paribus* relations either between supply and price or between demand and price. For the relation in Fig. 5 to be observed it is necessary only that there be an unchanging *adjustment mechanism* in the market, i.e., that a given excess demand should cause a given rate of change of price *whatever the reason for the excess demand*—whether demand shift, a supply shift, or a combination of both. The rate of change of price can be observed directly and, to obtain the relation shown in Fig. 5, it is only necessary to know demand and supply *at the existing market price;* it is not necessary to know what would be demanded and supplied at other prices.

Now if excess demand for labour were directly observable there would be no need to go any further. Unfortunately, this is not the

[1] This is Phillips' hypothesis, *loc. cit.*, p. 283. It is also used extensively, for example, by Bent Hansen, *The Theory of Inflation*, London, 1951.

[2] If we were only concerned with a single market, the hypothesis could be expressed either in absolute or in proportional terms. Inter-market comparisons, however, require a proportionate measure. Consider the elasticity analogy.

[3] The relationship might of course be non-linear, indicating that $\dot{w}$ increased at either an increasing or a decreasing rate as excess demand increased. The simpler linear relationship is, however, capable of explaining all of the observed phenomena and, in the absence of empirical evidence about the second derivative of $\dot{w}$, the simpler relationship is assumed.

case, at least over a large part of the period under consideration,[1] and it is necessary to relate excess demand to something that is directly observable, in this case the percentage of the labour force unemployed.

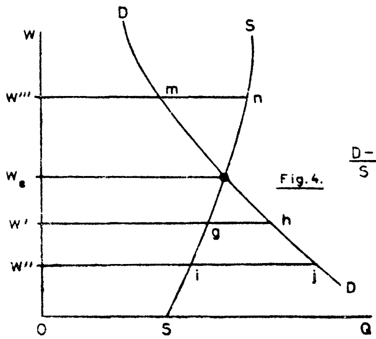

Fig. 4.

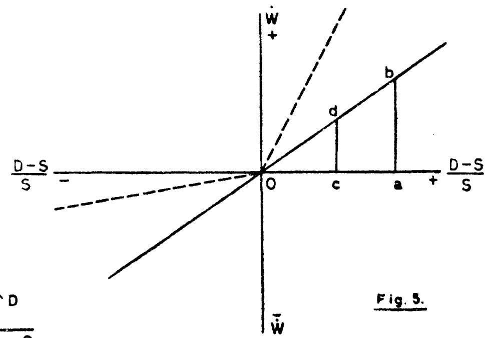

Fig. 5.

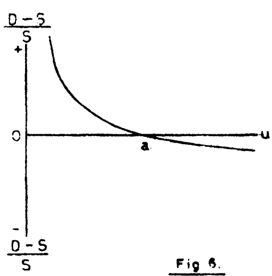

Fig. 6.

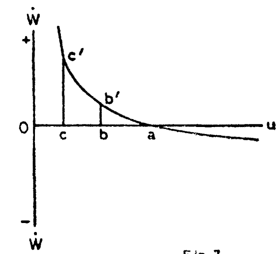

Fig. 7.

Fig. 6 shows the relation between $\frac{d-s}{s}$ and the percentage of the labour force unemployed, *u*. When demand is equal to supply (wage rate Ow_e in Fig. 4), there will be jobs available for all those who wish to work at the going wage rate. This is *not* equivalent to saying that there will be no one unemployed, but rather that the number of unemployed will be matched by an equal number of unfilled vacancies. Given that workers change jobs for any reason whatever, and that a finite time is taken to change, zero excess demand must be accompanied by some positive amount of *frictional unemployment.* From this it follows that, when the wage rate is stable (at Ow_e in Fig. 4), there will be some quantity of unemployment (*Oa* in Fig. 6), the exact quantity being determined by the amount of movement and the time taken to move. Now consider points to the left of *a* in Fig. 6. The larger is the excess demand the easier will it be to find jobs, and the less will be the time taken in moving between jobs. Thus, unless there is a

[1] The difference between unfilled vacancies and unemployed workers might provide a reasonable direct measure of excess demand; but such data are not available for most of the period under consideration.

completely offsetting increase in numbers of persons moving between jobs, an increase in excess demand will cause a reduction in u. It is, however, impossible that u could be reduced below zero so that as $\frac{d-s}{s}$ approaches infinity, u must approach zero (or some small value >0) asymptotically.[1] Now consider points to the right of a. Any increase in excess supply brings an equal increase in the number of persons unemployed. Therefore, to the right of point a, there will be a linear relation between $\frac{d-s}{s}$ and u.[2]

Now in order to obtain the relation between the two observable quantities, $\dot{w}$ and u, we need merely combine Figs. 5 and 6 to obtain the relation illustrated in Fig. 7. The relation between $\dot{w}$ and $\frac{d-s}{s}$ (Fig. 5)

[1] The following is a simple model which will produce the postulated relationship: *Symbols:* $L \equiv$ labour force $\equiv S$ in Fig. 4, $E \equiv$ number employed, $V \equiv$ number unemployed, $J \equiv$ total jobs available $\equiv D$ in Fig. 4, $N \equiv$ number of unemployed finding jobs, $X \equiv$ proportionate excess demand $\equiv \frac{J-L}{L} \equiv \frac{d-s}{s}$, α and β are two constants.

Assumptions: A constant proportion of those employed, αE, leave employment per unit of time; the number of unemployed who find jobs depends on the number looking for jobs and the number of jobs available: $N = \beta V(J-E)$.

A constant level of V requires: $\alpha E = \beta V(J-E)$.

But $E = L - V$, so $\alpha(L-V) = \beta V(J-L+V)$.

Expanding: $J = \frac{\alpha L}{\beta V} - V + L - \frac{\alpha}{\beta}$. But $X \equiv \frac{J-L}{L}$.

Eliminating J: $X = \frac{\alpha}{\beta V} - \frac{V}{L} - \frac{\alpha}{\beta L}$. ...(*I*)

Differentiating: $\frac{\partial X}{\partial V} = -\frac{\alpha}{\beta V^2} - \frac{1}{L} < 0, \frac{\partial^2 X}{\partial V^2} = \frac{\alpha}{\beta V} > 0$.

Therefore an increase in X is associated with a decrease in V but as X increases V falls at a decreasing rate and, from (*I*) above, as $X \rightarrow \infty$, $V \rightarrow 0$.

[2] There are some reasons for believing that, to the right of a the relation might have a slight curvature which would *increase* as u increased (i.e., $\frac{\partial w}{\partial u} < 0$ *and* $\frac{\partial^2 w}{\partial u^2} < 0$). The excess supply of labour is $\frac{d-s}{s} . 100$ while u is $\frac{d-s}{s} . 100 + F$, where F is the proportion of the labour force frictionally unemployed. If F remains constant as excess supply increases, the relationship between $\frac{d-s}{s}$ and u will be linear. If, on the other hand, $F \rightarrow 0$ as $u \rightarrow 100$, then the line relating u to $\frac{d-s}{s}$ will *curve* slightly downwards, starting at $u = F$ when $\frac{d-s}{s} = 0$ and reaching $u = \frac{d-s}{s}$ when excess supply is 100 per cent. If F is small (say 5 per cent.), this curvature will be very slight. A second reason is that people in excess supply may not register as unemployed so that recorded u may not increase as fast as real excess supply. With the data used in this study it is impossible to distinguish between $\frac{\partial^2 \dot{w}}{\partial u^2} \lesseqgtr 0$ for high values of u. If, however, it were possible to demonstrate that $\frac{\partial^2 \dot{w}}{\partial u^2} > 0$, we should have to abandon the linear hypothesis illustrated in Fig. 5, at least for situations of excess supply.

is assumed to be linear throughout. The relationship between $\dot{w}$ and u, however, is non-linear to the left of the point a because of the non-linear relation over that range between u and $\frac{d-s}{s}$ (Fig. 6) while the relation between $\dot{w}$ and u is linear to the right of a because of the assumed linear relation over that range between u and $\frac{d-s}{s}$ (Fig. 6). The relation illustrated in Fig. 7 shows the *speed at which prices adjust to a disequilibrium* and we shall call it an *adjustment function.*

This relationship between $\dot{w}$ and u is an extremely simple one, and it holds considerable promise for empirical testing. The relation is, however, easily misinterpreted, and it may be worth considering some examples. Consider, first, a case in which a market is observed over three successive time periods at the points a, b' and c' in Fig. 7. This means that the demand and/or the supply curves have shifted over the period in such a way as to increase the disequilibrium in spite of the increase in wage rates. For example, the demand curve may have shifted so quickly to the right that the equilibrating movements in w were more than offset. Now consider a case in which the market is observed first at c', then at b' and finally at a. This is consistent with many market changes, two of which will be mentioned by way of illustration. First, both the demand and supply curves might be stable while the increase in wages restores equilibrium. Second, even though the demand curve is shifting to the right, the rate of increase in wages is fast enough to reduce the excess demand. When we observe either of these time sequences (a to b' to c' or c' to b' to a) we do not know what shifts in the curves have occurred but only that, in the first case, the shifts were such as to increase the disequilibrium in spite of equilibrating movements in w while, in the second case, any shifts that did occur either were not sufficient to offset the equilibrating changes in w or actually helped to remove the disequilibrium. If, to take a final example, the market is observed at b' over several successive periods, then we know that rightward shifts in demand and/or leftward shifts in supply were sufficient just to offset the equilibrating effects of changes in w, leaving excess demand constant.

It must be emphasised that knowledge of the shape of the adjustment function does not allow one to distinguish between *causes* of disequilibrium. Consider a market that is observed at a at time 0, at b' at $t=1$, at c' at $t=2$, at b' at $t = 3$, and finally at a at $t=4$. All we know is that there was an increasing disequilibrium associated with ever faster increases in w, but that after a while the disequilibrium lessened until, at $t=4$, it is completely eliminated. Now these observations are consistent with either a rightwards shift in the demand curve, first at an increasing rate and then at a decreasing rate, or with a leftwards shift in the supply curve, indicating first a rapid withdrawal of labour supplies and then a slower withdrawal.

The relation also raises the problem of the influence of unions, but, in fact, tells us very little about their influence on the market processes. There are a number of points to notice here. First, the observation of the postulated relation is quite consistent with changes in wages caused by union-induced shifts in the labour supply curve. For, as illustrated in the previous paragraph, shifts in the supply curve would give rise to observations lying on the adjustment function. Second, unions might influence the speed of the dynamic adjustment illustrated in Fig. 5. They might, for example, cause a faster increase of wages in response to excess demand and a slower fall in response to excess supply than would otherwise occur. In other words, they might shift the adjustment function to the shape illustrated by the dotted line in Fig. 5.[1] If a completely stable relation between $\dot{w}$ and u is observed over time, all that can be said is that, whatever is the influence of the union on the market, this influence has remained *relatively stable* over that time period.

We must now consider the effect of aggregating a number of markets each with the same relation between $\dot{w}$ and u in order to obtain a relation between $\dot{W}$ (the rate of change of a national index of wage rates) and U (the percentage of the whole labour force unemployed). The main problems can be illustrated in the case of two markets, α and β, *with identical reaction functions* of the sort illustrated in Fig. 7. We assume for simplicity in exposition that the labour force is divided equally between the two markets so that

$$U=\frac{u_\alpha+u_\beta}{2} \quad \text{and} \quad \dot{W}=\frac{\dot{w}_\alpha+\dot{w}_\beta}{2}.$$

Consider, first, what would happen if both markets always had identical levels of unemployment. Since the percentage of the labour force unemployed would be the same in both markets, the national index of percentage unemployment would be the same as the figure for the two markets ($u_\alpha=u_\beta=U$). Also, since both markets would be showing identical rates of change of money wage rates, the national index would show the same rate of change ($\dot{w}_\alpha=\dot{w}_\beta=\dot{W}$). If the level of unemployment then were allowed to vary in exactly the same way in both markets (so that $u_\alpha=u_\beta$ and $\dot{w}_\alpha=\dot{w}_\beta$), it follows that the observed relation between $\dot{W}$ and U would be identical with the relation between $\dot{w}$ and u in each of the individual markets.

Consider, second, what would be observed if aggregate unemployment were held constant at say $0a$ per cent. $\left(\frac{u_\alpha+u_\beta}{2}=0a\right)$, while the

[1] It is worth noting that, if they were successful in shifting the reaction function, they could be affecting the distribution of the national product even though they were completely unable to shift either the demand or supply curve and thus were unable to affect the position of *equilibrium*. By increasing the *speed of adjustment* when there is excess demand and by slowing it down when there is excess supply, they would ensure that, over any finite time period, the average wage rate would be higher than it would otherwise be.

distribution of this unemployment were varied as between markets (say $u_\alpha < u_\beta$). Since the relation between $\dot{w}$ and u is non-linear to the left of the point a, wages will be increasing faster in the market with excess demand (α) than they will be falling in the market with excess supply (β). Therefore the national index of wage rates will be rising $\left(\dot{W} = \frac{\dot{w}_\alpha + \dot{w}_\beta}{2} > 0\right)$ in spite of the fact that the overall unemployment percentage remains unchanged at $0a$. Furthermore, as the distribution of U between the two markets is made less equal, $\dot{W}$ will take on larger and larger values since, when u_α is reduced by the same amount by which u_β is increased, $\dot{w}_\alpha$ will be increased by more than the amount by which $\dot{w}_\beta$ will be decreased.

Finally, consider what would happen if the two markets were kept in the same relation to each other (e.g. $u_\alpha = k \,.\, u_\beta$, where $k < 1$) while the total level of employment $\left(\frac{u_\alpha + u_\beta}{2} = U\right)$ were allowed to vary. As U varies, a relation between U and $\dot{W}$ will be traced out. We will call this curve A_m for *macro-adjustment curve* and distinguish it from the curves a_i for *individual market adjustment curves*. By the reasoning in the last paragraph, this relation between $\dot{W}$ and U will lie above the individual market adjustment curves. Now consider increasing the degree of inequality between two markets (i.e. reduce the value of k). Because of the non-linearity in the individual market relations between $\dot{w}$ and u, this will increase $\dot{w}_\alpha$ by more than it will reduce $\dot{w}_\beta$. Therefore $\dot{W}$ for the whole economy will be increased. It should be noted, however, that because of the linear relation to the right of a, this upward displacement will not occur if there is excess supply in both markets (u_α and $u_\beta > 0a$).

This analysis leads to a number of important conclusions about the relation between the individual adjustment functions (the a_i's) and the macro-curve (A_m). (1) The macro-function can never lie below the individual market functions.[1] (2) The macro-function will coincide with the individual (identical) a_i's only if there is an identical percentage of the labour force unemployed in each market at all levels of aggregate unemployment. (3) Whenever there is any degree of inequality in the distribution of unemployment combined with excess demand in at least one market ($u < 0a$ for some markets), the macro-observations will lie above the individual market curves for corresponding levels of unemployment. (4) The greater is the degree of inequality between markets, the further will the macro-observations be above the individual market curves, and thus the greater will be the degree of upward displacement of the observed macro-

[1] If the a_i curves are not identical this conclusion reads: " The curve A_m can er lie below the " average " or typical curve a_i".

function.[1] The macro-function relating W and U will be *linear* only if there is excess supply in all markets (i.e. if *all* markets are in the range where the relation between $\dot{w}$ and u is linear). In all other cases it will be non-linear.[2]

These conclusions have a number of interesting real-world implications: (1) If one wishes to predict the rate of change of money wage rates ($\dot{W}$), it is necessary to know not only the level of unemployment but also *its distribution between the various markets of the economy.* It follows immediately that the observed macro-function need not be accepted as immutable even if the individual functions are. The macro-relation may be shifted by a policy designed to change the degree of inequality existing between the individual markets; if the distribution of U were made more even the macro-curve would shift downwards, thus increasing the downward flexibility of the overall wage level. (2) Because of the upward displacement of the macro-observations, the observed macro-relation between $\dot{W}$ and U will always tend to overstate the upward flexibility and to understate the downward flexibility of wage rates to be found in a typical individual market. (3) Thus, given non-linear a_i's, if a stable macro-relation between $\dot{W}$ and U *is* observed over a large number of cycles, it is implied that in both the upswing and the downswing roughly the same degree of inequality of unemployment has existed as between cycles.[3] (4) Finally, great caution must be exercised in trying to infer from a statistically fitted relation between $\dot{W}$ and U what would happen to wage rates if unemployment were held constant at any level for a long time. If unemployment were held constant, we would expect the degree of inequality in its distribution between markets to change substantially. We would thus expect the macro-adjustment function to shift.[4]

2. *The relation between $\dot{W}$ and $\dot{U}$*

Phillips noted that the actual values for $\dot{W}$ tended to be above the curve relating $\dot{W}$ to U when U was falling, and below the curve when

[1] This conclusion can be upset only if the rate of response of wages to excess demand is slower than the rate of response to excess supply so that the a_i curves are kinked in the opposite way to the dotted function in Fig. 5.

[2] Thus the form of the function actually used (see equation 3) is to be understood as an approximation to the " true " curve which becomes linear (but with a negative slope) when there is excess supply in all markets. The difference between the $\frac{\partial^2 \dot{w}}{\partial u^2} = 0$ of the theory and the $\frac{\partial^2 \dot{w}}{\partial u^2} > 0$ of the fitted curve is slight over the range of u's studied, and the data is too crude to allow us to distinguish between the two.

[3] We would expect this to be true at least in some rough sense since certain sectors of the economy, e.g. the capital goods sectors, are typically hit much harder by fluctuations in the level of activity than are other sectors, e.g. the non-durable consumer goods sectors.

[4] It is an open question which way the curve would shift. It might be expected that a stable period would give time for the classical adjustment mechanism—movements of labour between markets and changes in relative prices—to reduce the degree of sectoral inequality. On the other hand, it might well be that cyclical fluctuations in employment aided the markets in adjusting to changes in demand and in techniques, and that the removal of these fluctuations would increase the average degree of inequality existing between markets.

U was rising. He therefore postulated a relation between the rate of change of wages, $\dot{W}$, and the rate of change of unemployment, $\dot{U}$, according to which $\dot{W}$ will be higher, for any given level of U, the larger is $\dot{U}$. The statistical analysis reported in Section I of this paper shows that a linear relation between $\dot{W}$ and $\dot{U}$ is capable of explaining about half of the variation in $\dot{W}$ not already associated with U alone. In the present section we must attempt a theoretical explanation of this relation.

Phillips argued that this relation was the result of a direct reaction of employers and workers to *changes* in the level of unemployment. He would seem to have had two possible reactions in mind. The first is that there will be more competitive bidding when $\dot{u}$ is negative than when it is positive, because in the former case there will be *net* hiring of labour while in the latter case there will be *net* dismissals. The second effect is the reaction of *expectations*, and hence of competitive bidding, to changes in u. Both of these explanations lead us to expect to find loops in a single labour market. It is most important to note that, to obtain a loop, it is necessary that something affect w without simultaneously affecting u. It is quite possible, however, that the factors mentioned by Phillips are unsatisfactory because they will produce changes in both $\dot{w}$ and u. We must, therefore, consider these factors carefully. Consider the first effect. When there is significant excess supply, more labour can be obtained at the going wage rate. As long as there is excess supply in a particular market throughout the period, there would seem to be no reason to expect there to be more competitive bidding on the average if excess supply falls from, say, 10 per cent. to 6 per cent., than if it rises, say, from 6 per cent. to 10 per cent. When there is significant excess demand, employers will be prepared to take on workers at the going wage rate if the labour were forthcoming. Assume that in January they are prepared to take on 10 per cent. more workers than they are employing at present but that demand steadily falls so that by December they are only prepared to take on 5 per cent. more than they are employing. There seems to be no reason to expect the situation just described to cause less competitive bidding than would occur when employers start by wanting 5 per cent. more labour in January and end by wanting 10 per cent. more in December. The second reason which Phillips apparently had in mind is that the loops might be the result of an expectation effect which makes employers bid harder when $\dot{U}$ is negative than when it is positive. Employers might vary the strength of their bidding not merely in response to present need but because of what they expect to need in the future. Assume a given demand for final goods and that the amount of labour required to produce these goods is such that 6 per cent. of the labour force would be unemployed and wages would be falling at 1 per cent. per annum. Assume, however, that the demand for goods is rising, and that employers increase their demands for labour in the expectation of needing more in the future. As a result of this change, unemployment will be lower than it otherwise would have been (say 4 per cent.) and the rate of fall of wages will be less than it otherwise would have been (say -0.25 per cent.). There is, however, no loop; all that happens is that the point attained on the adjustment curve is different than would have been predicted solely on the basis of current demand for final goods; u is lower and $\dot{w}$ is higher than they otherwise would have been.

The difficulties encountered with these explanations in terms of a single market suggested that the origin of the loops might lie in the aggregation of the u's and the $\dot{w}$'s for a number of different labour markets each affected differently by fluctuations in the level of aggregate demand for final goods.[1]

Fig. 2 shows the observations of $\dot{W}$ and U for the twelve years 1868–79. The fitted relation between $\dot{W}$ and U lies in the middle of the observations, and this invites an interpretation of the " loops " as consisting of both positive and negative deviations from the relation $\dot{W}=f(U)$.[2] The theoretical argument of the present paper suggests, however, that this interpretation may be seriously misleading. The stable behavioural relation that we have postulated is the one between $\dot{w}$ and u in individual markets (see Fig. 7). The analysis of the previous section suggests that the macro-relation between $\dot{W}$ and U will *always be displaced upwards* from the individual market relation. The degree of upward displacement will be a function of the degree of inequality in the distribution of U between the various markets. This invites interpretation of the " loops " not as positive and negative deviations from a stable macro-relation between $\dot{W}$ and U, but as upward displacements from the stable single-market relations between $\dot{w}$ and u, the loops being produced by systematic variations in the degree of upward displacement.

In order to see how macro-observations of the type illustrated in Fig. 2 might arise, we may follow out the course of a hypothetical cycle in an economy with two imperfectly linked labour markets. Fig. 8 shows the (identical) relation between $\dot{w}$ and u in the two labour markets;[3] Arabic numerals refer to the positions at successive time periods in the two markets, while the crosses with Roman numerals show the corresponding aggregate observations that will be generated.

[1] The hypothesis actually offered is by no means an untestable alibi. On the contrary, it leads to a number of testable hypotheses, other than the relation between $\dot{W}$ and U, that are of considerable interest. If the hypothesis stands up to these further tests it may be regarded as an interesting one. If it is refuted by these tests we shall learn from *the way in which it is refuted* much more about the conditions which must be fulfilled by its successor.

[2] Cf. Phillips, *loc. cit.*, p. 290.

[3] The assumption that the relations between $\dot{w}$ and u are identical in the two markets is relaxed later in the analysis.

Assume that the economy begins in a period of depression with heavy unemployment in one market (*a*) and lighter unemployment in the second market (*b*). The cross I indicates the percentage of the total labour force unemployed and the rate of change in a national

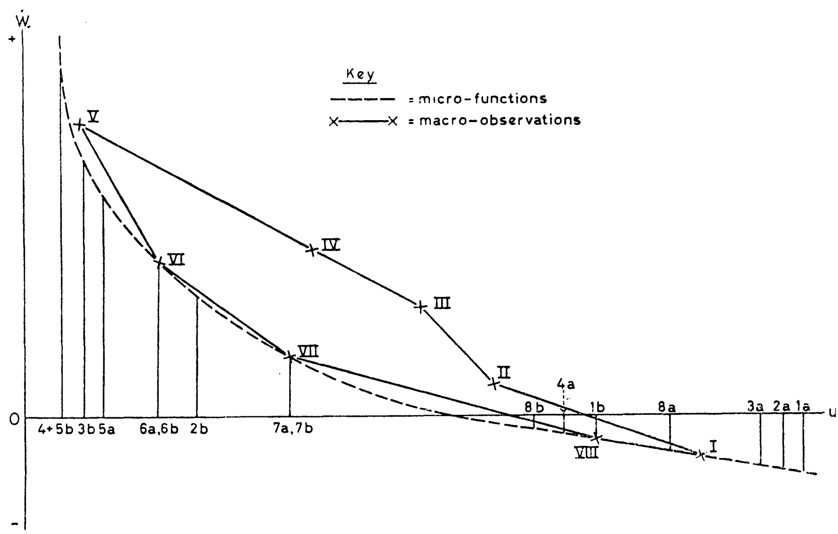

Fig. 8.

index of wage rates that will be observed. Now assume that a recovery starts, and that it is at first mainly centred in market *b*. As soon as excess demand occurs in market *b*, wage rates will begin to rise, although *U* for the whole economy is still high as a result of the heavy unemployment in market *a* (periods 2 and 3). As the excess demand in market *b* grows, the macro-observations will trace out a relation similar to that of the curve for market *b* but displaced to the right because of the influence of the heavy unemployment in market *a*. When market *a* begins to recover rapidly, *U* for the whole economy will fall rapidly but there will not be a further large increase in $\dot{W}$ until serious excess demand develops in market *a*. If both markets should reach the same level of excess demand, the macro-observations will lie on the micro-curve. Now assume a fall in activity in both markets. If U rises more or less uniformly in both markets, the observations of $\dot{W}$ in the downswing will lie near the micro-curves and, therefore, well below those for corresponding U's on the upswing. If the downswing comes before the same degree of excess demand is achieved in both markets, then the macro-observations for the downswing will lie above what they would be if the equality of excess demand had been achieved.

The " loops " can thus be accounted for on the hypothesis that the recovery affects different markets at different times while the fall in effective demand is, at least during the early stage of the recession, more evenly distributed.[1] Another way of making the same point is to say that the hypothesis requires that time lags are greater in the upswing than in the downswing. If a fall in demand in one market causes a fall in demand in other markets with a time lag of only a few months, then all markets will be observed to decline more or less together. If, on the other hand, there is a longer time lag before an increase in demand in one market is transmitted to other markets then all markets will not recover together and there will be a greater degree of sectoral inequality in unemployment in the early upswing than in the early downswing.[2]

This analysis points a general warning against the procedure of accepting statistically fitted relations without relating them to models of *market behaviour.* We have already seen that the data is consistent with the hypothesis that there is an association between $\dot{W}$ and $\dot{U}$ but it will be noted that, if a relation $\dot{W}=f(U)$ were fitted to the macro-observations of Fig. 8, the curve would go through the centre of the loop and thus be displaced upwards from the stable micro-adjustment functions. The observed macro-curve relating $\dot{W}$ and U goes through the centre of most of the " loops " and therefore gives the average relation between $\dot{W}$ and U, *given the degrees of inequality in excess demand that have in fact been experienced.* The macro-curve will thus be useful for prediction providing that the same sort of inter-market inequalities continue to occur. Great care must be taken in using the curve to predict what would happen if the level of U were held constant for some time for, if this were done, the degree of inter-market inequality in excess demand would be expected to change considerably.[3]

[1] This would be true if, for example, the consumer-goods industries recovered first while the capital-goods sector did not recover until significant excess demand had developed in the consumer industries; while, on the other hand, when demand fell in one sector demand also fell in the other with less than a one year time lag.

[2] It may be objected that the assumption of identical relations between w and u greatly restricts the applicability of the model. This is not so. It has been shown in the text that varying degrees of sectoral inequalities in the distribution of unemployment (for which there is some empirical evidence) is a *sufficient* condition for the generation of the loops. If the loops are explained as a phenomena of aggregation then inequality in distribution is also a *necessary* condition. If for any level of U, u_α and u_β always bear the same relation to each other there will be unique relation between $\dot{W}$ and U for any relations: $\dot{w}_\alpha = f_1(u_\alpha)$ and $\dot{w}_\beta = f_2(u_\beta)$. If different reaction functions (about which we have little empirical evidence) were superimposed onto the model in the text the only difference would be a change in the *shape of the macro-loop.*

[3] This would be particularly important in the middle range of U values, where all experience has been of rapidly changing level of U, and less important at extreme values where U has more often been stable at least for two or three years at a time.

III

THE PERIOD 1919–1957

Phillips' scatter diagram relating $\dot{W}$ to U for the period 1919–57 is reproduced here as Fig. 9.[1] The diagram reveals very little relation between the level of unemployment and the rate of change of wages. Phillips argued, however, that there was evidence of a close relation between the two variables in certain periods. He also argued that, in the period following the second world war, the relation between $\dot{W}$ and U was substantially the same as it had been in the period 1861–1913. In the present section we will first consider the years 1919–58 as a single period and then consider the various sub-periods dealt with by Phillips.

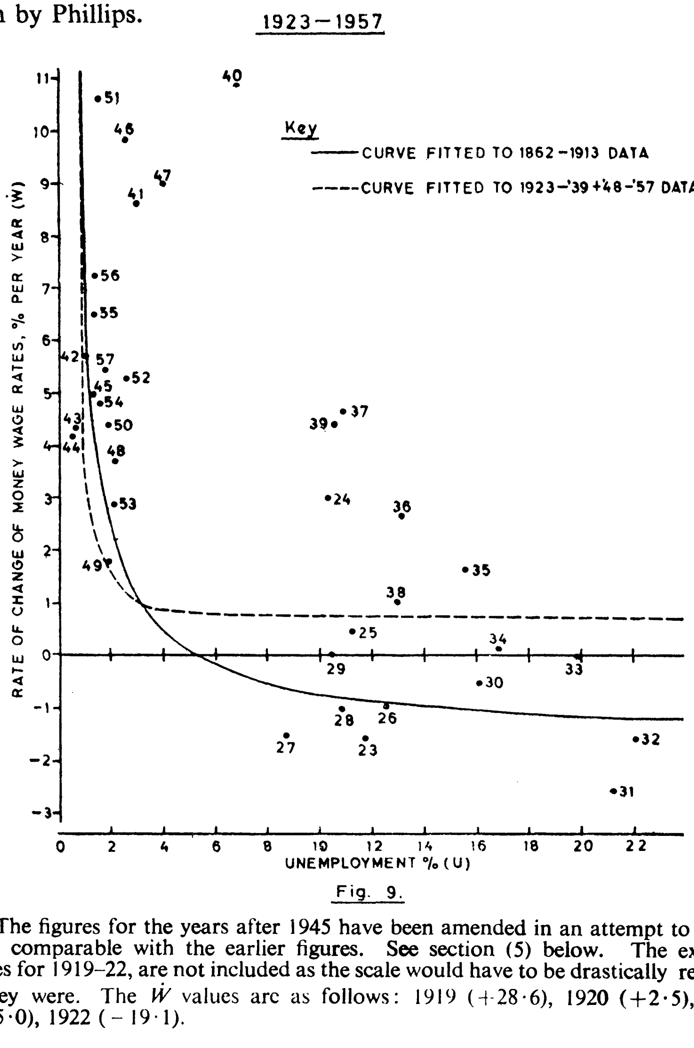

Fig. 9.

[1] The figures for the years after 1945 have been amended in an attempt to make them comparable with the earlier figures. See section (5) below. The extreme values for 1919–22, are not included as the scale would have to be drastically reduced if they were. The $\dot{W}$ values are as follows: 1919 (+28·6), 1920 (+2·5), 1921 (−25·0), 1922 (−19·1).

When considering this period there are three major hypotheses that may be worth testing: (i) that the changes in money wage rates continue to be explained mainly by changes in U, $\dot{U}$, and $\dot{P}$; (ii) that the relative explanatory power of these three independent variables is unchanged; and (iii) that the exact relation between $\dot{W}$, U, $\dot{U}$, and $\dot{P}$ is unchanged so that equation (10) which was fitted to the years 1862–1913, predicts accurately the experience of this period. The first hypothesis is in fact borne out by the data but the second and third are refuted.[1]

1. *The years 1920–39 and 1947–57*[2]

The curvilinear relation between $\dot{W}$ and U described by equation (3) was first fitted to the data for this period. R^2 for this relation is 0.28 which indicates that only a low proportion of the variance in $\dot{W}$ can be accounted for by variations in U. Next the variables $\dot{U}$ and $\dot{P}$ were added (i.e., equation 9 was fitted to this data) and the R^2 increased to 0.88. The squared partial correlation coefficients for this relation are $U=0.06$, $\dot{U}=0.05$, and $\dot{P}=0.83$ which indicate that $\dot{P}$ is the most important of the three explanatory variables while U and $\dot{U}$ add practically nothing to the explanation of $\dot{W}$. Even more startling than the high partial correlation between $\dot{W}$ and $\dot{P}$ is the magnitude of the regression coefficient for $\dot{P}$. This has a value of 1.28, indicating that on the experience of the whole period a 1 per cent. rise in prices is associated with a rise in wages of more than 1 per cent.

There are, however, a few very extreme values for $\dot{W}$ in this period and their existence poses some serious problems. The variance in $\dot{W}$ over the period under consideration is 47.2 while, if the four years 1920, 1921, 1922 and 1947 are eliminated, the variance drops to 10.2.[3] Thus 13 per cent. of the years account for 78 per cent. of the variance in $\dot{W}$, and any explanatory variable which accounts for $\dot{W}$ in these four years will necessarily produce a high R^2 for the whole period

[1] The model used throughout the present paper is the simplest sort of " single-equation model ". This report is a part of a larger study in which simultaneous relations will be used. The single-equation model is probably justified as a first approximation especially where it is desired to try alternative explanatory variables, alternate specification of the lags, and alternative functional forms. The single-equation model does, however, introduce some serious biases into the estimates. The most serious error is likely to be on $\dot{P}$ which is the main variable affected by other parts of the system. It is easily shown, however, that the regression coefficient of $\dot{P}$ is biased upwards. Calculations taking what appear to be reasonable specification of the dependence of prices on wages, suggest that the bias may be of the order of 0·2 to 0·3 (so that the subsequent estimate of 0·69 for the coefficient of $\dot{P}$ should probably be more like 0·40 to 0·50).

[2] The periods of the two world wars plus the first post-war year (1914–19 and 1940–46) were omitted on the argument that a period of heavy war-time controls is not an appropriate period from which to infer the relations being studied.

[3] It is probably reasonable enough to eliminate 1920 and 1947 on the argument of the previous footnote. One is less certain about the years 1921 and 1922.

irrespective of its ability to account for variations in $\dot{W}$ over the remaining years. It is also true that the regression coefficient associated with this variable will mainly reflect the relation between it and $\dot{W}$ over these four years. There is therefore good reason to mistrust the regression coefficients calculated from a series containing a few such very extreme values which must dominate the whole estimation procedure. For this reason the four extreme years were dropped from the series and the various relations recalculated.

2. *The years 1923–39 and 1948–57*

The curve fitted to this period was of the form:[1]

$$\dot{W}=a+bU^{-1}+cU^{-4}+d\dot{U}+e\dot{P} \qquad (12)$$

which, when fitted to the data, gives

$$\dot{W}=+0.74+0.43U^{-1}+11.18U^{-4}+0.038\dot{U}+0.69\dot{P} \qquad (13)$$

R^2 for this relation is 0.91, while the squared partial correlation coefficients are $U=0.38$, $\dot{U}=0.30$ and $\dot{P}=0.76$.[2]

There are a number of interesting things to note about these results.

(i) *The General Relation*: A very high proportion of the variance in $\dot{W}$ can be associated with these variables.[3] Thus the hypothesis that about the same proportion of the variance in $\dot{W}$ can be associated with U, $\dot{U}$ and $\dot{P}$ as in the earlier period is consistent with the facts.

(ii) *The Variable $\dot{P}$*: The importance of $\dot{P}$ as an explanatory variable has greatly increased compared with the pre-war period (a squared partial correlation coefficient of 0.76 compared to 0.17). The regression coefficient for $\dot{P}$ has also increased greatly (0.69 compared to 0.21). This indicates a substantial movement in the direction of a one-one relation between changes in prices and changes in wages. This is an extremely interesting change. The face-value interpretation is that the demand and supply model of Section II accounts for less of the variations in wage rates in the twentieth century than it did in the nineteenth, while more of the twentieth-century variations can be explained in terms of wages " chasing " prices or of prices chasing wages.

(iii) *The Variable U*: The fitted relation between $\dot{W}$ and U has changed substantially compared with the earlier period. The curve

[1] The curvature became much sharper in this period than it was in the nineteenth century. If Phillips' curve (2) were fitted to the data the coefficient γ would have been less than minus two. Thus the fixed coefficients on U had to be changed. The relationship described by equation (12) is the same as that described by (10) only the curvature is more marked.

[2] The standard error of estimate for $\dot{W}$ is 0·97, standard errors for the regression coefficients are: $b=2{\cdot}10$, $c=6{\cdot}00$, $d={\cdot}012$, $e=0{\cdot}08$. There is no evidence of significant auto-correlation of the residuals for lags of one to three periods at the 5 per cent. probability level. Correlation of the " independent variables " is as follows:

$$r^2 (U, U)=0{\cdot}003; \quad r^2 (U, \dot{P})=0{\cdot}47; \quad r^2 (\dot{U}, \dot{P})=0{\cdot}09$$

[3] Corrected for degrees of freedom, the R^2 is 0·89.

relating these variables has pivoted about the 3 per cent unemployment level (see Fig. 9). The new curve lies above the old one for levels of U greater than 3 per cent. and below the old one for levels of U less than 3.[1] This indicates that the post–1922 experience was of less flexibility of wages in response to excess demand, whether positive or negative, than occurred in the pre–1914 period. It will also be noted that the asymptote in equation (13) is positive. This indicates that, on the *average experience* of the 1920's and the 1930's, high levels of unemployment are not in themselves associated with a reduction in wages. Here again the theory of Section II must be recalled and the qualification " given the degree of sectoral inequality in unemployment that then existed " be emphasised.

(iv) *The Variable* $\dot{U}$: Finally, we must note the interesting changes in the relation between $\dot{W}$ and $\dot{U}$. Comparing equations (13) and (10), we see that the regression coefficient for $\dot{U}$ has changed signs. This reveals that, on the average experience of the post-1922 period, other things being equal, times of falling unemployment were associated with lower $\dot{W}$'s than were times of rising unemployment. It would appear then that Phillips' loops have changed directions. Before considering a theoretical explanation of this experience, it is necessary to check the relation between $\dot{W}$ and $\dot{U}$ in various sub-periods in order to determine exactly what it is that has to be explained. The data were broken up into three time periods and the following equation was fitted to each period[2]

$$\dot{W}=a+bU+c\dot{U}+d\dot{P} \qquad (14)$$

The coefficients for $\dot{U}$ were as follows:

1923–29 = +1.91, 1929–39 = − 6.25, 1948–57 = + 3.28

Thus we see that, taken period by period, the experience of the 1930's agreed with that of the nineteenth century while that of the 1920's and 1950's did not.

We must now ask if this experience can be explained by our theory. Feeding this data into the theory, we obtain the testable predictions that in the 1930's the upswing was associated with increasing degrees of sectoral inequalities in unemployment as some markets recovered very much more rapidly than did others. On the other hand, in the 1920's and the 1950's, downswings in activity were accompanied by increases in sectoral inequalities, while upswings were associated with decreases. Here again the theory accounts for the observations by producing hypotheses that are clearly testable. These tests, which are being conducted, are beyond the scope of the present paper.

[1] When the curve is fitted without a cost of living variable $[\dot{W}=f(U, \dot{U})]$, it shifts upwards from its pre-1914 position over its whole range, but when $\dot{P}$ is added the curve is found to pivot as described in the text.

[2] The range of variations in U within each of the three periods is such that a linear approximation to the relation between $\dot{W}$ and U is quite adequate. A similar disaggregation for the nineteenth century is summarised in Table 1.

These considerations point to the rejection of hypotheses (ii) and (iii) listed above. Hypothesis (ii), that the variables have had the same relative importance in explaining $\dot{W}$ in the periods before and since the first world war is refuted by the fact that the partial correlation coefficients relating $\dot{W}$ to each of the independent variables have changed considerably. Hypothesis (iii) is refuted by the fact that the regression coefficients have changed markedly.

In the following sections the period under consideration is broken up into three sub-periods. By comparing the predictions of equation (10) fitted to the period 1862–1913 with those of equation (13) fitted to the present period, we seek to determine how and when these relationships have shifted.

3. *The period 1920–29*

In the years 1920 and 1921, very large decreases in both the cost of living and money wage rates were experienced. When $\dot{W}$ for these years is predicted from equation (13) the errors are extremely large (a residual of 16.8 per cent. for 1921 and of 9.8 per cent. for 1922). This shows that the relation describing the remainder of the period (equation 13) is not a good description of these two years. This is mainly because the relation between $\dot{W}$ and $\dot{P}$ seems to be stronger in these two years than it is over the rest of the period.[1] In the years 1925 to 1929 the government attempted to check aggregate demand in order to reduce the price level. Unemployment stayed at about 10 per cent., while wage rates fell on the average less than 1 per cent. per year. Phillips makes the point that the results of this experiment could have been predicted quite accurately on the basis of the experience for 1861–1913. The average annual reduction in wage rates that in fact occurred over the five years 1925–29 was 0.60 per cent. The prediction for the annual average reduction made from the equation fitted to the 1862–1913 experience (equation 10) is 1.00 per cent. We must conclude, therefore, that there was no reason to be surprised at the very slow reduction in wage rates that actually occurred, and that the experience of the late 1920's seems to provide little evidence of diminished downward flexibility of wage rates. The measurements give strong support to Phillips' statement (*loc. cit.*, p. 295) that: " The actual results obtained, given the levels of unemployment which were held, could have been predicted fairly accurately from a study of the pre-war data, if anyone had felt inclined to carry out the necessary analysis."

4. *The period 1930–39*

The equation fitted to the pre–1914 data consistently underestimates the changes in wage rates over this period. In only three years, 1936,

[1] When $\dot{W}$ is estimated from the equation fitted to the years 1920–39 and 1947–57, the residuals are only 6·8 per cent. for 1921 and 1·8 per cent. for 1922. This shows how much the estimated relation is influenced by these extreme years.

1937 and 1939, does equation (10) not predict a fall in wage rates. The average annual predicted fall over the whole period is 0.54 per cent., while the average annual error $\Sigma/R_{10}/ \div n$ was 1.67 per cent. In fact, money wage rates rose from 1934 onwards and the average annual change in wage rates over the ten-year period was +0.99 per cent. Equation (13), on the other hand, predicts this result quite accurately at 0.89 per cent. Some of the errors in individual years are, however, quite large and the average annual error over the period is 0.74 per cent. We must conclude that there is evidence that $\dot{W}$ increased faster in the 1930's than in the pre–1914 period for comparable levels of U, $\dot{U}$, and $\dot{P}$.

It should also be noted that wages rose from 1934 onwards in spite of very high levels of unemployment (never less than 10 per cent. over the entire period). There are two probable causes of this experience. First, if we accept the results of the statistical analysis as showing an increased response of wages to changes in the cost of living, much of the rise in wages in the 1930's can be explained as a response to such changes (the average annual increase in the cost of living between 1934 and 1939 was 3.15 per cent.). If, however, the increase in wages due to cost of living changes is estimated from equation (13) and this amount deducted from the actual increase, the result is still positive.[1] Something further, then, is required to explain that part of the increase in wage rates not associated with $\dot{P}$. A second reason may be found in the degree of sectoral inequality in unemployment rates. The theory produces the testable hypothesis that from 1935 onwards there was sufficient excess demand in some markets to cause an increase in the national index of wage rates in spite of extremely large excess supplies in other markets.

5. *The period 1948–57*[2]

The following table shows the observed and the predicted changes in wage rates over the period.[3]

It will be noted that the average annual increase predicted from equation (13) agrees very closely with the observed annual average, while the average predicted from equation (10) considerably underestimates the observed figure. Considering the predictions from

[1] These corrected figures for $\dot{W}$ 1934 to 1939 are:
−0·62, +0·22, +0·13, +2·68, +0·13, −0·98.

[2] A detailed study of this period is to be found in L. A. Dicks-Mireaux and J. C. R. Dow, " The Determinants of Wage Inflation: United Kingdom, 1946–56 ", *The Journal of the Royal Statistical Society*, 1959. These authors obtain a coefficient of wages on prices of approximately 0·50.

[3] The figures have been changed to make them comparable with the earlier ones. The increase in coverage after the second war has been mainly in groups with very low unemployment percentages. Thus the post-war figures are not comparable with the pre-war ones. Mr. Routh (*loc. cit.*, p. 367) estimates that the figures for U must be raised by a minimum of 12½ per cent. in order to make them comparable with the earlier figures. In the present study the figure has been increased by 20 per cent. The most accurate adjustment probably lies somewhere between these two figures.

TABLE 2

Year	Observed $\dot{W}$	Estimated $\dot{W}$ equation 13	Error	Estimated $\dot{W}$ equation 10	Error
1948 ..	3·73	2·89	0·85	4·28	–0·54
1949 ..	1·82	3·58	–1·76	3·51	–1·69
1950 ..	4·40	5·71	–1·31	4·29	0·11
1951 ..	10·61	9·95	0·66	5·57	5·04
1952 ..	5·28	5·49	–0·21	2·76	2·52
1953 ..	2·90	2·49	0·41	3·37	–0·47
1954 ..	4·88	3·76	1·12	4·53	0·35
1955 ..	6·58	7·32	–0·74	5·92	0·66
1956 ..	7·31	6·87	0·44	4·80	2·51
1957 ..	5·50	5·19	0·31	3·09	2·41
Mean ..	5·30	5·33	0·78[1]	4·21	1·63[1]

equation (13), the large errors occur in the years 1949, 1950 and 1954. 1949–50 were the years of wage restraint, and the large errors shown in Table 2 indicate that over the two years wages rose much less than would have been expected from the experience of the rest of the period 1923–57. These large errors provide a measure of the effectiveness of the wage policy. In 1954, on the other hand, the increase in wage rates was more than 1 per cent. in excess of the value predicted from equation (13). We must conclude, therefore, that, except for 1949 and 1950, there is evidence of a more rapid increase in wages in response to demand and prices in the period since the second world war than in the period prior to the first world war.

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Phillips used his curve relating $\dot{W}$ to U to predict the level of unemployment that would be compatible with stable prices and a 2 per cent annual increase in productivity (a little under 2½ per cent. according to Phillips). There are at least three very serious problems involved here. (i) The estimated value can be shifted a great deal by fitting curves of different types, by including additional variables and by excluding particular years. *Thus, although it might be held with a high degree of confidence that a significant and very interesting relation had been discovered, a very low degree of confidence might be attached at this stage to a particular estimate of the parameters.*[2] (ii) The theory outlined in Section II suggests that the fitted relation may not be a very good guide to the relation between $\dot{W}$ and U if U were to

[1] Ignoring signs.

[2] Mr. Routh in the article already cited has constructed some alternative series to the ones used by Phillips and has done some alternative correlations. He concludes (p. 314): " I have shown that there are other equations, in some ways more valid, that would give different results." To my mind, the remarkable thing is not that Mr. Routh is able to get different results, but that the differences are so slight for all the possible variations that he suggests (see, for example, his Diagram I, p. 311). He also appears to be rather uncritical in assessing the significance of his possible variations. For example, he suggests a possible alternative to the series used by Phillips for 1948–57 and concludes " The points in Professor Phillips' Fig. ii, if row 2 (Routh's series) were substituted for row 1 (Phillips' series), would

remain substantially unchanged for a long time. (iii) A satisfactory theoretical explanation (together with independent tests) would be needed of the high correlation between $\dot{W}$ and $\dot{P}$. Until more is known about the causal links between $\dot{W}$ and $\dot{P}$ it is very dangerous to argue as if either of these variables were independent of the other.[1]

The analysis given in this paper has considerable bearing on the controversy about the causes of inflation. There are a number of points to be noted here. Phillips clearly considered a high correlation between $\dot{W}$ and U as evidence in favour of a demand-pull as against a cost-push hypothesis. This is not the occasion to state these hypotheses in sufficient detail to make them testable. However, the theory outlined in Section II suggests that there are versions of the cost-push hypothesis which are compatible with this relation.[2] The present study does, however, seem to refute the extreme version of the cost-push *spiral* which envisages an unstable situation in which wages and prices chase each other in a non-covergent cycle. This theory predicts a one-one relation between changes in prices and changes in wages, and the present coefficient of 0.69 would, if correct, refute the theory. On the other hand, it must be noted that the considerable increase in the coefficient attached to $\dot{P}$ indicates a very much closer association between changes in prices and changes in wages after the first world war than before it. Only a very much more detailed analysis than that conducted here could attempt to sort out the direction of the causation between $\dot{P}$ and $\dot{W}$. The analysis so far conducted is, however, not inconsistent with the hypothesis that there is a strong feed-back from price changes to wage changes with a great deal *but not all* of the rise in wages being attributed to wages chasing prices.

In my opinion it would be a serious mistake to try to judge between cost-push and demand-pull hypotheses solely, or even mainly, on the basis of the present paper although the material presented here is relevant evidence. The conclusions of this analysis would seem to be much more important for economic theory than for *immediate* policy issues. At this stage the numerical values of any of the parameters is not so important; what is important is the possibility of measuring and testing the type of dynamic relation used here, and of building up a theory that will, as ours already has done, suggest further hypotheses, the testing of which will in turn suggest further improvements in the theory.

The London School of Economics.

no longer ' lie closely along a smooth curve which coincides almost exactly with the curve fitted to the 1861–1913 data ' (p. 306)." This is just not correct. Consider the deviations of the two series from Phillips' curve. The standard deviation of the residuals for Routh's series are 1·6 and for Phillips 1·9, while the mean deviations are 1·4 for Routh and 1·1 for Phillips. We must conclude therefore that there is very little between the two series as far as lying on the curve is concerned.

[1] When policy decisions must be made they have, of course, to be based on the best evidence available at the moment. A premature application to policy can, however, easily discredit a hypothesis that is potentially very fruitful.

[2] See pp. 16 and 17.