CENTRE for ECONOMIC PERFORMANCE

CEP Discussion Paper No 632

May 2004

Two Sides to Every Story: Measuring the Polarisation of Work

Paul Gregg and Jonathan Wadsworth

Abstract
Individual and household based aggregate measures of joblessness can, and do, offer conflicting signals about labour market performance if work is unequally distributed. This paper introduces a simple set of indices that can be used to measure the extent of divergence between individual and household-based jobless measures. The indices, built around a comparison of the actual household jobless rate with that which would occur if work were randomly distributed over the working age population, conform to basic consistency axioms and can be decomposed to try to identify the likely source of any disparity between nonemployment rates calculated at the 2 levels of aggregation. Applying these measures to data for Britain, we show that there has been a growing disparity – polarisation - between the individual and household based jobless measures that are largely unrelated to changes in household structure or the principal characteristics associated with individual joblessness.

JEL Classification: C1, J0, J6
Key Words: Workless households, Distribution of work, Polarisation, Joblessness

This paper was produced as part of the Centre's Labour Markets Programme. The Centre for Economic Performance is financed by the Economic and Social Research Programme.

Acknowledgements
The authors thank the Leverhulme Foundation for financial support. LFS data made available by the ONS through the Data Archive at the University of Essex. The views expressed are those of the authors and do not necessarily reflect those of the Leverhulme Trust. Thanks to Stephen Jenkins, Marco Manacorda, Alan Manning, John Schmitt and Mark Stewart for helpful comments and suggestions.

Paul Gregg works at the University of Bristol, H.M. Treasury and the Centre for Economic Performance at the London School of Economics. E-mail: p.gregg@bristol.ac.uk

Jonathan Wadsworth works at Royal Holloway College University of London and at the Centre for Economic Performance at the London School of Economics.
E-mail: j.wadsworth@lse.ac.uk; j.wadsworth@rhul.ac.uk

Published by
Centre for Economic Performance
London School of Economics and Political Science
Houghton Street
London WC2A 2AE

ISBN 0 7530 1758 X

1. Introduction

Analysis and examination of labour market data usually relies on information collected on individuals which is then aggregated across the population to produce estimates of, say, the unemployment or employment rates. Poverty and income inequality are typically calculated from household level data, but until recently, it was unusual to measure joblessness at household level. Since Gregg and Wadsworth (1996, 1998) showed that the distribution of work in Britain, and certain OECD countries, had become increasingly unevenly distributed across households, the EU and OECD and other national statistical offices have begun to compile workless household rates among their labour market and social exclusion indicators[1]. The household circumstances of workless individuals are clearly important. Households lacking any wage income will be more likely to be dependent on welfare payments and more likely to be poor. This in turn has implications for the scale of government welfare finance for a given level of employment. OECD (2001) shows that workless household rates are far more highly correlated with non-pensioner poverty across countries than individual based unemployment or employment rates. Dickens and Ellwood (2002) show that changes in household-level employment patterns help explain rising poverty levels amongst the working age population in Britain compared to the USA, a point echoed by Nickell (2003).

Once non-employment is measured at both individual and household levels, two issues become readily apparent. The first is how to reconcile any differences in the level of, or trends in, jobless rates or trends across the two levels of aggregation. The second is how to locate the source of any divergence. For example, more single adult households in the population mean a greater likelihood of both fully employed and no work households at any given employment level. If rising workless household rates stem from the growth of smaller households, then there is a need to understand the processes that underlie household

formation and dissolution. Conversely, if there is a growing division of work across households of given size, policy makers need to focus on the reasons why jobs are going disproportionately to households already benefiting from earned income.

To try and address these issues, this paper introduces a simple framework that can be used to measure the extent of any discrepancy between jobless rates based on individual or household levels of aggregation. The favoured index is based around a comparison of the actual household jobless rate with a counterfactual rate that would arise if employment were distributed randomly across the population. This index satisfies basic consistency axioms and can be decomposed to identify the source of any disparity. Applying this index to British data, we show that the counterfactual and the actual workless household rate have diverged appreciably over the past twenty years, which we term polarisation. Most of this polarisation is shown to be within rather than between household types. Since household occupants tend to have characteristics in common, any major change in employment centred on certain demographic groups, a shift in demand away from the less skilled for example, could help explain the observed polarisation. We show that our chosen methodology can be extended to allow for differences in employment probabilities according to individual characteristics.

Section 2 sets out the basic facts concerning the divergence between individual and household based jobless measures for Britain. Section 3 considers formally why such divergences can arise and defines a set of household based measures of joblessness and polarisation. Section 4 extends these results to the entire distribution of employment across households. Section 5 uses British Labour Force Survey data to measure polarisation and decomposes the change over time into the various competing explanatory components and section 6 sets out some conclusions.

2. Household Employment Patterns

To motivate what follows, we begin with a simple outline of the differences in

household and individual based measures of non-employment. The Labour Force Survey, (LFS), for Britain contains household identifiers. We can therefore count the numbers of adults employed and the number out of work, on the ILO definition, in each of the 50,000 working age households sampled in every survey. A workless household, in our definition, is observed when all the adult occupants are out of work. Conversely an all-work household occurs when all adult members are in work. We confine our estimates to the population of working age[2], exclude full-time students and households where the head is above statutory retirement age, to try and minimise the effects of educational participation and retirement on the estimates. Since we are interested primarily in the diverging signals emanating from the individual and household non-employment rates, we make no distinction between ILO unemployed and ILO inactive and simply add the two groups together[3].

Table 1 and Figure 1 document the growth in the proportion of working age workless households in Britain from 1975 onward. The aggregate, individual based, non- employment rate moves over the cycle but remains broadly untrended. However, over the same period, the share of households where no adult works triples. By 1996, nearly one in five of all (working age) households were jobless and one in every seven individuals lived in a workless household, up from one in twenty in 1975[4]. Hence joblessness in Britain is much more concentrated than in the mid-seventies, but inspection of the individual-based jobless rate does not reveal this.

Figure 1 (lower panel) and Table 1 also document the simultaneous rise in the proportion of households where every one is in work. Households containing a mixture of working and non-working adults are in secular decline. The share of mixed-work households has fallen whilst the share of households where everyone works has risen alongside the workless household share.

Table 2 documents changes in workless household rates conditional on the number of

adult occupants. Two trends are apparent. First, while workless household rates are highest for single adult households, the jobless rate rises over time for all household types. Second, the share of single adults rises over time, particularly during the latter half of the sample period. Which of these trends is the dominant factor behind the discrepancy between household and individual jobless rates is one of the issues we explore in the decomposition that follows.

3. Defining Polarisation

We now consider how best to reconcile any discrepancy between the jobless trends based on either individual or household levels of aggregation. To understand why this may occur, consider first a simple world of 2 households each containing 2 adults and a non-employment rate in the population of 50%. The world in which one adult is out of work in each household is very different from the world in which both adults work in one household and no one works in the other. Yet the aggregate non-employment rate in the population is the same, so that this statistic alone is unable to distinguish between the two outcomes.

We are interested in measuring and comparing the distribution of a discrete, binary outcome across different levels of aggregation - in this case work or the absence of it - unlike, say, the inequality literature which is concerned with the distribution of a continuous variable. Binary outcomes also mean that, unlike in the poverty literature, we do not need to define a benchmark based on an arbitrary level of a continuous variable, or need to weight according to distance from any given benchmark. Consideration of a binary variable automatically creates the idea of homogeneity within the group and heterogeneity between groups with or without that attribute. We will, however, examine whether our chosen index adheres to some basic consistency axioms, similar to those required of inequality and poverty measures, (see for example, Sen (1979)), but applied to the analysis of the distribution of work.

One simple measure of changes in a discrete distribution, alluded to by Esteban and Ray (1994) in their study of polarisation of continuous variables, is simply to calculate relative size of the central mass support, in our case the proportion of households containing a mixture of working and non-working adults,

$$(1) \qquad \sum_{h=1}^{H} (Mix_h = 1) / H \qquad\qquad h = 1, 2 \ldots H \text{ households}$$

Any fall in this proportion must lead to movements toward either, or both, poles of the (discrete) distribution, in our case the shares of all-work or no-work households in the population. This is a useful statistic and is easy to calculate. However, this measure does not imply whether any movement to the extremes of the distribution results in more workless or more all-work households, and from a welfare point of view, we are likely to be disproportionately concerned with the former[5]. Nor does the measure lend itself readily to further decomposition. For example, if changes in the share of households containing different numbers of adults were thought to be important, this would not be picked up in an index which measured the mixed work household rate in each household type i, m_i, multiplied by the share of each household type, s_i, $M = \Sigma_i s_i m_i$, since this is necessarily zero for all households containing only one adult. Moreover, as we show below, a falling mixed work rate need not, in itself imply a divergence between the signals emanating from the household and individual based non-employment rates and the measure does not make explicit the link between the individual and household workless rates.

Haddad and Kanbur (1990) decomposed the level of individual inequality and poverty based on a continuous variable, (calorie consumption), into within and between household effects and disaggregated the between-household effect. They show that inequality measured at the household level underestimates individual inequality *if* the distribution across individuals is a mean preserving spread of the distribution across households. Unlike them we

are concerned with a variable, the non-employment rate, whose mean across individuals is *not* the same as the mean value across households whenever there are households of different size in the population[6]. As a result, the level of inequality of non-employment at the household level is not always lower than when measured at the individual level. So comparisons of inequality at the two levels of disaggregation will not give a sense of "how much" the signals from the different levels of aggregation diverge. It seems that complementary analysis is required.

Standard shift share analysis will decompose the total change in the workless household rate into within and between household components. Let the household non-employment rate be written as the simple weighted average of the non-employment rate in each household type, $w = \Sigma_i s_i w_i$, where s_i is the share of households with i adults in the population and w_i is the proportion of households of type i where no one is in work. Then the shift-share decomposition of the change in the workless household rate in the interval [t, t+1] is given by

(2) $$\Delta w = \Sigma_i \Delta s_i w_i = \Sigma_i \Delta s_{i*}[0.5w_i^t + 0.5w_i^{t+1}] + \Sigma_i \Delta w_i*[0.5\, s_i^t + 0.5\, s_i^{t+1}]$$

The larger the within-group component, the lower the contribution of changing shares of different household types[7]. Whilst ultimately providing an answer to the source of any workless household growth, this approach cannot reveal the extent of any discordance in the information stemming from the individual and household workless measures.

We therefore propose to construct an index that can reconcile the signals coming from the two levels of aggregation using a counterfactual workless household benchmark, namely the jobless household rate that would occur if work were randomly distributed in the population, so giving the same probability of being out of work to each individual and leaving the total non-employment rate unchanged. Given an aggregate non-employment rate at time t, $n_{t,}$ and ρ individuals in the population, then in the counterfactual case the vector of

individual non-employment rates, $N(n_1, n_2, \ldots n_\rho)$ becomes $N(n_t, n_t, \ldots n_t) = n_t$ and

$E[n_i /n, t] = n_t , \quad \forall i$

Why use equally distributed employment probabilities as a benchmark? We believe that the notion of the line of pure equality has intuitive appeal, like the benchmark used in the Lorenz curve. The idea is also consistent with Atkinson's (1970) equally distributed equivalent income and so fits within a (concave) Social Welfare function framework. There are also parallels with the information theoretic entropy benchmark used in the Theil indices of inequality. In our case, "maximum entropy" is obtained by everyone having the same non-employment rate.

Existing indices of inequality or poverty tend to ignore the link between individuals and households. To make this link explicit in the case of a discrete variable, given an individual counterfactual prediction, it follows that the counterfactual jobless *household* rate, w_h, for every household h with i adults at time t is then given by:

(3) $$E[w_h / i , n, t] = n_t^i$$

So, for example, the counterfactual probability of observing a single adult household out of work would then equal the individual non-employment rate, and the probability of a two adult household being out of work would be the square of the non-employment rate. Ignoring time subscripts, the aggregate counterfactual jobless household rate is then the weighted average of these rates, where the weights are the shares of each household type, s_i, and type is, in this instance, defined by the number of resident adults – though type could refer to any readily identifiable household grouping in the population, (eg. single parents or single childless adults);

(4) $$\hat{w} = \Sigma_i s_i \hat{w}_{i =} \Sigma_i s_i n^i$$

Our definition of polarisation, P, is the difference between the actual and counterfactual rates,

the extent to which there are more or fewer workless households than would be predicted by a random distribution of employment.

$$(5) \qquad P(n, s_i, w_i) = w - \hat{w} = \Sigma_i s_i w_i - \Sigma_i s_i n^i = \Sigma_i s_i (w_i - n^i)$$

P is a cardinal measure. The larger the value, the greater the percentage point "excess" of workless households and the greater polarisation of work. A negative value indicates that work is distributed such that there are fewer workless households than merited by a random draw. At the limit where work is equally distributed, the predicted and actual workless household rates are identical and polarisation is zero. This allows us to use the index in a simple graphical exposition. The line of equality is zero and departures away from this line represent polarisation. The further from zero, the greater the extent of polarisation. The upper and lower bounds of this measure vary with the level of non-employment and with changes in the relative shares of each household type[8].

We can also calculate a relative measure of polarisation using the ratio of the actual and predicted rates, $w/\hat{w}$. In this case, a value of one would indicate no polarisation, values above one gives the percentage excess deviation of the workless household rate above the norm, values below one give the percentage deviation below the norm. Any change in this index over time gives the percentage point deviation. We have no reason to favour the absolute or relative version, so in what follows we present estimates from both specifications.

One might also consider normalising the polarisation measures to try and take account of variation in employment over the economic cycle. Any given percentage point estimate for the polarisation count may be considered to need a larger weight when the non-employment rate is low than when it is high. We therefore also divide the absolute polarisation index by the non-employment rate, n, in each year, $(w - \hat{w})/n$. This scale invariant measure, centred on zero, also facilitates cross-country comparisons[9]. Standard errors for all these statistics can be

produced using the bootstrap method[10].

Measuring Polarisation of Individuals

The E.U. currently counts the number of individuals living in workless households, (Eurostat 2003). In a 2 household type world, the number of jobless individuals, N, is distributed across households according to the identity: $N = W_1 + (2W_2 + Mix_2^1)$. Generalising to i types gives

(6) $$N = \Sigma_i\, i*W_i + \Sigma_i\Sigma_j\, j*Mix_i^j$$

where W_i is the number of workless households with i occupants and Mix_i^j is the number of jobless individuals in household group i living in a mixed-work household with j jobless occupants. Taking the mixed household terms from the right to left hand side of (6) gives the number of individuals living in workless households, $\eta = \Sigma_i\, i*W_i$

Dividing by the individual working age population, p, gives the proportion of individuals living in workless households,

(7) $$\eta/p = \Sigma_i\, i*W_i / p = \Sigma_i\, i*(W_i/ p_i)*(p_i/p)$$

where p_i is the total population living in household type i.

Since $p_i = i*H_{i,}$ where H_i is the number of households with i occupants, then (7) can be written as

$$\eta/p = \Sigma_i\, i*(W_i/ i*H_{i,})*(p_i/p)$$

(8) $$\eta/p = \Sigma_i\, (W_i/ H_{i,})*(p_i/p)$$

Since $W_i/ H_{i,}$ is the workless household rate for household type i, then the number of individuals living in workless households is just a weighted average of the workless household rates for each household size group where the weights are now the shares of individuals living in household type i, $\pi_i = p_i/p$, rather than the household type shares as used in (4) to construct the counterfactual household rates. It follows that (8) can be used to construct a counterfactual individual living in workless household rate in much the same way. Substituting the counterfactual predicted rate (4) into (8) gives

(9) $$\frac{\hat{\eta}}{\rho} = \Sigma_i \hat{w}_i * \pi_i \qquad = \Sigma_i n^i * \pi_i$$

and an individual polarization measure,

(10) $$P(n, \pi_i, w_i) = \eta/\rho - \frac{\hat{\eta}}{\rho} = \Sigma_i \pi_i * (w_i - n^i)$$

Equation (10) gives the percentage point difference between the observed individuals in workless households rate and the rate that would occur if work were randomly distributed across households, which can then be decomposed the same way as (5) into within and between- group shares.

Axioms

We next examine whether the polarisation index, P, in (5), adheres to axioms similar to those invoked in the inequality and poverty literatures, but which seem to be relevant to an analysis of the distribution of work.

Principle of Population

Since P is calculated as a rate it is robust to the size of the population, p. Then for two distributions (n , s_i, w_i, p) and (n' , s_i', w_i', p'), if $P(n , s_i, w_i, p) > P(n' , s_i', w_i', p')$ then for $\forall \lambda>0$, $P(n , s_i, w_i, \lambda p) > P(n' , s_i', w_i', \lambda p')$. However the index P is designed to vary with changes in the relative size of sub-groups, s_i, in the population.

Scale Invariance

The relative and normalised versions of (5) are scale invariant and the absolute measure is invariant to the units in which the non-employment and workless household rates are measured, subject to a constant of multiplication, λ , ie $P(w, n / \lambda) = P(w, n)/ \lambda$.

Monotonicity

Sen's (1979) monotonicity axiom applied to this context is satisfied at the household level,

since any fall in the number of workless households will reduce the polarisation count, other things equal. However the trends outlined in section 2 above make it clear that a fall in the number of jobless *individuals* need not.

Subgroup Monotonicity

Since (4) can be applied separately to any household size type, it is apparent from (5) that the sub-group and aggregate polarisation measures will always move in the same direction. Since (5) is a weighted average of polarisation for each household type, then if there is more polarisation, among single adult households, for example, then there is more polarisation in aggregate. This then is similar to the subgroup monotonicity axiom and consistency requirement advocated by Foster, Greer and Thorbecke's (1984) analysis of poverty indices.

Transfer Sensitivity:

A transfer of an individual job from one household with work to another without work, will reduce the polarisation index, but a transfer of an individual job from one individual with work to another without need not. In general, the usual transfer axiom is not satisfied because of the different possible combinations of distributing employment of individuals across different household types.

However it is the violation of the transfer and monotonicity axioms that underlie any discrepancy between individual and household jobless counts. If new jobs go mostly to households containing a mixture of working and non-working adults rather than to workless households then P need not fall.

These observations also give rise to the following propositions.

Proposition 1: *The actual workless household rate and the polarisation index will rise more if jobs are disproportionately lost in single rather than multiple adult households.*

Proof: The set of work/no-work combinations in a household containing i individuals is $(2)^i$ so the expected probability of observing a workless household in type i is

(11) $\Pr(\text{Workless Household} / \text{i individuals}) = 1/(2)^i$

A job lost in a single adult household increases the workless numbers by one; a job lost to an individual in a 2 adult household has a two in three chance of raising the workless household numbers and there is a three in seven chance of a job is lost by an individual in a 3 adult household[11]. Since the counterfactual component of P in (5) is invariant to the actual distribution of work, P will increase more if job loss is concentrated on households with fewer resident adults.

Proposition 2: *A rise in the share of households containing one adult will raise the counterfactual workless household rate more than a similar size increase in the share of households with more than one adult. As the household share rises, the polarisation index will only rise if the incidence of job loss is concentrated on that household type.*

Proof: Let the cumulative share of household types $S_i = \sum_{j=1}^{i} s_j$ so that (4) can be written

(12) $\hat{w} = \Sigma_i (S_i - S_{i-1}) n^i = \Sigma_i S_i (n^i - n^{i+1}) = \Sigma_i S_i n^i (1- n)$

and hence $d\hat{w}/d S_1 > d\hat{w}/d S_2 > \ldots d\hat{w}/d S_n$ since $n^1 > n^2 > \ldots . n^n$.

Whether polarisation rises depends on whether the observed $dw/dS_i > d\hat{w}/dS_i$ in (5).

Proposition 3: *the individual non-employment rate and the workless household rate need not move at the same rate or in the same direction over time*

This follows directly from the arguments above. If job creation is skewed toward multiple adult households then whilst the individual non-employment rate will fall, following (6), there may be little impact on the workless household rate. Given the workless household rate $\Sigma_i s_i w_i$, then if for example, $dw_1/dn > dw_2/dn$, depending on the size of the relative household

shares, s_i, this is sufficient to generate a differential response in the rate of change or even in the direction of change of the workless household and non-employment rates[12].

Decomposition of Polarisation

Since (5) (or (10)) is a weighted average of polarisation in each household type, our aggregate polarisation index is additively decomposable with population share weights. Since $P(n, s_i, w_i) = \Sigma_i s_i P_i(n, w_i)$, this allows us to assess the contribution of any sub-group to the level of or change in polarisation. The index is also readily decomposed into within and between group components. To examine the change in P over time interval [t, t+1], a shift-share breakdown of (5) gives:

(13) $\Delta P = \Sigma_i \Delta s_i(w_i - n^i) = \Sigma_i \Delta s_i[0.5(w_i - n^i)_t + 0.5(w_i - n^i)_{t+1}] + \Sigma_i \Delta(w_i - n^i)[0.5\, s_{it} + 0.5\, s_{it+1}]$

The first term gives the contribution of changing household shares keeping the polarisation count at its average value, the second term measures the changing within household component keeping household shares constant. Since the actual rate equals the predicted plus residual polarisation a similar shift-share breakdown gives:

$$\Delta w = \Delta \hat{w} + \Delta(w - \hat{w}) = \Sigma_i \Delta_i s_i\, n^i + \Sigma_i \Delta_i s_i(w_i - n^i)$$

$$= \Sigma_i \Delta_i s_i[0.5\, n^i{}_t + 0.5\, n^i{}_{t+1}] + \Sigma_i \Delta_i n^i\, [0.5\, s_{it} + 0.5\, s_{it+1}]$$

(14) $$+ \Sigma_i \Delta_i s_i[0.5(w_i - n^i)_t + 0.5(w_i - n^i)_{t+1}] + \Sigma_i \Delta_i (w_i - n^i)[0.5\, s_{it} + 0.5\, s_{it+1}]$$

The 1st term gives the contribution of the change in the predicted rate due to changing household shares, the 2nd the change in the predicted rate due to changing non-employment rates, the 3rd between group polarisation and the 4th term within group polarisation. Each of these terms can be decomposed further to give the contribution of each sub-group.

Decomposing by Sub-Group Characteristics

It may be argued that a random counterfactual benchmark takes no account of the fact that non-employment rates often vary by individual characteristics. Moreover, household

occupants may have common characteristics, such as lower levels of educational attainment, which could make them more likely to experience joblessness simultaneously. To address this issue, the counterfactual non-employment rate in equation (1) can be assigned instead by the mean non-employment rate of sub-groups disaggregated according to a vector of characteristics, X, known to affect the probability of employment, $E(n_i /X) = n_x$. The counterfactual workless household rate now equals the product of the i individual (conditional) non-employment probabilities for each household occupant,

$$E[w_h^X / i , n, X] = \prod_{i=1}^{i} n_{Xi} = w_{Xi,}$$

Since the predicted rate is now based on the average non-employment rate for the vector of characteristics, X, the predicted and actual rates will converge faster the larger the conditioning set of variables in the X vector. This conditional polarisation measure now becomes

$$(15) \qquad P(n, s_i, w_i , X) = \Sigma_i s_i w_i - \Sigma_i s_i n_x^i = \Sigma_i s_i(w_i - n_x^i)$$

Proposition 4: *if employment dispersion across any factor lies behind the divergence between actual and predicted measures then disaggregating by this variable should reduce polarisation more.*

This follows directly from (4). Since the average actual rate, $\Sigma_i s_i w_i$, is unchanged by disaggregation, the better the prediction, $\Sigma_i s_i n_{xi}^i$, the lower the polarisation measure. Given 2 variables, Y and Z, if the non-employment rate varies widely across different values of Y, but is unchanged across different values of Z, then $P(n, s_i, w_i , Y) < P(n, s_i, w_i , X)$.

This helps clarify the extent to which polarisation rises if either (a) multi-adult household members have common characteristics across which employment varies substantially or (b) single adult households have more of the characteristics associated with low employment probabilities. Note that because (a) only applies to multi-adult households, the larger the

share of single adult households the smaller the impact of disaggregation on the polarisation measure.

4. Other Household Work Patterns

From a welfare stance, workless households are of primary interest. However, we can compile a counterfactual for the entire distribution of work since the decompositions above can also be used to predict the share of households where there either is full employment or a mixture of employed and non-working adults. This may help us understand why, for example, as Figure 1 shows, the workless and fully employed household rates have risen together at certain points over time.

Taken together, the counterfactual distribution of work across households is given by,

(16) $\hat{Dist} = \hat{NoWork} + \hat{MixWork} + \hat{AllWork} = \sum_i s_i n^i + \sum_i s_i (1 - n^i - (1-n)^i) + \sum_i s_i (1-n)^i$

which can be compared with the actual rates documented earlier in Figure 1 and Table 1.

Proposition 5: *Under a random allocation of work, for any change in the aggregate non-employment rate, the predicted no work and all work rates will always move in opposite directions, though the size of the changes are not symmetric.*

The first point follows directly from (16), since

(17) $d(n^i)/dn = \Sigma_i s_i i n^{i-1} > 0$ and $d(1-n)^i/dn = \Sigma -s_i i (1-n)^{i-1} < 0$

(17) also shows that a given change in the non-employment rate has a non-symmetric effect on the predicted workless and all work rates, (unless n=0.5). Over time, these two predicted rates, and indeed the actual rates, need not move in the same proportion and so changes in a polarisation count for no work households will vary differ from one based on all work households. Note that a positive polarisation count using the all-work household measure implies that there are more all-work households than would be predicted under a random allocation of work.

5. Results

We now apply the index outlined in (5) to British LFS data[13]. We begin, in Table 3 with information on actual workless household rates and our estimates of the random baseline counterfactual rate, using (4), and polarisation, using (5). We present results for the years 1977, 1990 and 2003, when the aggregate individual based non-employment rate was broadly the same and at a cyclical peak, together with the years 1987 and 1996, when the workless household rate was at a cyclical high point. Figure 2 graphs movements in the polarisation count over time alongside the workless household rate.

In 1977, the counterfactual random distribution prediction is close to the actual workless household rate, so that the polarisation estimate was negligible. In 2003, despite there being a similar non-employment rate as in 1977, the proportion of households with no adult in work had risen by over 8 percentage points, but the predicted rate had risen by just 2.1 points, (Table 3, column 2). As a result, the polarisation measure rises from zero to almost 6 percentage points above the expected rate on the absolute measure, (column 3), and 54% above the expected rate using the relative measure, (column 5). The standard errors suggest that changes greater than 0.2 points are statistically significant. Given that there are around 17.5 million (working age) British households, the polarisation count suggests that there are currently around 1 million extra workless households than would be expected if work were equally distributed given the non-employment rate. Similar patterns are observed using the individuals living in workless households, (see Table A1 in the appendix).

The use of the absolute, normalised or relative polarisation measures makes little difference to the trends over most of the sample period, (see Figure A1). However the choice of measure does have some influence on the timing of turning points in the data. Since 1996, when the absolute polarisation measure began to fall, the relative and normalised measures have fallen less. The normalised polarisation measure indicates that the workless household

count may therefore have fallen less than expected given the strength of improvement in the individual non-employment rate since 1996.

Using the accounting decomposition given by equation (14), Table 4 shows that for the sample period as a whole, only around one third of the rise in the workless household rate can be explained by either changing household structures or changes in the aggregate non-employment rate. The much larger residual, polarisation, is mostly accounted for by within rather than between household variation in the distribution of work. Changes in household shares account for the vast majority of the predicted change, as employment rates are little changed. Indeed shifts in family structure accelerated in the latter half of the sample period, so that this explains the bulk of the increase in the overall workless household rate between 1990 and 2003.

Accounting for Polarisation

We next relax the random distribution of work assumption and instead assign a conditional non-employment rate to each member of the household based on a vector of characteristics. Taking the product of the individual prediction for each household occupant gives a revised predicted household probability of worklessness. The characteristics we use are the principal variables known to be associated with differential employment probabilities; gender, region, (11 groups), age (3 groups; 16-24,25-49, 50+) and education (4 groups; degree, upper and lower intermediate and no qualifications). We use one characteristic at a time and then combine, giving us a maximum of 264 cells in any one year. Whilst this is done non-parametrically, note that parametric predicted values from a regression of the probability of the individual being out of work, applied to each member of the household, could be used once cell sizes become too small[14].

Table 5, (column III), allows for gender specific non-employment rates. Convergence in male and female employment rates over the last 25 years has a net positive effect on the

predicted household employment rate. In a world where nearly all men and few women work, conditioning on gender will predict few workless couples. The convergence in employment rates by gender over time changes the predicted distribution of work, generating more households where both individuals work and others where no-one works at any given employment level.

Column IV shows that allowing for regional variation in non-employment makes little difference to the predicted rates[15]. Age and education have a modest impact on the predicted rates, but the interaction of all four factors, (column VI) has a more noticeable effect on the predicted rates. Indeed this disaggregation can explain around a third of the rise in polarisation over the sample period. This is consistent with the notion that older, less educated men are losing work and prime-aged, better educated women are entering work. These groups live in different households and hence polarisation rises. We note in passing that it seems unlikely that any increase in "assortative mating" along education lines can underlie much of the change in polarisation over this period[16]. However there remains a large within-group residual of around 4 percentage points or nearly half the total rise in workless households. Polarisation is therefore growing given shifts in employment patterns by gender, age, education and region.

Polarisation by Household Sub-Groups

Whilst the analysis so far indicates that most polarisation is within group, this does not reveal amongst which types has polarisation increased most. Since the polarisation measure is additively decomposable with population share weights, we can estimate separate rates for each household type using equations (4) and (5). Table 6, (and Figure 4), suggest that our earlier finding of no polarisation at the aggregate level in 1977 also held for all household types. Since then, the share of single adult households has grown by 12 percentage points over the sample period, mainly at the expense of the 3 or more adults

household group. Propositions 1 and 2 indicate that this would be expected to increase the aggregate actual and predicted workless household rates for a given non-employment rate, but not necessarily polarisation within each household type.

Table 6 shows that workless household rates for all household types are diverging from the random counterfactual predictions over time. Hence polarisation rises among all types and the relative size of the changes across household types are broadly equal. Over the latter half of the sample period, despite falling polarisation, the contribution of single adult households to total polarisation remains stable, as a rising share of single adult households offsets any effect of falling polarisation within the group.

Conditioning on characteristics generally increases polarisation in multi-adult households and reduces polarisation in single adult households. Between-group employment shifts across age, gender, education and region explain more of the polarisation in single households though, as before, there remains a substantial within-group component to the workless household rates that can not be explained by these factors and this is focused on single adult households.

6. Conclusion

Labour market jobless measures aggregated from individuals can give conflicting signals about labour market performance compared with jobless measures derived using the household as the basis of aggregation. We believe that the simple set of indices used in this paper can be used to identify the extent of and the likely source of any disparity in the signals emanating from individual and household-based measures of non-employment, which we term polarisation. Our favoured measure, based on the assignment of counterfactual predictions, has the advantage that it conforms to basic consistency axioms, gives a cardinal value to any discrepancy and can be decomposed in order to isolate the likely source of any disturbance.

Applying this index to data for Britain, we show that there has been a dramatically growing disparity between the individual and household based jobless measures unrelated to changes in household structure. This polarisation is shown to be highest among single adult households, who also contribute most toward the total polarisation count, but polarisation has occurred within all household sizes.

Relaxing the counterfactual benchmark by conditioning on a set of observable individual characteristics known to be associated with joblessness helps explain some of this within-group polarisation. However there remains a large within-group residual. These features would not have been revealed using statistics based solely on individual or household jobless aggregations. Perhaps the measures used here show how complementary analysis could proceed.

Footnotes

[1] For example, Labour Market Trends (2003), OECD (1998, 2002), European Union (2001), Eurostat (2003)

[2] Men aged 16-64, women aged 16-59.

[3] See Gregg and Wadsworth (2001) for the unemployed/inactive composition of workless households.

[4] There are, currently, around 17 million households of working age in Britain.

[5] The existence of a mixed household group invalidates the dichotomy required to calculate a Duncan and Duncan (1955) type segregation index. Their index reduces to the proportion of mixed households in each group. Similarly, the turbulence index used to outline the extent of labour market "mismatch", $T = \frac{1}{2} \sum_i |.(N_i/N) |$, where N_i is the share of employment in group i, (see Layard, Nickell and Jackman (1990)), does not readily lend itself to the measure of the distribution of work *within* household types.

[6] For example. given 2 households, one single and one 2 adult. Then an individual non-employment rate of 33% could be consistent with a distribution of 1 single adult workless or with one of the two adults workless. In neither case is the mean of the workless household rate the same as the mean individual non-employment rate. Indeed this applies to any situation in which the number of household occupants varies across the population.

[7] Throughout, we assume that household size and labour market performance are independent. We leave the exploration of the relation between the two factors to future work. Our data do suggest that changes in the shares of different household types appear secular rather than cyclical. To the extent that the labour market does influence household size then we will overestimate the share attributable to households in our decomposition. The polarisation definition used here when not decomposed is however unaffected by these considerations.

[8] In theory, if non-employment is measured as a rate, the index is bounded by –1 and 1, though simulations using plausible parameters in (5) suggest the index lies mostly in the range ±25.

[9] In a 2 person to each household world, the three measures can be thought of as capturing the following:

$P_{Absolute} = Pr(Non_1 = 1 \ \& \ Non_2 = 1) - Pr (Non_1 = 1)*Pr(Non_2 = 1)$

$P_{relative} = Pr(Non_1 = 1 \ \& \ Non_2 = 1) / Pr (Non_1 = 1)*Pr(Non_2 = 1)$

$P_{normalised} = Pr(Non_2 = 1 / Non_1 = 1) - Pr(Non_2 = 1) = P_{Absolute} / Pr (Non_1 = 1)$

[10] We use 200 replications to generate the standard errors in the tables.

[11] This is because the set of all possible employment combinations is {1,0} in a 1 adult household; {0,0; 1,1; 0,1; 1,0} in a 2 adult household and {1,0,0; 0,1,0; 0,0,1; 1,0,1; 1,1,0; 1,1,1; 0,1,1; 0,0,0} in a 3 adult household.

[12] For example, net job loss amongst single adult households and net job creation amongst multiple adult households against a background of net employment growth in the economy could be sufficient to generate a differential effect of the change in the workless household and non-employment rates.

[13] See Gregg and Wadsworth (2003) for a detailed cross-country comparative exercise.

[14]This strategy does however imply that a logit or probit prediction based on a linear specification, bX, like OLS, will predict only the mean of the dependent variable and the mean workless probabilities of each right hand side variable, not their interactive cell means. This is analogous to the difference between predictions from the non-parametric and propensity score techniques in the matching literature. The median cell size in 1977 is 172 with a minimum of 1 and a maximum of 2429.

[15] This does not rule out the possibility that a finer area disaggregation may have a role to play.

[16] We leave the issue of the role of assortative mating to future work, but note that for this explanation to work changes in characteristics must dominate changes in coefficients in the predicted probabilities over time. Using a parametric version of the predicted workless probability we find that changes in coefficients dominate the decomposition of the change in predicted workless probabilities for 2 adult households.

References

Atkinson, A., (1970), ”On The Measurement of Inequality,” Journal of Economic Theory, vol 2, pp. 244–263.

Dickens, R & D. Ellwood (2002) “Whither Poverty in Britain and the US? The Determinants of Changing Poverty and Whether Work Will Work” in R. Blundell, D. Card and R.Freeman (eds) Seeking a Premier League Economy, University of Chicago Press.

Duncan, O. & Duncan, B., (1955), “A Methodological Analysis of Segregation Indices”, American Sociological Review, Vol. 20, No. 2, pp. 210-217.

Esteban, M. & Ray, D., (1994), “On the Measurement of Polarisation”, Econometrica, July, pp. 819-851.

Esteban, M., Gradin, C. & Ray, D., (1999), “Extensions of a Measure of Polarisation with an Application to the Income Distribution of Five OECD Countries”, LIS Working Paper 218.

European Commission (2001) ‘Draft Joint Report on Social Inclusion’ Communication from the Commission, COM(2001) 565 final.

Eurostat (2003), “Poverty and social exclusion in the EU after Laeken: Part 2”’, Theme 3: 9/2003, European Community.

Foster, J. Greer, J. & E. Thorbecke (1984), “Decomposable Poverty measures”, Econometrica, May, pp. 761-766.

Gregg, P. & Wadsworth, J., (1996), "More Work in Fewer Households?" in New Inequalities ed J. Hills, C.U.P., 1996

Gregg, P. & Wadsworth, J., (1998), "It Takes Two. Employment Polarisation in the OECD", Centre for Economic Performance Discussion Paper No. 304

Gregg, P. & Wadsworth, J., (2003), “Why we should also measure worklessness at the household level. Evidence from 5 OECD Countries”, Centre for Economic Performance Working Paper 1168.

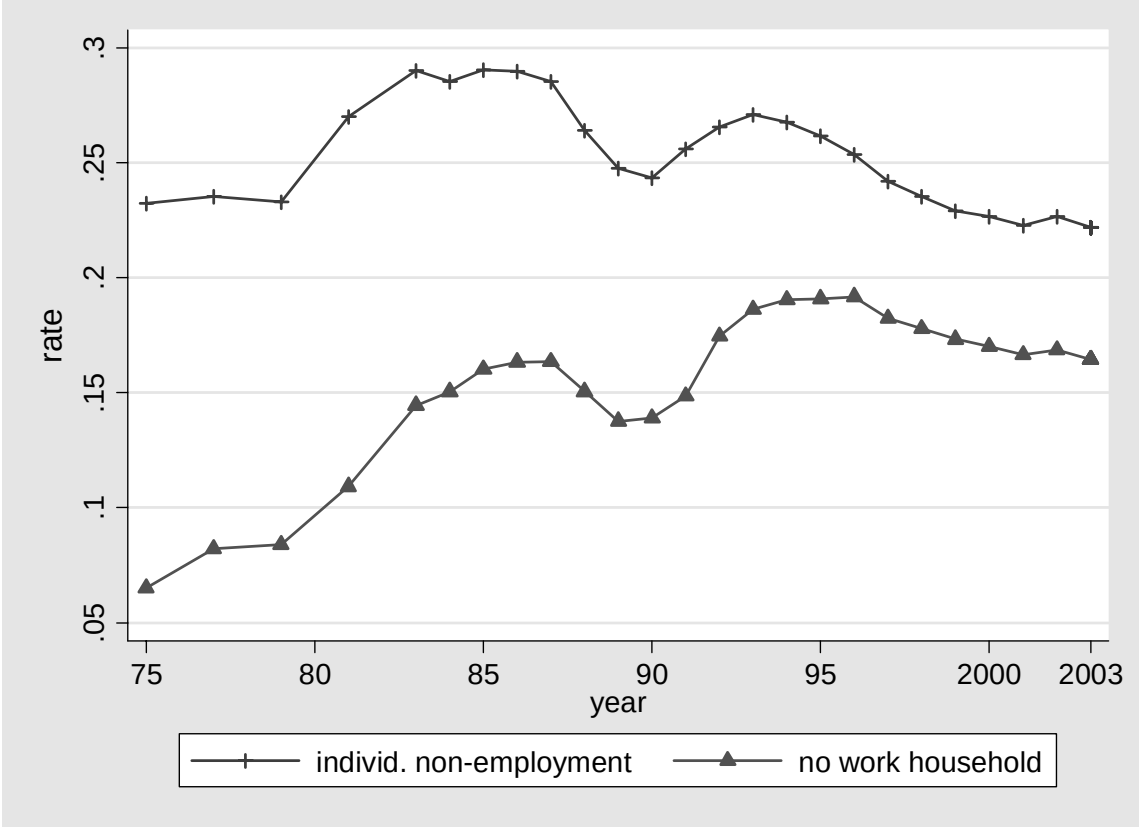
Haddad, L. & Kanbur, (1990), “How Serious is the Neglect of Intra-Household Inequality?”, Economic Journal, Vol. 100, September, 866-881.

Nickell, S. (2003) ‘Poverty and Worklessness in Britain’, forthcoming Economic Journal

OECD (1998), OECD Employment Outlook 1998, OECD, Paris
OECD (2001), OECD Employment Outlook 2001, OECD, Paris
OECD (2002), OECD Society at a Glance 2002, OECD, Paris

Sen, A., (1979), “Issues in the Measurement of Poverty”, Scandinavian Journal of Economics, Vol. 81, pp. 285-307.

Figure 1. Distribution of Work Across Households, 1975-2003



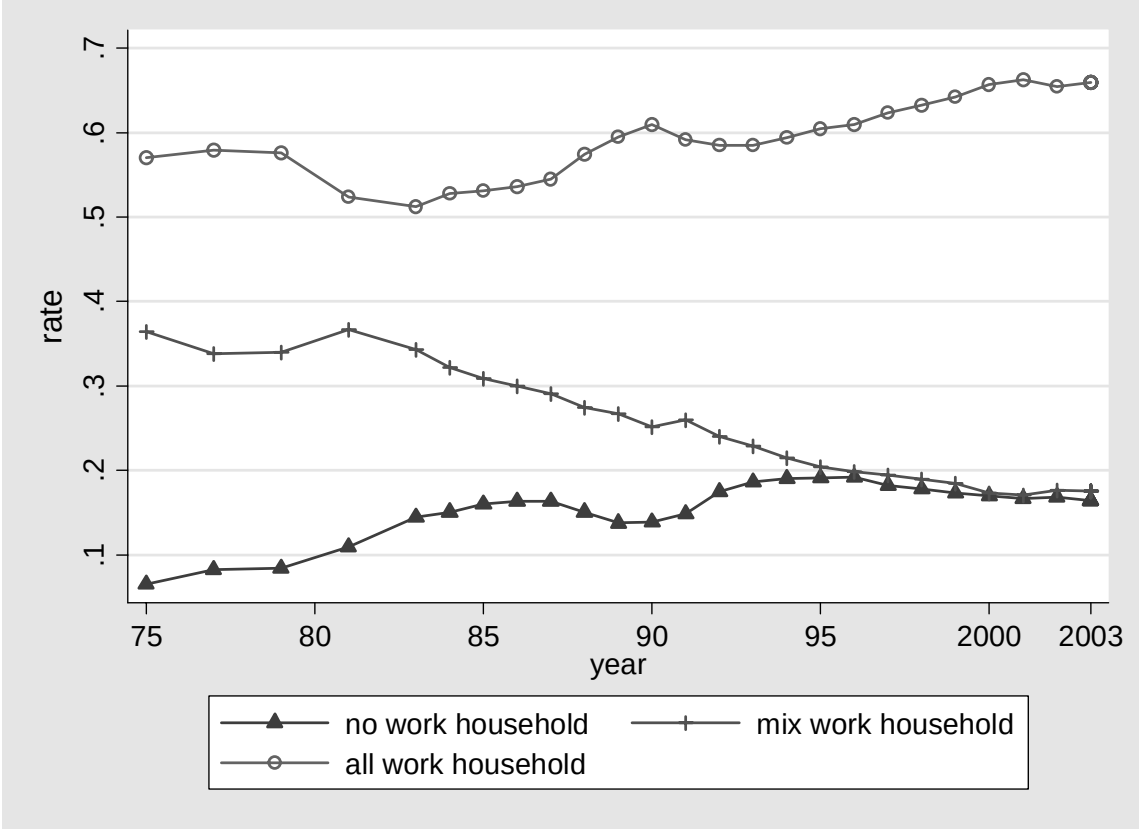


Figure 2. Polarisation of Employment Across Households:

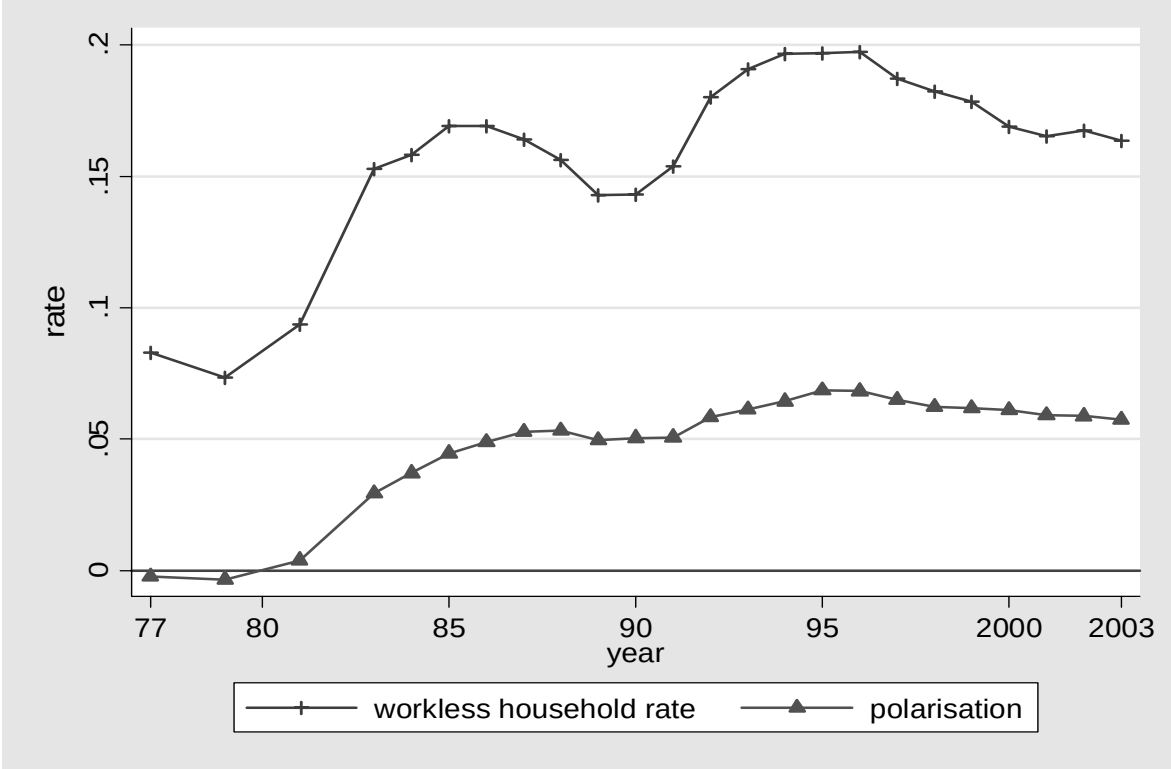


Figure 3. Accounting for Polarisation in Workless Households

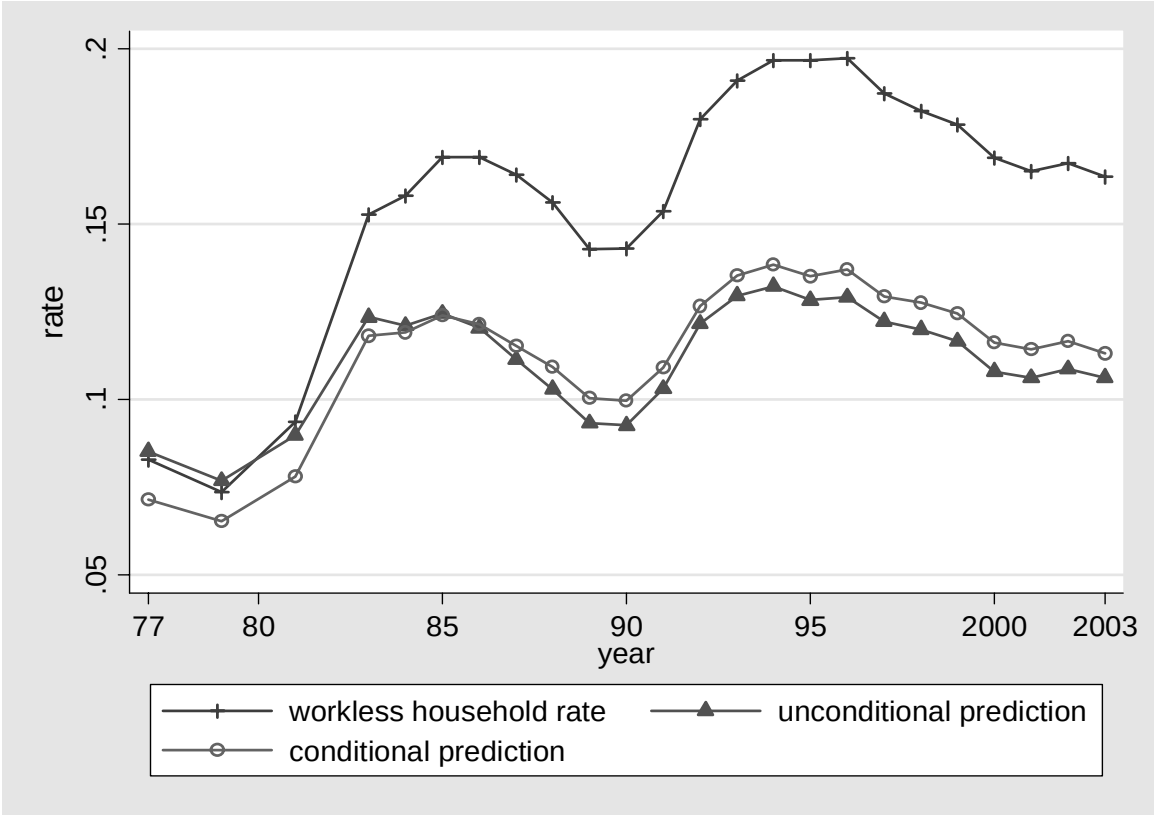
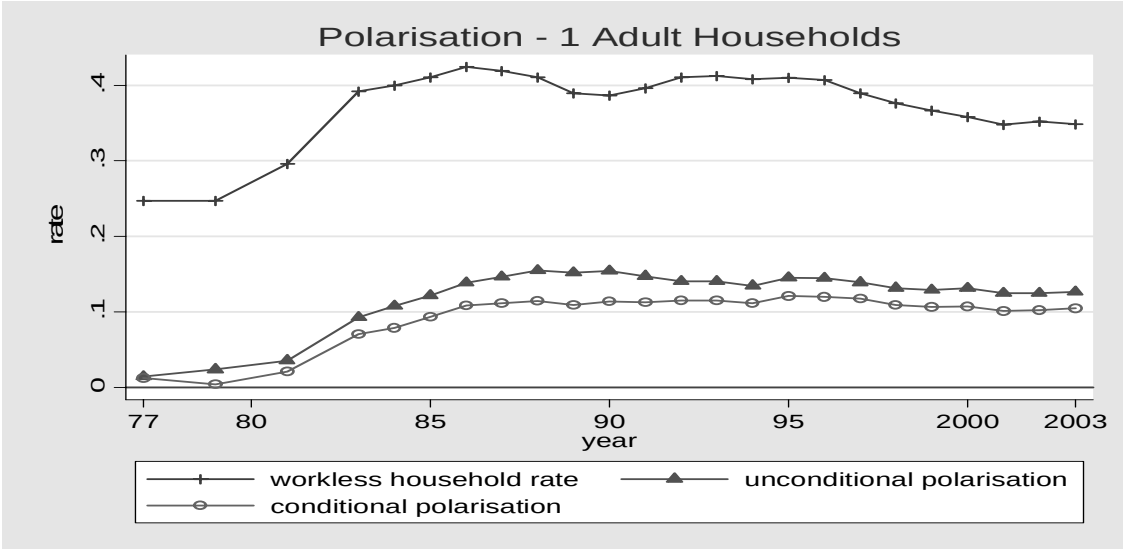
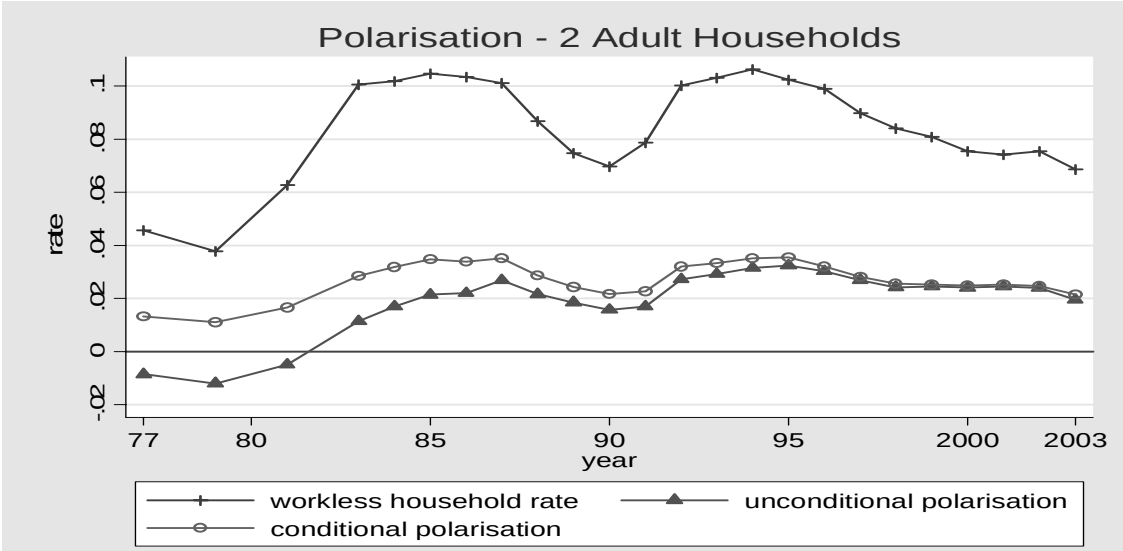


Figure 4. Worklessness and Polarisation By Household Size





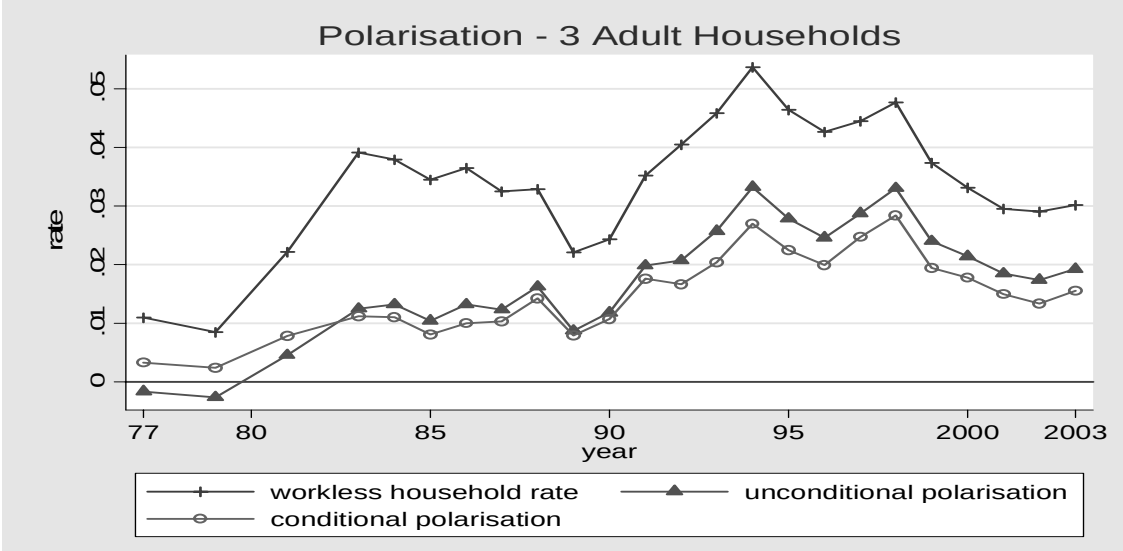


Table 1. Workless households in Britain

	Individuals in workless households (%)	Workless Household rate (%)	All-Work Household rate (%)	Non-employment Rate (%)
1975	4.3	6.5	57.0	23.3
1987	11.8	16.4	54.5	28.5
1990	9.6	13.9	60.9	24.3
1996	14.1	19.2	61.0	25.4
2003	11.8	16.4	66.0	22.2

Source: LFS, authors' calculations. Employment rate excludes students and households with retired heads. Estimates are weighted using population frequency weights.

Table 2. Household Type Shares and Workless Rates in Britain

	1 Adult Households		2 Adult Households		3+ Adult Households	
	Workless rate	Household share	Workless rate	Household share	Workless rate	Household share
1975	22.3	19.5	3.8	63.6	0.7	17.0
1987	42.0	23.0	10.4	58.1	3.6	18.9
1990	37.7	24.8	7.0	58.0	2.7	17.2
1996	41.0	32.3	9.9	55.4	3.9	12.3
2003	33.6	35.4	7.0	54.0	3.2	10.6

Source: LFS, authors' calculations.

Table 3. Polarisation of Work Across Households in Britain

	Workless Household Rate (1)	Predicted Rate (2)	Polarisation (1)-(2)	Standardised Polarisation	Relative Polarisation (1)/(2)
1977	8.3 (0.06)	8.5 (0.08)	-0.2 (0.08)	-1.0 (0.33)	0.97 (0.01)
1987	16.4 (0.10)	11.1 (0.10)	5.3 (0.10)	19.3 (0.42)	1.47 (0.02)
1990	14.3 (0.09)	9.3 (0.10)	5.0 (0.10)	21.7 (0.50)	1.54 (0.02)
1996	19.7 (0.11)	12.9 (0.11)	6.8 (0.13)	26.0 (0.59)	1.53 (0.02)
2003	16.4 (0.09)	10.6 (0.09)	5.8 (0.10)	25.8 (0.49)	1.54 (0.02)
	Δworkless rate	Δ predicted rate		Δ polarization	
77-03	8.1	2.1	5.9	26.8	.57
77-87	8.1	2.6	5.6	20.3	.50
87-90	-2.1	-2.2	-0.3	2.4	.07
90-96	4.4	3.6	1.8	4.3	-.01
96-03	-3.3	-2.3	-1.0	-0.2	.01

Source: Labour Force Survey, authors' calculations. Standard errors in brackets. Standard errors for polarisation measures are bootstrapped. Estimates are unweighted.

Table 4. Decomposition of change in workless household rate

	1977-2003	1977-1987	1987-90	1990-96	1996-2003
Actual Change	**8.1**	**8.1**	**-2.5**	**5.8**	**-3.3**
Predicted	**2.1**	**2.6**	**-2.1**	**4.0**	**-2.2**
: of which					
Due to non-employment	-0.6	0.4	-2.4	2.0	-2.5
Due to household shares	2.7	2.2	0.3	2.0	0.3
Polarisation	**6.0**	**5.6**	**-0.3**	**1.8**	**-1.1**
:of which					
Between group	0.9	0.2	0.1	1.1	0.2
Within group	5.1	5.4	-0.4	0.8	-1.3
: of which					
1 Adult	3.2	3.0	0.1	-0.1	-0.7
2 Adult	1.6	2.1	-0.5	0.7	-0.6
3+ Adult	0.3	0.2	0.1	0.1	-0.1

Note: Decomposition based on equation (9).

Table 5. Workless Household Counterfactuals by Characteristics

	Actual workless household rate	Counterfactual rate (unconditional)	Counterfactual (conditional) allowing variation by:			
			Sex	Region	Age and education	Region, sex, age, education
	I	II	III	IV	V	VI
1977	8.3	8.5	7.0	8.5	8.6	7.2
1987	16.9	11.7	11.3	11.8	12.4	12.2
1990	14.3	9.2	8.9	9.4	10.2	10.1
1996	19.7	12.9	12.8	13.1	13.6	13.7
2003	16.7	10.6	10.6	10.7	11.3	11.6
			Change			
77-2003	8.4	2.1	3.6	2.2	2.6	4.4

Note: values in columns 1&2 may differ from numbers reported in Table 3 because of missing regional, gender, age or qualifications data.

Table 6. Polarisation by Household Type

Year	1 Adult		2 Adult		3+ Adult	
	Polarisation rate	*% contribution to total*	Polarisation rate	*% contribution to total*	Polarisation rate	*% contribution to total*
Unconditional						
1977	1.4	*-122*	-0.9	*211*	-0.2	*11*
1987	14.7	*66*	2.7	*30*	1.2	*4*
1990	14.9	*74*	1.8	*21*	1.5	*5*
1996	14.5	*73*	3.0	*24*	2.5	*3*
2003	12.6	*78*	2.0	*19*	1.8	*4*
Conditional						
1977	1.1	*23*	1.3	*73*	0.3	*4*
1987	11.2	*54*	3.5	*42*	1.0	*4*
1990	11.1	*66*	2.1	*30*	1.1	*4*
1996	12.1	*66*	3.1	*31*	2.0	*3*
2003	10.3	*73*	2.5	*23*	1.5	*3*

Source: LFS. Note: conditional rows give polarization count conditional on age, sex, region and education.

Figure A1. Alternative Polarisation Indices Over Time

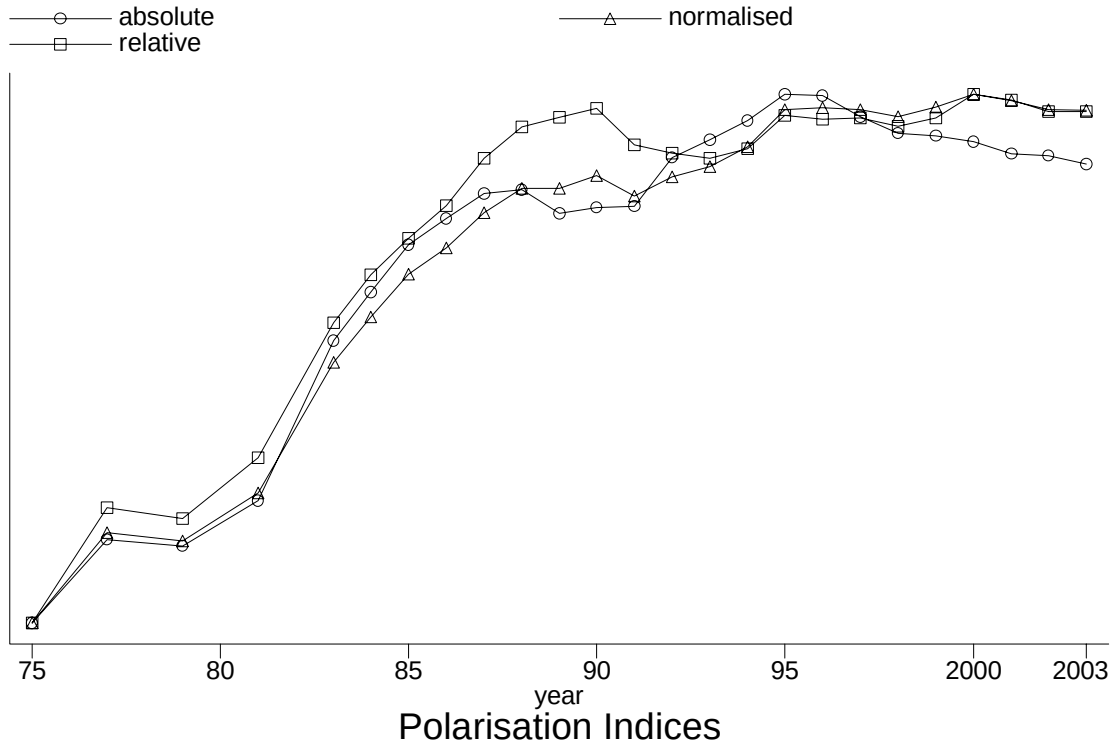


Figure A2. Non-Parametric and Parametric Polarisation counts

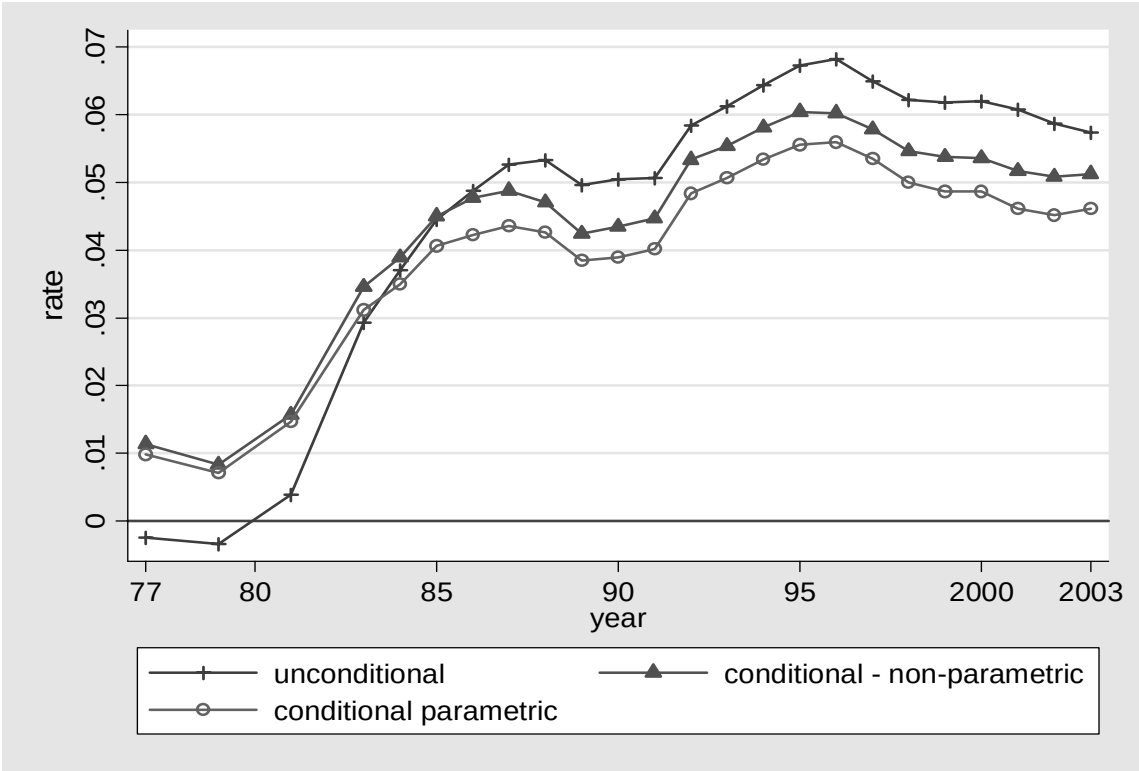


Table A1. Polarisation of Work Across Households in Britain (Individuals)

	Individuals in Workless Household Rate (1)	Predicted Rate (2)	Polarisation (1)-(2)	Standardised Polarisation	Relative Polarisation (1)/(2)
1977	5.8 (0.06)	6.2 (0.06)	-0.4 (0.06)	-1.6 (0.24)	0.88 (0.01)
1987	11.8 (0.11)	8.1 (0.11)	3.7 (0.09)	13.5 (0.34)	1.45 (0.02)
1990	9.8 (0.11)	6.5 (0.12)	3.3 (0.09)	14.2 (0.38)	1.51 (0.03)
1996	14.2 (0.12)	9.1 (0.13)	5.1 (0.09)	19.7 (0.35)	1.56 (0.02)
2003	11.8 (0.13)	7.7 (0.14)	4.1 (0.12)	18.7 (0.52)	1.53 (0.02)
	Δworkless rate	Δ predicted rate		Δ polarization	
77-03	6.0	1.5	4.5	20.3	.65
77-87	6.0	1.9	4.1	15.1	.57
87-90	-2.0	-1.6	-0.4	0.7	.06
90-96	4.4	2.6	1.8	5.5	.05
96-03	-2.4	-1.4	-1.0	-1.0	-.03

Source: Labour Force Survey, authors' calculations. Standard errors in brackets. Standard errors for polarisation measures are bootstrapped. Estimates are unweighted.

Table A2. Decomposition of change in workless households rate (individuals)

	1977-2003	1977-1987	1987-90	1990-96	1996-2003
Actual Change	**6.1**	**6.1**	**-2.2**	**4.6**	**-3.3**
Predicted	**1.5**	**2.4**	**-1.7**	**1.9**	**-2.2**
: of which					
Due to non-employment	-0.6	2.4	-2.1	0.5	-2.5
Due to household shares	2.1	0.0	0.4	1.4	0.3
Polarisation	**4.7**	**3.7**	**-0.5**	**2.7**	**-1.1**
:of which					
Between group	0.6	0.1	0.2	0.8	0.2
Within group	4.1	3.7	-0.7	1.9	-1.3
: of which					
1 Adult	1.7	1.3	0.0	0.3	-0.7
2 Adult	1.8	1.9	-0.7	1.3	-0.6
3+ Adult	0.5	0.4	0.0	0.3	-0.1

Note: Decomposition based on equation (10).

CENTRE FOR ECONOMIC PERFORMANCE
Recent Discussion Papers

631	Jeremy Grant Thomas Kirchmaier	Corporate Ownership Structure and Performance in Europe
630	Neal Knight-Turvey Andrew Neal Michael A. West Jeremy Dawson	The Impact of an Innovative Human Resource Function on Firm Performance: the Moderating Role of Financing Strategy
629	Nicholas Oulton	A Statistical Framework for the Analysis of Productivity and Sustainable Development
628	Vasileios Gkionakis	Short Job Tenures and Firing Taxes in the Search Theory of Unemployment
627	L. Rachel Ngai Christopher A. Pissarides	Balanced Growth With Structural Change
626	Malcolm Patterson Peter Warr Michael West	Organizational Climate and Company Productivity: the Role of Employee Affect and Employee Level
625	John Schmitt Jonathan Wadsworth	Is There An Impact of Household Computer Ownership on Children's Educational Attainment in Britain?
624	Andrew Neal Michael A. West Malcolm G. Patterson	Do Organisational Climate and Strategic Orientation Moderate the Relationship Between Human Resource Management Practices and Productivity?
623	Michele Pellizzari	Do Friends and Relatives Really Help in Getting a Good Job?
622	Steven McIntosh	The Returns to Apprenticeship Training
621	Steven McIntosh	The Impact of Vocational Qualifications on the Labour Market Outcomes of Low-Achieving School-Leavers
620	David Marsden	The 'Network Economy' and Models of the Employment Contract: Psychological, Economic and Legal

619	Alan Manning	Instrumental Variables for Binary Treatments with Heterogeneous Treatment Effects: A Simple Exposition
618	Mari Kangasniemi L. Alan Winters Simon Commander	Is the Medical Brain Drain Beneficial? Evidence from Overseas Doctors in the UK
617	Vicente Cuñat Maria Guadalupe	Executive Compensation and Product Market Competition
616	James Harrigan Anthony J. Venables	Timelines, Trade and Agglomeration
615	Howard Gospel Paul Willman	Comparatively Open: Statutory Information Disclosure for Consultation and Bargaining in Germany, France and the UK
614	Andrew B. Bernard Stephen Redding Peter K. Schott Helen Simpson	Relative Wage Variation and Industry Location
613	David Marsden	Unions and Procedural Justice: An Alternative to the Common Rule
612	David G. Blanchflower Alex Bryson	The Union Wage Premium in the US and the UK
611	Stephen Gibbons Stephen Machin	Valuing Rail Access Using Transport Innovation
610	Johannes Hörner L.Rachel Ngai Claudia Olivetti	Public Enterprises and Labor Market Performance
609	Nikolaus Wolf	Endowments, Market Potential, and Industrial Location: Evidence from Interwar Poland (1918-1939)

The Centre for Economic Performance Publications Unit
Tel 020 7955 7673 Fax 020 7955 7595 Email info@cep.lse.ac.uk
Web site http://cep.lse.ac.uk