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ESTIMATING A WAGE CURVE FOR BRITAIN 1973-1990

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ABSTRACT

Following Phillip's original work on the UK, applied research on unemployment and wages has been dominated by the analysis of highly aggregated time-series data sets. However, it has proved difficult with such methods to uncover statistically reliable models. This paper adopts a different approach. It uses microeconomic data on 175,000 British workers from 1973-1990 to provide evidence for the existence of a negatively sloped relationship linking the *level* of pay to the local rate of unemployment. This 'wage curve' is found to have an elasticity of approximately -0.1. Contrary to the Phillips Curve, no autoregression is found in wages. The paper casts doubt on standard ideas in macroeconomics, regional economics and labour economics.

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Although the question 'How does unemployment affect pay determination?' is one of the most intensively debated issues in economics, there continues to be relatively little agreement about the answer. Following Phillips's (1958) work, research in this field has been dominated by time-series analysis of highly aggregated data sets. However, it has proved difficult with such methods to uncover statistically reliable models. While macroeconomics textbooks contine to use the Phillips Curve as a centrepiece, the quality of the supporting empirical evidence is not high.

The object of this paper is to use microeconomic data on a sample of approximately 175,000 British workers from the 1970s to the 1990s to provide evidence for the existence of a negatively sloped curve linking the level of pay to the rate of local unemployment[1]. This spatial relationship, christened a 'wage curve' by Blanchflower and Oswald (1990), differs from Phillips's relationship. It also differs from the conventional wisdom and large literature stemming from Harris and Todaro (1970) and Hall (1970). That literature asserts that, by a compensating-differentials argument, wages and unemployment must be positively correlated across regions.

Later results touch upon the three fields of macroeconomics, regional economics and labour economics. Although the paper is primarily concerned to document a statistical relationship, the Appendix sets out a theoretical model, as an illustration and one possible interpretation of the data, in which a negative association between wages and unemployment emerges. It is a multi-regional framework extending research that derives theoretical wage-setting curves in aggregate models. This work includes Akerlof and Yellen (1990), Bowles (1985), Carlin and Soskice (1990), Layard and Nickell (1986)[2], Lindbeck (1992), Phelps (1990, 1992), Rowthorn (1977), Shapiro and Stiglitz (1984), and unpublished lectures given by David Soskice at Oxford University in the 1970s. In a recent review article, Woodford (1992) points out that the central and distinguishing theoretical feature of this new family of macroeconomic models is the idea that there exists a negatively sloped curve tying the level of pay to the rate of unemployment. A necessary (though not sufficient) condition for such models to be believable is that there be empirical evidence, preferably of a kind easily replicated by other investigators, for the existence of such a curve.

I. Outline

Later sections estimate weekly earnings equations[3] in which, along with conventional control variables for personal characteristics, local unemployment is included as an independent variable. The unemployment variable enters with a negative coefficient and an elasticity close to -0.1. Hence, according to these data, a doubling of unemployment is associated statistically with a drop of one tenth in wages. One interpretation of this unemployment elasticity of pay is that it provides a measure of the degree of wage responsiveness in the labour market. Section II of the paper describes the main results and discusses a variety of econometric specifications.

There are a number of questions that can be raised about this approach, and the paper tries to address them in turn.

1. Fixed effects A weakness of earlier estimates in, for example, Blanchflower and Oswald (1990) is that, because of the lack of a sufficient longitudinal element, it was not possible there to allow properly for regional fixed effects. This paper's use of a pooled GHS data set makes it possible to include these. The comparatively long time period also provides an opportunity to check whether the British wage curve holds in a convincingly stable way across sub-samples of different years.

2. Labour supply It could be that unemployment is acting as a form of aggregate labour supply variable. On this view, the correct interpretation of the wage curve is as a mis-measured labour supply curve. Such an objection is potentially important because it throws into doubt the main component, and novel feature, of the non-competitive models discussed above. This objection, which would be difficult to test convincingly with aggregate time-series data, is checked in Section III by including a local labour force participation variable instead of the unemployment rate.

3. Harris-Todaro and simultaneity Some commentators have argued that unemployment and pay are determined by the interaction of a negatively sloped wage curve with a positively sloped Harris-Todaro (1970) or Hall (1970) zero-migration condition, and that this creates simultaneity bias. Although that is likely to be true in estimation using a single cross-section, it is less serious when longitudinal data are available. Assuming that migration is costly, and so chosen on the basis of long run views about the desirability of living in different regions, the Harris-Todaro condition requires, as the Appendix shows, that it is permanent unemployment and permanent wages that are positively associated. A regression that includes a set of regional dummies is equivalent to estimating deviations from long run means, and has thus been purged of the effect of a zero-migration equation defined on unchanging regional means. This argument may be less applicable in a country undergoing dramatic spatial restructuring, but Great Britain, with little inter-regional net migration[4], is not of that type.

4. Labour demand A further possible source of simultaneity is through labour demand responses: current regional wages may affect the current unemployment rates in regions. Perhaps because of a perception that this effect is likely to be small (apparently confirmed in US data by the instrumenting in Blanchard and Katz (1992)), the existing literature has largely ignored the potential problem. This paper examines whether instrumenting unemployment with lagged values of itself leaves the results unchanged, which, given the lack of other instruments, is probably the best that can be done. If any simultaneity bias remains, it will tend to make it harder to obtain a negatively sloped wage curve.

5. Hourly wages Most previous work studies annual or weekly earnings rather than wages. The use of weekly earnings, rather than what might be considered a preferable form of hourly wage variable, is also necessitated here by the lack in the GHS of hourly wage data over most of the period. To check whether this is a problem, however, the same framework is estimated over a sub-sample for which an hourly pay series can be calculated, and the findings are compared with those from weekly earnings equations.

6. Group errors Early British estimates of the effect of regional unemployment, in sources such as Blackaby and Manning (1987) and Blanchflower and Oswald (1990), defined unemployment at a highly aggregated level and the dependent wage variable at a microeconomic level. Moulton (1986, 1987, 1990) has pointed out that in such estimation the t-statistics are likely to be biased upwards by common group errors. Section III of the paper corrects for this by estimating regressions on cell means.

The paper uses General Household Survey data to pool a series of individual cross-section samples from 1973 to 1990. This process provides information on a sample of approximately 175,000 employees in Great Britain. The availability of the General Household Survey series means that it is possible to derive for the first time a consistent series of data for Britain through the interesting decades of the 1970s and 1980s. Pooling raises a number of issues about consistency over the period. There were changes in the design of the survey over time, in the wording and coding of many of the relevant questions, and in both the occupational and industry classifications. A detailed summary of the merging of the data is provided in a separate technical appendix that is available from the authors. It is not possible to obtain a consistent series on hours in all of the years of data, but that can be done for a sub-sample.

For the years 1973-1977, respondents were asked to report both their earnings over the preceding twelve months and the number of weeks worked. In each survey after 1977 the following questions were asked of employees:

a) On what date were you last paid a wage or a salary?

b) How long a period did your last wage/salary cover?

c) What was your gross pay last time before any deductions were made?

These questions were used to construct the dependent variable: log weekly earnings. To control for a change in the nature of the earnings question in 1978 and onwards, a series of eleven interaction terms were included in the regressions. These were interacted with each of the regional dummy variables with a dummy variable set to one if the data were taken from a survey prior to 1978 and to zero otherwise.

For the years 1973-1986, the GHS was conducted in every month of the calendar year. Since 1987 the survey has been conducted during the financial year April to March: hence the 1987 and subsequent surveys contain nine monthly interviews in 1987 and three in 1988. Consequently, the later regressions include both month and year-of-interview dummies, as well as controls for gender, race, years of schooling, experience and its square, marital status, part-time, highest qualifications, and industry (for work on inequality using the same data, see Katz, Loveman and Blanchflower, 1992). The total sample is approximately one third of a million, which provides 175,946 employees with wage data. This means that, on average, there are approximately 10,000 observations per year. However, as can be seen below, sample sizes were reduced from 1982 onwards.

Year	*Sample Size*	*Employees with wage data*
1973	21516	12255
1974	19884	11434
1975	21887	12644
1976	21653	12061
1977	21319	12023
1978	21165	11802
1979	20417	11451
1980	21087	11597
1981	21641	11145
1982	18339	9137
1983	17760	8451
1984	16947	7966
1985	17386	8449
1986	17704	8763
1987	18087	9085
1988	13058	6524
1989	17195	8946
1990	4356	2213
Total	331401	175946

The small sample size in 1990 is due to the fact that 1990 information is available only for the months January to March of 1990.

The model described in the Appendix implies that movements in local unemployment should produce movements in the opposite direction in local wages, that is, that a negatively sloped wage curve should exist. The remainder of the section examines this empirically and summarizes wage curves estimated over the period 1973-1990.

II. Wage Equations

In the initial regressions, the dependent variable is the log of weekly earnings[5]. Unemployment rates were mapped in at the level of the standard region for the year of the interview, to give observations on 11 regions by 18 years. Table 1 reports the first results from estimating a log earnings equation for the periods 1973-1980, 1981-1990, and for the entire period 1973-1990. In each case, Table 1's results are provided with and without controls for regional fixed effects. Little evidence could be found for any effect from a long-term unemployment variable or for highly non-linear unemployment terms, so these are omitted. Year dummies and personal controls are always included.

The main finding in Table 1 is that there is a well-defined unemployment effect. In the key columns 2, 4 and 6, where regional dummies are in each case incorporated, the unemployment elasticity of pay estimated using these data is fractionally below -0.1. It is approximately the same in the two sub-periods (-0.09 and -0.07 respectively), and -0.08 overall. Therefore, there appears to be a wage curve, and it is stable across these periods. The addition of the region dummies turns out to reduce the absolute size of the coefficient on the log of the unemployment rate, but to make comparatively little difference to the findings.

These data provide an opportunity to examine for the first time the relative responsiveness of different groups' wages -- controlling for fixed effects -- to regional unemployment. The unemployment rate used for the regressions is that for all workers (not just that for the particular group of workers). Table 2 gives disaggregated wage curve estimates after controlling for region-specific fixed effects. The pay of blacks is dramatically sensitive to local unemployment: the unemployment elasticity in this case is approximately -0.22. The pay levels of construction workers, the young, and the least experienced also seem to be more flexible (than the average) to changes in the unemployment rate. These findings mean that secularly rising unemployment in an economy will tend to raise inequality by depressing most intensely the wages of some of the most vulnerable groups.

For brevity, the coefficients on the other control variables in Table 2 are not given. However, because these pooled GHS regression results are not available elsewhere, Tables 3 and 4 report a limited selection of coefficients. Table 3 provides estimates for males, females and blacks. For example, consistent with Greenhalgh (1980), being married means higher male earnings but lower female earnings. The rate of return to an additional year of schooling is higher for men than it is for women, whereas the return to a college qualification (e.g. degree, HND or a teaching diploma) is higher for women. Black men appear to earn nearly 15% less, ceteris paribus, than white men; black females do not appear to earn less than white females, ceteris paribus. Male experience-earnings profiles are steeper than for females. Both male and female earnings reach their maximum after approximately 30 years of experience. Apprenticeships appear to convey substantial benefits to men but none for women, which is consistent with findings in Blanchflower and Lynch (1994).

The estimates in Tables 1-3 impose the assumption that unemployment enters in a log-linear way. To examine the association between unemployment and wages without making assumptions about functional form, Table 4 reports the results of estimating an unrestricted specification. The distribution of unemployment rates is split into 5% segments of approximately equal size (in terms of numbers of individuals in each cell). This allows the inclusion of 19 separate dummy variables -- one for each twentieth part of the unemployment axis -- and thus produces a non-parametric way of incorporating an unemployment variable. Once again the standard control variables discussed above are included, along with a set of region dummies.

Again consistent with the existence of a wage curve, eighteen of the nineteen dummies are significant, and all lie approximately on a negatively sloped line. As the unemployment rate rises, the drop in the size of the coefficient tends to fall. In Figure 1a the antilogs of the coefficients are plotted against the mid-point of the range of unemployment rates given in Table 3. There is strong evidence of a downward slope and a little of convexity. Figure 1b reveals that a second-order polynomial of the following form seems to fit the data reasonably well (R^2=.979). The exact functional form, which minimizes at an unemployment rate equal to 20%, is: $w = 1.0263 - .02344U + .00059U^2$

III. Checks and Experiments

The previous literature has ignored the econometric aggregation problems pointed out by Moulton (1986), which will lead to an inflated estimate of the significance of any aggregated variable such as local unemployment. One way to correct for this is to ensure that the levels of aggregation are the same on each side of the wage equation. Table 5 thus makes use of data for each year aggregated into cell means (for all variables) across the eleven standard regions of Britain. This gives a total of 198 cells (18 years by 11 regions). Data on the 175,000 individuals were used to create region/year averages for, for example, each of the personal characteristics. A form of panel, for these regions, was thereby created.

Column 1 of the Table includes the log of the current year unemployment rate without any controls for region fixed effects; it has a coefficient of -0.04. The addition of the region dummies in column 2 then produces, once again, a well-defined wage curve (with a coefficient of -0.1 and a t-statistic of 3.7). This seems to support the idea that, perhaps for Harris-Todaro reasons, omission of region-specific fixed effects leads to downward bias of the unemployment elasticity of pay. The principal conclusion, however, is that estimating regressions on cell-means leaves unchanged the earlier estimates of the unemployment elasticity.

Table 5's estimation on cell means means that wage dynamics can also be studied. This might be thought of as a microeconometric descendant of Sargan's work (1964), who may have been the first to consider the Phillips Curve as an adjustment mechanism around a long run relationship between the level of pay and the level of unemployment. However, the results are probably not what most macroeconomists would expect. No support statistically can be found, with a full set of region dummies incorporated (columns 4-6 of Table 5), for the inclusion of a lagged dependent variable or a lag on the unemployment rate. The coefficient on the log of last period's wage is approximately 0.07 with a t-statistic of unity. This contrasts with most time-series estimation, and with a regression using pooled cross-sections that is reported on page 314 of Layard, Nickell and Jackman (1991) in which, without any control variables, the lagged dependent variable in a British wage equation has a coefficient of 0.4.

Despite the prominence given to the Phillips Curve in macroeconomics texbooks, the traditional autoregression of wage levels that has been found in many decades of empirical studies may be due to the omission of variables and to aggregation error, rather than be a true reflection of the nature of wage determination. A well-known problem with time-series modelling is that aggregate variables routinely look close to random walks. Macroeconomic wage equations could be spuriously generating a lagged dependent variable with a coefficient close to unity, and thereby producing a correlation that would have the appearance of a wage change specification. Inflation would then intrude by mistake into an analysis of the determinants of the level of pay. Perhaps this is what lies at the heart of Phillips (1958).

Although the inclusion here of year and regional dummies capture a multitude of unknown forces, and the modelling should be thought of as in deviations from means, the results in the paper are consistent with the view that within regions there is nothing that could usefully be thought of as a Phillips relationship. In the far right columns of Table 5, the coefficient on the lagged dependent variable is zero. This raises the possibility that the Phillips Curve is an error of interpretation that would not have arisen if previous researchers had been able to use micro data[6].

Is the correlation between pay and unemployment in the paper's Tables merely a misspecified kind of conventional neoclassical supply curve? This is a likely reaction from someone who views the labour market as usefully described by the competitive model. As a check, Table 6 experiments with specifications that include the participation (or 'activity') rate. These use the GHS data files to generate aggregate participation rates, across the regions, for individuals in the age range 16-70. Table 6's results are not favourable to the idea that the wage curve is simply a poorly identified labour supply function. The participation rate, whether measured as a level or as a log, is always insignificantly different from zero, and has the wrong sign. The local unemployment variable dominates it. Experimentation confirmed this conclusion and so casts doubt on the view that the wage curve is merely a mis-measured supply curve. It is then not easy to see how the wage curve's existence could be explained by competitive theory.

The estimate of an unemployment elasticity of pay of close to -0.10, obtained in Table 5 in the presence of a full set of area-specific fixed effects, is similar to the aggregate time-series estimates for Great Britain of Layard and Nickell (1986), the micro-based estimates of Blackaby and Manning (1987, 1990) and Blackaby, Bladen-Hovell and Symons (1990), and the regional-level estimates of Jackman, Layard and Savouri (1991). The estimates are consistent with the idea suggested some years ago that the unemployment elasticity of real wages in Britain is close to -0.1 (Oswald 1986, p. 190).

An objection to the findings is that most models, including that in the Appendix, focus upon the wage and not earnings. Table 7 re-estimates on a sub-sample from 1973-1977 in order to test the implications of switching to hourly earnings as the dependent variable. It limits the analysis to a data file consisting of slightly over 60,000 individuals who were employees at the date of interview and who reported their gross weekly earnings, including wages, salary, tips, bonus, and commission, for the preceding twelve months. Interviews were spread across the twelve months of the year, so all equations include 11 month dummies and 4 year dummies, in addition to a vector of industry, occupation, region and qualification dummies and a set of personal controls. Unemployment rates were again mapped in at the level of the standard region for the year of the interview.

Table 7 reports the results of estimating a weekly earnings equation using this 1973-1977 sub-sample. In column 1, the log of the unemployment rate has a coefficient of -0.07 with a t-statistic of over 10. The addition of a full set of regional dummies in column 2 changes the size of the coefficient only slightly to -0.09: the coefficient remains significant with a t-statistic of just under 5. The data did not support the inclusion of higher order unemployment terms, such as the cube of the logarithm. There is little to choose statistically between the log or the level of unemployment. For ease of exposition, and following Layard and Nickell (1986) and Nickell (1987) on aggregate data, only the results with the log of the unemployment rate are given.

In columns 3 and 4 of Table 7, the dependent variable is re-defined as hourly earnings, that is, as total earnings in the previous year divided by (usual weeks * usual weekly hours). It is noteworthy that the estimated unemployment elasticities of pay are similar in the two halves of the Table. For example, in columns 2 and 4 of Table 7, the estimated unemployment elasticity of pay is approximately -0.09. Therefore, switching to an hourly wage variable apparently makes no difference to the conclusions of the paper.

Finally, columns 1-4 of Table 5 were re-estimated instrumenting the unemployment variable by various combinations of itself lagged (results not reported). The unemployment elasticity of pay continued, across a range of specifications, to be just below -0.1. The use of simple lagged unemployment variables is less than ideal, but data on exogenous regional demand variables are not available. The outcome here is consistent with the general finding reported in Blanchflower and Oswald (1994b) -- drawing upon US data -- that instrumenting the unemployment rate does not materially affect these kinds of econometric results. Another indication is that the unemployment elasticity of pay is apparently close to -0.1 regardless of which data set or sample period is studied.

IV. Conclusions

This paper uses pooled data on approximately 175,000 workers from the General Household Surveys of 1973-1990 to explore the effect of unemployment upon pay. It argues that there exists a negatively sloped 'wage curve' in Great Britain. The paper is apparently the first to show that, after controlling for workers' personal characteristics and regional fixed effects, there is an inverse relationship between the level of Britons' pay and the local unemployment rate. The estimated unemployment elasticity of wages[7] is approximately -0.1, so that a doubling of local unemployment is associated with a fall of one tenth in the level of workers' remuneration. No autoregression in wages is found. In other words, the lagged dependent variable in a wage-level equation is zero. This raises the possibility that the use of macroeconomic data has set a large earlier literature off on the wrong path.

The paper's results seem to shed doubt on textbook ideas in macroeconomics, regional economics and labour economics. They are not easily reconciled with the Phillips Curve, nor with the literature built around Harris and Todaro (1970), nor with the competitive model of the labour market. One interpretation of the paper is that it provides microeconometric evidence for the wage-setting relationship that is the central theoretical assumption of papers such as Shapiro and Stiglitz (1984), Layard and Nickell (1986), and Phelps (1990). These papers are important because they argue that the traditional neoclassical demand-and-supply framework is fundamentally the wrong way to think about the labour market. It is likely that the future will produce other, and perhaps better, explanations for the wage curve.

The empirical findings seem to be robust to changes in the sample and the exact procedures used. Estimation over the sub-sample period 1973-1980, for example, yields a wage curve with an elasticity of -0.07. Over the historically rather different sub-sample of 1981-1990, a similar elasticity, -0.09, is found. Thus it is possible to discard a decade of data, re-estimate on the eighty thousand observations that remain, and obtain the key finding almost unchanged. Such constancy is unusual in econometric work. The empirical results also appear to be robust to alterations in the nature of the dependent variable, to a switch to cell means in response to Moulton's (1986) critique, to the instrumenting of the unemployment variable (though this can be done only in a crude way), to the inclusion of a labour force participation variable, and to disaggregation into categories such as race, skill and gender.

Endnotes

1. The form of this 'wage curve' is consistent with newly emerging estimates from other nations' data sets. The role of local unemployment is studied in, for example, Blanchflower and Oswald (1990, 1994b), Christofides and Oswald (1992), Edin et al (1994), Freeman (1990), Groot et al (1992), Holmlund and Zetterberg (1991) using industry data, Katz and Krueger (1991a, 1991b), and Montgomery (1993). Topel (1986) does not examine the effect of the local unemployment rate upon pay, but does study the impact of individual unemployment risk and of regional employment growth.

2. The only one of these to provide empirical evidence to back up their theoretical analysis is the paper by Layard and Nickell (1986).

3. Early work, on smaller British data sets, is reported in Blackaby and Manning (1987, 1990), Blanchflower (1991), Blanchflower et al (1990), and Blanchflower and Oswald (1990). These rely almost exclusively on single cross-sections and are unable, therefore, to control fully for fixed effects.

4. By way of example, UK Regional Trends shows that in 1989 among those aged 15-44 only 4000 net people moved from or to the South-East. The total population of the South-East is more than 17 million.

5. It might be argued that regional price deflators should be used to create real wages. The paper uses nominal wage data, and includes both regional fixed effects and year dummies to control for price levels, which should obviate most of the problem. Blanchflower et al (1990) finds a wage curve with an elasticity of -0.1 in a single cross-section with aggregated regional dummies, so the phenomenon itself is probably not due to omitted regional price levels. Moreover, if local prices (and house prices) are a multiple of wages, they can be substitued out of a wage equation to leave the form used here. Finally, Blackaby and Manning (1990) show in other data that an unemployment term is robust to the inclusion of house prices, and, consistent with the view that the unemployment effect is not the result of omitted regional price effects, Blanchflower and Oswald (1994b) report an industry wage curve with an unemployment elasticity of approximately -0.1.

6. A defence of Phillips Curve methodology has been provided recently by Manning (1993). He argues, among other things, that wage-level equations are not identified (because they might be inverted labour demand curves), and that in a microeconometric version of such wage equations the lagged dependent variable need not be unity (because its coefficient and that on an aggregate alternative wage should sum to unity). One defence, though open to objections, is that if unemployment is in a econometric sense pre-determined, the former will not in practice be a problem. On Manning's second point, the inclusion of year dummies in Tables 5 and 6 will presumably pick up the influence of the alternative wage, and it is not clear how he would react to our finding that the lagged dependent variable is literally zero.

7. This is close to the estimates recently documented for nine other countries in Blanchflower and Oswald (1994b). With one exception, however, the quality of the data sets, which are cross-sections with few years, is considerably lower than that available here. The exception is the pooled CPSs for the USA, which give virtually identical results (an unemployment elasticity of pay of approximately -0.09) to those derived in this paper. This similarity between the US and Great Britain raises interesting issues for future research.

Figure 1a. Unrestricted British Wage Curve: 1973-1990 (5% Sample)

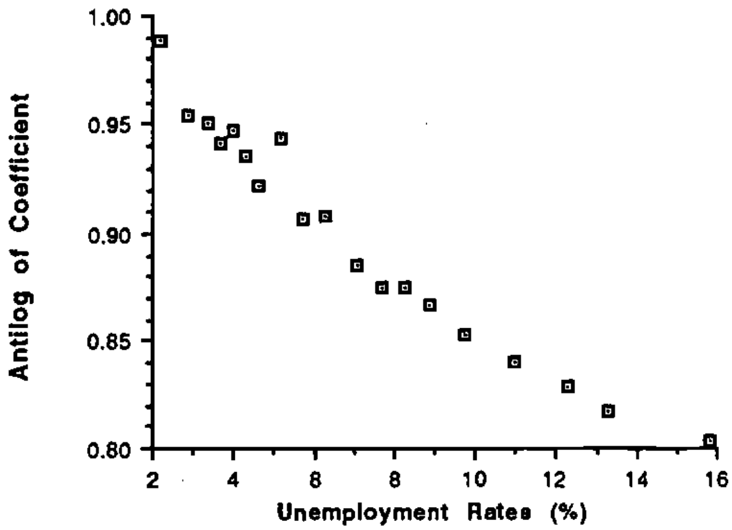


Figure 1b. Unrestricted British Wage Curve: 1973-1990 (5% Sample)

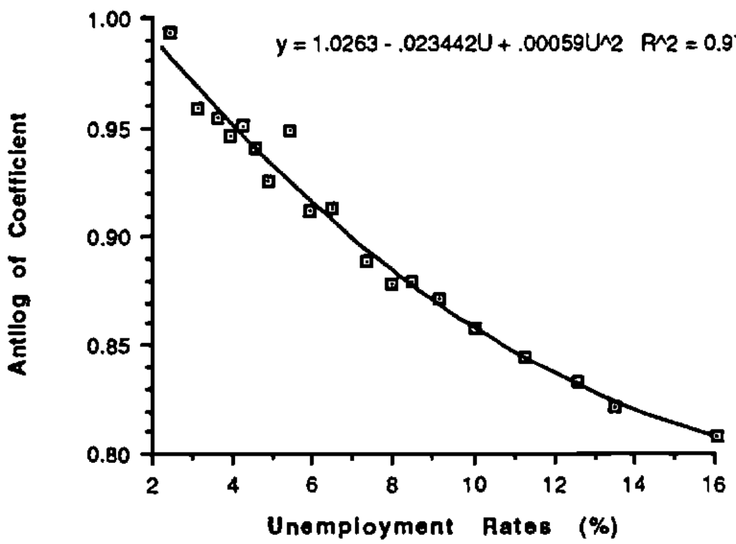


Table 1. Wage Curves for Great Britain 1973-1990

	(1)	(2)	(3)	(4)	(5)	(6)
	1973-1980		**1981-1990**		**1973-1990**	
U_t	-.0896 (18.05)	-.0697 (4.41)	-.1619 (22.91)	-.0927 (2.79)	-.1283 (24.64)	-.0822 (6.23)
Regional dummies	No	Yes	No	Yes	No	Yes
Constant	1.9049 (84.72)	2.8946 (90.46)	3.4217 (104.70)	3.3408 (51.19)	2.7832 (141.24)	2.7543 (91.86)
$\bar{R}^2$	.7029	.7076	.6654	.6720	.7633	.7665
DF	96352	96332	79108	79098	175495	175485
F	4387.04	3240.78	2916.73	2534.60	7862.87	7028.98
N	96405	96405	79163	79163	175568	175568

Source: General Household Survey Series.

Notes: Unless stated otherwise the following control variables were included: 1) 9 industry dummies 2) 4 marital status dummies 3) 15 highest qualification dummies 4) 17 year dummies 5) gender dummy 6) experience and its square 7) part-time dummy 8) 11 month of interview dummies 9) race dummy 10) 11 region dummies interacted with dummy for years up to 1977.

The dependent variable is the natural log of gross weekly earnings. U_t is the natural log of the regional unemployment rate. Unemployment is available for 11 regions by 18 years.

t-statistics in parentheses.

Table 2. Unemployment Elasticities from Disaggregated Wage Curves

	Coefficient	t-statistic	N
All workers	-.0822	6.23	175568
Male	-.0935	6.41	96260
Female	-.0742	3.28	79308
Black	-.2291	3.09	5304
White	-.0809	6.00	170265
Part-time	-.0462	1.06	34945
Full-time	-.0888	7.17	140623
Agriculture	-.0713	0.63	3106
Energy and water	.0097	0.14	4220
Extraction	-.0709	1.45	7899
Metal goods, engineering etc.	-.0554	2.10	24489
Other manufacturing	-.1073	3.21	21494
Construction	-.1497	3.59	10696
Distribution	-.0206	0.55	26295
Transport & communication	.0000	0.00	11399
Banking, finance, insurance	-.1277	2.27	11899
Other services	-.0918	3.32	54074
Manufacturing	-.0863	4.51	53881
Services	-.0728	3.82	103665
Age < 25 yrs.	-.1329	5.09	34115
Age ≥ 25 but < 50 yrs.	-.0677	3.78	97629
Age ≥ 50 yrs.	-.0698	2.68	43815
Experience < 10 yrs.	-.1164	4.86	42927
Experience 10-29 years	-.0564	2.66	73557
Experience ≥ 30 yrs.	-.0764	3.51	59084
No qualifications	-.0651	3.53	79070
O-Levels etc.	-.1155	4.93	57902
A-Levels	.0003	0.01	12998
College	-.0531	1.33	25598

Source: General Household Survey Series: Pooled 1973-1989.

The dependent variable is the log of weekly earnings. The same controls were used as reported in Table 1, including 10 region dummies.

Table 3. British Earnings Equations: Pooled GHS 1973-1990

	Males	Females	Blacks
Log regional unemployment	-.0935 (6.4)	-.0742 (3.3)	-.2290 (3.1)
Higher degree	.6396 (50.7)	.8940 (25.5)	.5806 (10.1)
1st degree, univ.diploma	.5380 (86.9)	.7943 (61.7)	.6227 (19.9)
Teaching qualification	.5510 (42.0)	.9305 (71.8)	.8771 (11.3)
HNC, HND,Tech. certificate	.3353 (61.5)	.5142 (28.8)	.3032 (8.9)
Nursing qualification	.2068 (9.0)	.5246 (45.8)	.4115 (13.2)
GCE 'A'level, ONC, OND.	.2284 (45.6)	.3116 (28.3)	.2547 (9.9)
GCE 'O'levels-5 or more	.1804 (38.1)	.2104 (25.1)	.1753 (7.0)
GCE 'O'1-4,with clerical quals	.1739 (5.9)	.1945 (18.4)	.3273 (6.7)
GCE 'O'1-4, no clerical quals.	.1053 (18.0)	.1259 (13.9)	.1021 (3.5)
Clerical & commercial quals.	.1178 (6.3)	.1291 (16.6)	.1327 (3.6)
CSE	.0326 (4.1)	.0764 (6.0)	.0940 (3.0)
Apprenticeship	.0695 (14.5)	.0023 (0.1)	.1237 (2.2)
Any foreign qualifications	.1757 (13.7)	.1760 (8.3)	.1298 (6.4)
Other qualifications	.1127 (13.6)	.0967 (6.6)	.1358 (2.8)
Years of schooling	.0396 (29.1)	.0292 (12.1)	.0067 (2.3)
Black	-.1452 (19.5)	-.0186 (1.5)	-
Married	.1959 (49.1)	-.0687 (10.7)	.1186 (6.7)
Separated	.1181 (10.1)	-.0815 (5.8)	.1173 (2.8)
Divorced	.0949 (8.8)	-.0793 (6.4)	.0333 (0.8)
Widowed	-.0213 (3.2)	-.0561 (6.3)	-.0245 (0.9)
Part-time	-.8322 (103.8)	-.9358 (209.0)	-.8580 (40.8)
Male	-	-	.3407 (24.7)
Experience	.0489 (122.0)	.0336 (54.5)	.0324 (17.3)
Experience^2 * 10^3	-.8507 (115.3)	-.5825 (48.8)	-.5862 (15.0)
$\bar{R}^2$	.7589	.6953	.7435
N	96260	79308	5304

All equations include 11 month dummies, 10 region dummies, seventeen year dummies, 9 industry dummies, 11 pre-1978*region interactions, and a constant.

t-statistics in parentheses.

The dependent variable is the log of weekly earnings.

Table 4. 5% Disaggregations 1973-1990

1.9% - 2.5%	-.0120 (1.38)	7.5% - 7.9%	-.1344 (5.90)
2.7% - 3.0%	-.0469 (4.08)	8.0% - 8.5%	-.1336 (5.40)
3.3% - 3.4%	-.0511 (3.99)	8.6% - 9.2%	-.1428 (5.69)
3.5% - 3.8%	-.0598 (4.50)	9.3% - 10.2%	-.1585 (5.95)
3.9% - 4.1%	-.0547 (3.66)	10.3% - 11.7%	-.1744 (6.10)
4.2% - 4.4%	-.0664 (4.16)	11.8% - 12.8%	-.1877 (6.14)
4.5% - 4.7%	-.0816 (5.08)	13.0% - 13.5%	-.2015 (6.24)
4.9% - 5.4%	-.0575 (3.21)	≥ 13.6%	-.2185 (6.33)
5.6% - 5.8%	-.0977 (4.90)	$\overline{R}^2$	.7665
		DF	175467
5.9% - 6.6%	-.0965 (4.61)	F	5765.26
		N	175568
6.8% - 7.4%	-.1224 (5.73)		

Source: General Household Survey Series

The dependent variable is the log of weekly earnings.
The Table corresponds to the points on Figure 1.

Table 5. The British Wage Curve Using Cell Means: 1973-1990

	(1)	(2)	(3)	(4)	(5)	(6)
U_t	-.0385	-.1015	-.0192	-.0819	-.1215	-
	(1.61)	(3.65)	(0.77)	(2.54)	(2.44)	
U_{t-1}	-	-	-	-	+.0487	-.0380
					(1.04)	(1.23)
w_{t-1}	-	-	.2382	.0615	.0707	.0745
			(3.45)	(0.89)	(1.01)	(1.04)
Regional dummies	No	Yes	No	Yes	Yes	Yes
Constant	6.2407	5.8528	5.1973	5.6442	5.6326	5.4350
	(7.03)	(6.59)	(5.26)	(5.58)	(5.57)	(5.27)
$\bar{R}^2$	.9972	.9980	.9969	.9976	.9976	.9975
F	989.69	1234.08	839.76	946.40	935.66	904.55
DF	126	116	115	105	104	105
N	198	198	187	187	187	187

Source: General Household Survey Series.

Notes: The following control variables were included, all of which were cell means: 1) 9 industry variables 2) 4 marital status variables 3) 15 qualification variables 4) 17 year dummies 5) gender 6) experience and its square 7) part-time 8) 11 month of interview variables 9) race variable 10) 11 region dummies interacted with dummy for years up to 1977.

The dependent variable, w_t, is the natural log of gross earnings in the relevant year/region cell. U_t is the natural log of the regional unemployment rate.

t-statistics in parentheses.

Table 6. Further Results Using Cell Means: 1973-1990

	(1)	(2)	(3)	(4)	(5)	(6)
U_t	-	-	-	-	-.0824	-.1209
					(2.54)	(2.42)
U_{t-1}	-	-	-	-	-	+.0475
						(1.01)
P_t	-.2117	-.2013	-.1349	-.0707	-.0900	-.0746
	(1.02)	(1.01)	(0.65)	(0.34)	(0.44)	(0.36)
w_{t-1}	-	-	.2474	.0957	.0635	.0721
			(3.56)	(1.36)	(1.91)	(1.02)
Regional dummies	No	Yes	No	Yes	Yes	Yes
Constant	6.5628	6.0869	5.4261	5.6576	6.0135	5.9756
	(6.97)	(6.13)	(5.36)	(5.14)	(5.55)	(5.52)
$\bar{R}^2$	.9972	.9978	.9969	.9974	.9976	.9976
F	977.59	1116.36	838.47	892.65	927.66	916.67
DF	126	116	115	105	104	105
N	198	198	187	187	187	187

Source: General Household Survey Series.

Notes: The following control variables were included, all of which were cell means: 1) 9 industry variables 2) 4 marital status variables 3) 15 qualification variables 4) 17 year dummies 5) gender 6) experience and its square 7) part-time 8) 11 month of interview variables 9) race variable 10) 11 region dummies interacted with dummy for years up to 1977.

The dependent variable, w_t, is the natural log of gross earnings in the relevant year/region cell. U_t is the natural log of the regional unemployment rate. P_t is the natural log of the labour force participation rate.

t-statistics in parentheses.

Table 7. The British Wage Curve: Sub-sample 1973-1977

	(1)	(2)	(3)	(4)
	Weekly Earnings		Hourly Earnings	
U_t	-.0704 (10.47)	-.0895 (4.83)	-.0796 (12.72)	-.0876 (5.08)
Regional dummies	No	Yes	No	Yes
Constant	2.8902 (74.01)	2.9221 (63.04)	-.7634 (20.79)	-.7430 (17.10)
$\overline{R}^2$	.5984	.6011	.4345	.4382
DF	60486	60476	60186	60176
F	1158.21	1038.12	594.73	535.12

Source: General Household Survey Series.

In all cases there are 60,565 observations. Unless stated otherwise the following control variables were included: 1) 24 industry dummies 2) 11 regional dummies 3) 5 marital status dummies 4) 17 qualification dummies 5) 18 occupation dummies 6) 4 year dummies 7) gender dummy 8) experience and its square 9) part-time dummy.

U_t is the log of the regional unemployment rate.

t-statistics in parentheses.

Appendix

The paper is concerned with the statistical fact that a downward sloping wage curve is observed in the General Household Surveys. The purpose of this Appendix is, as an illustration, to discuss briefly one model (developed more fully in Blanchflower and Oswald (1994a)) that makes the correct prediction about the correlation found in the data.

An intuitive but misleading objection to the empirical results is that the wage-unemployment correlation should -- by an argument based on compensating differentials -- be positive rather than negative. This is the criticism that we encountered most frequently in seminar presentations in the US. A milder version of such a view is that, at best, the estimated wage curves are likely to be a mixture of downward- and upward-sloping functions, so that there is an unresolved simultaneity problem. According to this point of view, the estimates conflate the positive Harris-Todaro gradient and the negative gradient of a new-style macroeconomic model such as efficiency wage theory.

This Appendix sets out a model in which a downward sloping wage curve is derived from optimizing behaviour. The reason for the negative gradient is that unemployment frightens workers and, in consequence, firms find that in recessions it is feasible to pay their employees less well. The model is constructed in a way in which, contrary to Harris and Todaro (1970), wages and unemployment are inversely related.

The theoretical framework allows workers to migrate across regions, but assumes that it is costly to do so. Hence unemployed individuals do not immediately attempt to migrate: they migrate only if one region offers a better expected utility than another. This realistic assumption of costly, rational, far-sighted migration decisions is important. It effectively de-couples current pay and current unemployment, and so by-passes the positive gradient of the Harris-Todaro relationship. A high wage in the current period need not be accompanied by high unemployment; pay and unemployment are positively related only, put loosely, in expected or permanent terms. One version of the model goes further: it shows that regions that differ only in non-pecuniary attractions may have the same wage curve and nothing that corresponds to a visible positive wage-unemployment relationship. This is possible, for example, if one region is inherently attractive and, to ensure consistency with a zero-migration equilibrium, therefore offers both low pay and high unemployment. The other region pays well and has low unemployment, and is inherently unattractive. The result is a negatively-inclined wage function even in long-run equilibrium.

Consider an economy consisting of just two regions (this is inessential). The following assumptions are made about region 1, and, with small modifications, about region 2.

A.1 Assume that workers are risk-neutral, and get utility from income and disutility from effort. Define the wage as w and the level of on-the-job effort as e. Assume that utility equals the difference between income and effort, so that (pecuniary) utility is

$$u = w - e.$$

A.2 Assume that effort at work, e, is a fixed number determined by technology, but that individual employees can decide to 'shirk' and exert zero effort. If undetected by the firm, these individuals earn wage w and have $e = 0$, so that $u = w$. They are then better off than employees who provide effort.

A.3 An individual who shirks runs the risk of being detected. Designate as δ the probability of successfully shirking, that is, of escaping detection. Assume that anyone caught shirking is fired, and has then to find work elsewhere (at required effort e). Let the expected utility of a fired worker be $\overline{w}$. Define it

$$\overline{w} = (w - e)\,\alpha(U) + b\,[1 - \alpha(U)].$$

This is a convex combination of w - e, the utility from working at the required effort level, and of b, which is defined as the income value of unemployment benefit plus leisure. The function $\alpha(U)$ measures the probability of finding work, and how that is affected by the level of unemployment, U, prevailing in the local labour market.

A.4 Assume that there is a constant rate of break-up, r, of firms. In steady-state equilibrium, total new hires in the local economy are $\alpha\ [1 - n]$, where l is population and n is employment, and

$$rn = \alpha [l - n].$$

Unemployment is $U \equiv 1 - n/l$, so

$$r = \frac{r}{U} - \alpha.$$

This defines a function $\alpha\,(U)$ with derivatives:

$$\alpha\,'(U) = -\frac{r}{U^2} < 0$$
$$\alpha\,''(U) = \frac{2r}{U^3} > 0.$$

Thus the probability of finding a job, α, is a convex function of unemployment, U.

A.5 Equivalent conditions hold in the second region. The wage there is ω and the level of unemployment benefit is β. The unemployment rate in the second region is μ.

A.6 The second region differs from the first in that both workers and non-workers enjoy a non-pecuniary benefit, ϕ, from living in the region. Their utility is thus $u = \omega - e + \phi$ when working, and $u = \beta + \phi$ when unemployed.

A.7 Each region is affected by shocks to the demand for labour. The shock variable is denoted s in region 1, with a density function g(s). The shock variable in region 2 is σ, with density of $h(\sigma)$.

A.8 Workers are free, between periods, to choose to live in whichever region they prefer. They cannot migrate during a period.

The assumptions given above describe a form of efficiency-wage model. The model's key characteristic is that employers must pay a wage that is sufficently high to induce employees not to shirk. In equilibrium, workers must be behaving optimally in their effort decisions, and firms must be behaving optimally in their wage-setting. Regions differ in their non-pecuniary attractions: one of the two is a nicer place to live than the other. Excluding degenerate equilibria, however, each region must offer workers the same level of expected utility. This condition defines a zero-migration equilibrium.

A number of results can be proved. Only one is reproduced here.

Proposition 1.

Each region has a downward sloping convex wage curve. If both regions have the same level of unemployment benefit (so $b = \beta$), they have a common wage curve given by the equation:

$$w = e + b + \frac{e\delta}{(1 - \delta)[1 - \alpha(U)]}.$$

Proof of Proposition 1.

For a no-shirking equilibrium, the expected utility from not shirking must equal that from shirking. Thus in region 1

$$\mathrm{w} - \mathrm{e} = \delta \mathrm{w} + (1 - \delta)\{(\mathrm{w} - \mathrm{e})\,\alpha(\mathrm{U}) + \mathrm{b}[1 - \alpha(\mathrm{U})]\}, \qquad (1)$$

which simplifies, after manipulation, to

$$\mathrm{w} = \mathrm{e} + \mathrm{b} + \frac{\mathrm{e}\delta}{(1 - \delta)[1 - \alpha(\mathrm{U})]}. \qquad (2)$$

In region 2, in which individuals receive a utility supplement ϕ, the no-shirking condition is

$$\omega - \mathrm{e} + \phi = \delta(\omega + \phi) + (1 - \delta)\{(\omega - \mathrm{e} + \phi)\alpha(\mathrm{U}) + (\beta + \phi)[1 - \alpha(\mathrm{U})]\}. \qquad (3)$$

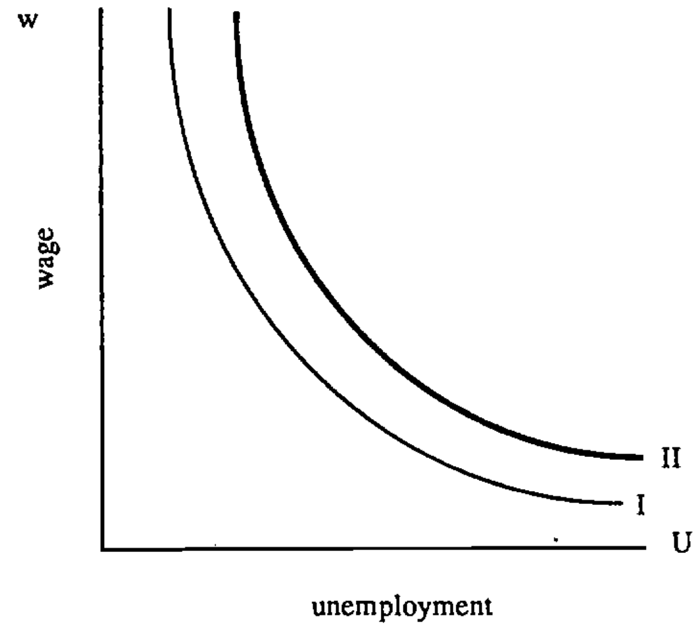
The ϕ terms cancel from both sides, leaving a wage equation

$$\omega = \mathrm{e} + \beta + \frac{\mathrm{e}\delta}{(1 - \delta)[1 - \alpha(\mathrm{U})]}. \qquad (4)$$

If $\mathrm{b} = \beta$, equation (2) is identical to equation (4), and the two regions have the same wage equation. The convexity of this wage curve follows from the convexity of the $\alpha(\mathrm{U})$ function and can be checked by differentiation. A region with a higher level of unemployment benefit will have a (vertically) higher curve, as in Figure A.1.

Within this framework, contemporaneous wages and unemployment are negatively related by a no-shirking condition. Simultaneously an *integral* over wages and an *integral* over unemployment will -- in the spirit (but against the letter) of Harris and Todaro (1970) -- be positively related. This is why the empirical finding of a wage curve need not be inconsistent with the idea of compensating differentials across regions. A more formal treatment is provided in Blanchflower and Oswald (1994a).

Figure A1



Two wage curves

(Region II here has a higher level of unemployment benefit than Region I)

References

Akerlof, G. A. and Yellen, J. L. (1990), 'The Fair Wage-Effort Hypothesis and Unemployment', Quarterly Journal of Economics, 105, 255-284.

Blackaby, D. H., and Manning, D.N. (1987), 'Regional Earnings Revisited', Manchester School, 55, 158-183.

Blackaby, D. H., and Manning, D.N. (1990), 'The North-South Divide: Questions of Existence and Stability', Economic Journal, 100, 510-527.

Blackaby, D. H., Bladen-Hovell, R. C. and Symons, E. J. (1991), 'Regional Prices, Unemployment and Unemployment Duration Effects on Wage Determination in the UK. Evidence from the FES, 1980-1986', Oxford Bulletin of Economics and Statistics, 53, 377-399.

Blanchard, O.J. and Katz, L.F. (1992), 'Regional Evolutions', Brookings Papers on Economic Activity, 1, 1-75.

Blanchflower, D. G. (1991), 'Fear, Unemployment and Pay Flexibility', Economic Journal, 101, 483-496.

Blanchflower, D. G. and Lynch, L. (1994), 'Training at Work: A Comparison of US and British Youths', forthcoming in International Comparisons of Private Sector Training, edited by L. Lynch, Chicago University Press and National Bureau of Economic Research.

Blanchflower, D. G., Oswald, A. J. and Garrett, M. (1990), 'Insider Power in Wage Determination', Economica, 57, 143-170.

Blanchflower, D. G. and Oswald, A.J. (1990), 'The Wage Curve', Scandinavian Journal of Economics, 92, 215-235.

Blanchflower, D. G. and Oswald, A.J. (1994a), The Wage Curve, MIT Press, forthcoming.

Blanchflower, D. G. and Oswald, A.J. (1994b), 'International Wage Curves', forthcoming in Differences and Changes in Wage Structures, edited by R. Freeman and L.F. Katz, University of Chicago Press and National Bureau of Economic Research.

Bowles, S. (1985), 'The Production Process in a Competitive Economy: Walrasian, Neo-Hobbesian and Marxian Models', American Economic Review, 75, 16-36.

Carlin, W. and Soskice, D. (1990), Macroeconomics and the Wage Bargain, Oxford University Press, Oxford.

Christofides, L. N. and Oswald, A. J. (1992), 'Real Wage Determination and Rent-Sharing in Collective Bargaining Agreements', Quarterly Journal of Economics, 107, 985-1002.

Edin, P. A., Holmlund, B. and Ostros, T. (1994), 'Wage Behavior and Labor Market Programs in Sweden: Evidence from Micro Data', forthcoming in Labour Markets and Economic Performance: Europe, Japan and the US, edited by T. Tachibanaki, Macmillan .

Freeman, R. B. (1990), 'Employment and Earnings of Disadvantaged Young Men in a Labor-Shortage Economy', NBER Working Paper 3444, Cambridge, Mass.

Greenhalgh, C. (1980), 'Male-Female Wage Differentials in Great Britain: Is Marriage an Equal Opportunity?', Economic Journal, 90, 751-775.

Groot, W., Mekkeholt, E. and Oosterbeek, H. (1992), 'Further Evidence on the Wage Curve', Economics Letters, 38, 355-359

Hall, R. E. (1970), 'Why is the Unemployment Rate So High at Full Employment?', Brookings Papers on Economic Activity, 1, 369-402.

Harris, J. R. and Todaro, M. P. (1970), 'Migration, Unemployment and Development: A Two-Sector Analysis', American Economic Review, 60, 126-142.

Holmlund, B. and Zetterberg, J. (1991), 'Insider Effects in Wage Determination. Evidence From Five Countries', European Economic Review, 35, 1009-1034.

Jackman, R., Layard, R. and Savouri, S. (1991), 'Labour Market Mismatch: A Framework for Thought', Centre for Economic Performance, LSE, Discussion Paper number 1.

Katz, L. F., and Krueger, A. B. (1991a), 'The Effects of the New Minimum Wage Law in a Low-Wage Labor Market', Working Paper # 298, Industrial Relations Section, Princeton University.

Katz, L. F., and Krueger, A. B. (1991b), 'Changes in the Structure of Wages in the Public and Private Sectors', Research in Labor Economics, 12, 137-172, Jai Press, Greenwich, Conn..

Katz, L. F., Loveman, G. and Blanchflower, D. G. (1992), 'A Comparison of Changes in the Structure of Wages in Four OECD Countries', forthcoming in Differences and Changes in Wage Structures, edited by L.F. Katz and R. Freeman, University of Chicago Press and National Bureau of Economic Research.

Layard, R. and Nickell, S. J. (1986), 'Unemployment in Britain', Economica, 53, S121-S170.

Layard, R., Nickell, S. J. and Jackman, R. (1991), Unemployment: Macroeconomic Performance and the Labour Market, Oxford University Press, Oxford.

Lindbeck, A. (1992), 'Macroeconomic Theory and the Labour Market', European Economic Review, 36, 209-236.

Manning, A. (1993), 'Wage Bargaining and the Phillips Curve: The Identification and Specification of Aggregate Wage Equations', Economic Journal, 103, 98-118.

Montgomery, E. B. (1993), 'Patterns in Regional Labor Market Adjustment: The US Versus Japan', National Bureau of Economic Research, Working Paper 4414, Cambridge, Mass.

Moulton, B. R. (1986), 'Random Group Effects and the Precision of Regression Estimates', Journal of Econometrics, 32, 385-397.

Moulton, B. R. (1987), 'Diagnostics For Group Effects in Regression Analysis', Journal of Business and Economic Statistics, 5, 275-282.

Moulton, B. R. (1990), 'An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units', Review of Economics and Statistics, 72, 334-338.

Nickell, S. J. (1987), 'Why is Wage Inflation in Britain So High?', Oxford Bulletin of Economics and Statistics, 49, 103-128.

Oswald, A. J. (1986), 'Wage Determination and Recession: A Report on Recent Work', British Journal of Industrial Relations, 24, 181-194.

Phelps, E. S. (1990), 'Effects of Productivity, Total Domestic Product Demand and Incentive Wages on Unemployment in a Non-Monetary Customer-Market Model of the Small Open Economy', Scandinavian Journal of Economics, 92, 353-368.

Phelps, E. S. (1992), 'Consumer Demand and Equilibrium Unemployment in a Working Model of the Customer-Market Incentive-Wage Economy', Quarterly Journal of Economics, 107, 1003-1032.

Phillips, A. W. (1958), 'The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957', Economica, 25, 283-299.

Rowthorn, R.E. (1977), 'Conflict, Inflation and Money', Cambridge Journal of Economics, 1, 215-239.

Sargan, J.D. (1964), 'Wages and Prices in the UK: A Study in Econometric Methodology', in Econometric Analysis for National Economic Planning (ed. P.E. Hart, G. Mills and J.K. Whittaker), New York, Macmillan.

Shapiro, C. and Stiglitz, J. E. (1984), 'Equilibrium Unemployment as a Worker Discipline Device', American Economic Review, 74, 433-444.

Topel, R.H. (1986), 'Local Labor Markets', Journal of Political Economy, 94, S.111-S.143.

Woodford, M. (1992), 'Seven Schools of Macroeconomic Thought, by ES Phelps: A Book Review', Journal of Economic Dynamics and Control, 16, 391-398.