

Real wages, working time, and the Great Depression

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September 2010

JEL Classification: E32, J31, J33, N64

Keywords: Real wage cyclicality, working time, piecework, timework, the Great Depression

Abstract: We have assembled two British data sets to re-examine the behaviour of real wages over the 1927-1937 cycle that contained the Great Depression. Both provide a degree of micro detail that greatly exceeds previous studies. The first consists of annual wages for 36 manufacturing industries. The second is based on blue-collar workers' company payroll data within engineering and metal working firms. It allows us to distinguish between pieceworkers and timeworkers, 14 occupations and 51 travel-to-work geographical districts. We measure the cycle using national unemployment rates as well as rates that match our industrial and district breakdowns. The roles of standard and overtime hours are found to be crucial to the behaviour of real pay during the Depression. Real weekly earnings are strongly procyclical. Real hourly earnings of pieceworkers are also significantly procyclical. Otherwise, real wage measures that do not fully reflect hours changes produce either weak procyclical or acyclical wage responses.

Acknowledgements: Work on this research was funded by ESRC Grant RES-000-22-3574. We are grateful to the Engineering Employers' Federation (EEF) for allowing access to their payroll records and to Warwick University Modern Record Centre and Glasgow University Archive Centre for their help in assembling the data. We thank Andrew Currall for transcribing the data. We also thank Paul Devereux, Olaf Hübler, and Gary Solon for very helpful comments on an earlier draft. The full EEF data base, containing all EEF data and accompanying unemployment rates used in this project, is available at the UK Data Archive, Study 5569 (<http://www.data-archive.ac.uk/searchStart.asp>).

1. Introduction

Over the past two decades, a consensus has grown among empirical economists that real wages are procyclical. Following Bils (1985), this has largely come about through an increasing recourse to the use of micro longitudinal panels that have allowed researchers to tackle problems of aggregation biases. Before this time, no obvious empirical consensus had emerged.¹ One of the earliest and best known examples in this respect concerned the conjecture by Keynes in the *General Theory* (1936) that reductions in aggregate employment are likely to be associated with falls in money wages and rises in real wages. While labour is unlikely to resist money wage reductions during severe economic downturns, real wages would be expected to rise given labour's decreasing marginal product. In other words, real wages should move countercyclically.² Subsequent empirical findings of Dunlop (1938) using British data and Tarshis (1939) using U.S. data, and largely accepted by Keynes (1939), supported positive correlations between money and real wages.³ This evidence pointed to real wage procyclicality.

Both the Dunlop and Tarshis studies included Great Depression wage rates, a period displaying exceptionally strong ups and downs in the employment cycle. However, despite the fact that the events of the 1930s have continued strongly to influence contemporary national

¹ The earlier debates on the cyclical behaviour of real wages in both the theoretical and empirical literature are usefully summarised in Bernanke and Powell (1986), Barsky and Solon (1989), Solon, Barsky, Parker (1994), Abraham and Haltiwanger (1995), and Swanson (2007).

² This view of real wage behaviour was not only reflective of the earlier classical school but was also shared by Friedman (1968) and mainstream New Classical economists (see Carlin and Soskice, Chapter 16).

³ Although their findings by no means represented an emerging consensus (Bodkin, 1969).

economic debates on the cyclical behaviour of wages and other economic variables, definitive interpretations have proved to be difficult to establish because 1930s pay statistics largely consist of highly aggregate time series observations. Due to a lack of individual-level data, we cannot investigate real wage behaviour in the Great Depression with the equivalent power of modern micro studies. Nonetheless, given the continued relevance and importance of the early 1930s downturn, it remains important to move as far as possible in the direction of greater data disaggregation. One of the best known earlier contributions down along these lines was provided by Bernanke and Powell (1986) who base their work on monthly data for eight U.S. manufacturing industries. Here, we move considerably further by making use of two important sources of British wage statistics. With each, we cover the period 1927 to 1937.

The first data source offers a wide coverage of national manufacturing activity combined with very high levels of industrial disaggregation. It is based on Agatha Chapman's British manufacturing industry annual wage estimates (Chapman, 1953). These are broken down into 14 main manufacturing industries as well as a further 36 subdivisions of these industries. However, the Chapman data stop short of allowing us to explore two areas of wage cycle research that modern studies have shown to be potentially important considerations. These concern (i) distinguishing between incentive compatible pay and hourly pay (Devereux, 2001) and (ii) incorporating firms' working time schedules (Bils, 1985). Our second, and principal, data source allows us to incorporate these extensions. It consists of payroll data obtained from British engineering and metal working firms that are members of

the Engineering Employers' Federation (EEF).⁴ Its primary focus is on the pay and hours of blue-collar workers. A big advantage of these statistics, even by modern standards, is that they distinguish between pieceworkers and timeworkers. Piece rates constituted a major payments method among British blue-collar inter-war occupations and, in fact, account for over half of workers in the EEF during the period of study. These two pay groups are further subdivided into 14 manual occupations and 51 EEF travel-to-work geographical districts. Crucially, the EEF payrolls allow us to break down weekly wage earnings into hourly pay and weekly hours components. For timeworkers, the latter distinguish between standard and overtime hours.

The predominant approach in the literature has been to concentrate on a national cyclical indicator, usually the rate of unemployment, to reflect business cycle effects that inform pay decisions. We too construct national rates that match the Chapman and EEF aggregate industrial coverage (see Figures 1 (a) and 1 (b)). But we argue, especially in relation to our EEF data, that local product and labour markets played important roles in inter-war wage bargaining because, for example, older manufacturing industries were located in the north of Britain and more modern industries in the south. Additionally, therefore, we undertake estimation using unemployment rates that match the industrial breakdowns in the Chapman data and the engineering districts in the EEF data.

⁴ The Employers' Federation of Engineering Associations was established in 1896 and by 1899 had become known as the Engineering Employers' Federation. It later merged in 1918 with the National Employers' Federation and became known as the Engineering and Allied Employers' National Federation. In 1961 it changed its name back to the Engineering Employers' Federation.

We show that average weekly hours and average real weekly earnings of both pieceworkers and timeworkers were strongly procyclical over this period. In fact, our estimated weekly earnings–unemployment elasticities are almost identical to the hourly earnings–unemployment elasticities derived using modern micro longitudinal panels. For both pieceworkers and timeworkers, a one point increase in the national rate of unemployment is associated with a one percentage point reduction in real weekly pay. We argue that these findings reflect the fact that changes in working time lay at the core of firms’ adjustments of real pay in the face of extreme product market fluctuations of the 1930s. By contrast, real annual wages from the Chapman data and the real hourly wage rates of timeworkers from the EEF payrolls are found to be either acyclical or weakly procyclical. These outcomes are conditioned by the fact that both of these remuneration measures fail adequately to reflect paid-for hours’ effects. For pieceworkers, however, hourly wage earnings are unequivocally, but relatively modestly, procyclical.⁵

2. Estimated real wage cyclicity based on Chapman’s annual wage data: 1927-1937

Agatha Chapman constructed annual wages and salaries by industry. They are derived as part of a broader objective of estimating net national product based on an individual industry’s

⁵ Bernanke and Powell (1986) also find weekly earnings procyclicality. However, these authors do not separate piece workers and time workers (see their Appendix, note 1, p. 618) and it may be the case that their findings of weak associations between real wage rates and the cycle disguise similar piecework/timework differences to those found here. These data are also used by Bernanke (1986) where it is also noted (p. 106) that the two pay groups are not separated.

income payments⁶ and subsequently aggregated industry by industry. Largely due to the way the source data were collected, the calculations of labour payments distinguish between wage earners and salary earners and the estimates here concentrate on the former group. The comparative advantages of these data are their breadth of coverage and detailed breakdowns of national manufacturing industry.

For the manufacturing disaggregations in Chapman's data, we can construct matching unemployment rates taken from various issues of the British Ministry of Labour Gazettes between 1924 and 1938. The unemployment rate is defined as the number of insured workers wholly unemployed in each industry divided by the industry's total number of insured workers (employed plus unemployed). We obtain 14 matches based on main manufacturing industrial headings and 36 matches based on further breakdowns of these industries. Main industries and subdivisions are listed in Table 1, with the former in bold type. As in the subsequent EEF work, we also show estimates using a single national rate of unemployment to represent the cycle. This is undertaken to compare wage-unemployment elasticities with modern micro-based studies most of which have adopted a single national-level rate. Figure 1a shows the aggregate manufacturing unemployment rate based on the weighted average of the 36 manufacturing subdivisions from 1926 to 1938. We also undertake wage regressions based on a single national manufacturing unemployment rate.

⁶ Defined as total income (wages, salaries etc.), interest, and operating surpluses.

Our first, and simplest, wage specification makes use of aggregate national-level wage data provided by Chapman and covering all industries as well as manufacturing industries.⁷ Let average national real annual wage earnings changes – covering either all industries or manufacturing industries - in year t be given by $\Delta \log A_t$. As price deflators we use both a consumer price index and a final output price index (Feinstein, 1972, Table 61). Then we have

$$(1) \Delta \log A_t = \alpha_1 + \alpha_2 \Delta U_t + \alpha_3 \text{YEAR}_t + u_t$$

where ΔU_t is the annual change in the national unemployment rate (for all industries or for manufacturing industries) and where YEAR_t is a time trend. The change in the log earnings is multiplied by 100. We estimate (1) by OLS. The estimated coefficient α_2 reflects the percentage change in the real annual wage for a one-point change in the unemployment rate.

Our second specification retains the national manufacturing unemployment rate but breaks down the annual wage data into either 14 main manufacturing headings or 36 manufacturing subdivisions. Let average real annual wage earnings changes in industry i in year t be given by $\Delta \log A_{it}$. We adopt the two-step estimation procedure of Solon, Barsky and Parker (1994). This is designed to tackle the following problem. Unlike the wages data, the national unemployment rate does not differentiate among specific industries. Across industries, workers may share common components of variance that are not captured by the single unemployment rate. This may serve to bias downwards the estimated unemployment standard errors (Moulton, 1986; Angrist and Pischke, 2009).

⁷ Data are obtained from Chapman (1953, p.27, Table 7). The series covering all industries exclude directors' fees.

Then the step 1 estimating equation is given by

$$(2) \quad \Delta \log A_{it} = d_i + \sum_{t=1}^T \phi_t d_t + \varepsilon_{it}$$

where d_i represents a set of industry dummies, where d_t is a time dummy that is equal to 1 if the observation is from year t and where ε_{it} is an error term. The estimated coefficients on the time dummies, $\hat{\phi}_t$ ($t = 1, \dots, T$), are regressed in step 2 on the change in the unemployment rate and the time trend:

$$(3) \quad \hat{\phi}_t = \alpha_1 + \alpha_2 \Delta U_t + \alpha_3 \text{YEAR}_t + v_t.$$

We estimate (2) by OLS and (3) by weighted least squares (WLS) where the weights are the number of individuals represented in each year.

The third, most disaggregated, specification replaces the national unemployment rate with matching industry unemployment rates for both main manufacturing industrial headings and the manufacturing subdivisions. Here, the Moulton-type bias does not arise and we simply estimate the equation:

$$(4) \quad \Delta \log A_{it} = \alpha_1 + \alpha_2 \Delta U_{it} + d_i + d_t + \varepsilon_{it}$$

where d_i and d_t are industry and time dummies. Equation (4) is estimated by OLS.

Results are presented in Table 1. At the most aggregate levels – i.e. based on equation (1) for all industries and for manufacturing industries – the first two rows of results reveal, using either price deflator, unemployment coefficients consistent with acyclical real wage

movements. Basing estimation on the two-step method shown in (2) and (3), the next two rows show results using the disaggregate manufacturing wages data combined with the annual average manufacturing rate of unemployment. Wages deflated by the consumer price index are procyclical while those deflated by final output prices are countercyclical. It is well known that results can be sensitive to the choice of price deflator though observed differences are not systematic through time or from study to study (see Geary and Kennan, 1982; Bernanke and Powell, 1986; Abraham and Haltiwanger, 1995). The last two rows show our most disaggregate regression results, based on (4), incorporating both real wages and unemployment rates based on the manufacturing industry breakdowns. Price changes are controlled for in these specifications through the fact that they incorporate both industry and time fixed effects (Blanchflower and Oswald, 1994). Results indicate significant but very modest wage procyclicality. A one point increase in the unemployment rate is associated with an 0.05/0.06 percentage decrease in annual manufacturing real wages.

All in all, and despite providing industrial breakdowns unequalled in earlier research, the results arising from the use of Chapman's data do not give a consistent picture of real wage cyclicality during the Great Depression. On the basis of maximum disaggregation of wages and unemployment rates, we perhaps would favour the evidence of slight procyclicality of real pay. However, these outcomes may well reflect the fact that Chapman's wage measures exclude several potentially important considerations. As we will show, two highly important aspects of pay during the 1920s and 1930s are missing in Chapman's estimates. First, the annual wage estimates preclude observing the roles played by paid-for hours in the measurement of wage earnings. Second, the estimates fail to differentiate between remuneration based time rates

and on payments-by-results. While our EEF manufacturing data are narrower in coverage - though describing the core industries in engineering and metal working - they are excellent in their measurement of these two aspects of pay. The weekly wage earnings data provide detailed breakdowns weekly paid-for hours and weekly pay rates. Moreover, the data comprehensively subdivided blue collar workers into those paid on time rates and those on piece rates. Before discussing the potential importance of these two additional pay dimensions to the study of wage cyclicalilty, we begin by describiing the EEF payroll statistics since it is a newly available data set.

3. The Engineering Employers' Federation Payroll Data: 1927-1937

The EEF is the largest sectoral employers' organisation in the United Kingdom with a current membership of nearly 6000 firms. From 1926 to 1968, the Federation asked each member firm to conduct annual earnings enquiries based on its payroll records. During our period of study, the Federation represented between 1,800 and 2,200 firms employing between 390,000 and 520,000 adult male manual workers (Wigham, 1973, Appendix, J). At this time, as itemised in Table 2, the EEF embraced a wide range of engineering, metal, aircraft, and automotive sections of industry. Essentially, therefore, this represents an important sub-set of Chapman's manufacturing coverage. In the inter-war period the total of these sections (i.e. EEF

and non-EEF firms) accounted for about 25% of British manufacturing. Of this 25%, EEF firms represented about 30%. Our recorded data cover between 10% and 15% of this EEF share.⁸

Statistics cover a specimen week in each October and we concentrate on manual males over the age of 21. The payroll statistics were collected, in part, for the purpose of being of direct use in employer-union negotiations at national, district, and section levels. Recently, these data have been digitised and made generally available. Virtually all member firms were unionized⁹ and somewhat skewed towards larger employers.¹⁰ Table 2 identifies the EEF occupations, geographical districts, and engineering sections. While wages and hours data are not available at the level of the individual worker, they provide a level of micro detail that is unmatched by other data sets of this era. They consist of cell means. Each cell is defined by a pay or hours measure of either pieceworkers or timeworkers at a give annual (October) time period delineated by one of 14 occupations and one of 51 engineering districts. For a shorter

⁸ Our wages and hours measures tally very closely with those supplied by the Federation to the Ministry of Labour – and published in the Ministry of Labour Gazette. Table 3 compares estimates published in the Gazette in the early 1930s with those from our own data set based on five time-worker occupations and on pieceworkers over all occupations.

⁹ Wigham (1973) indentifies three union-related basic functions of the Federation. First, it provided collective support in order to protect individual firms from being singled out in union actions. Second, it aimed to preserve the relative power of employers to make management decisions. Third, it helped towards conflict resolution in union disputes.

¹⁰ Hill and Knowles (1956) have undertaken a detailed analysis of the 1953 membership of the EEF. They show that while 50.7 of federated firms employed fewer than 100 workers, they accounted for only 6.2 per cent of total employment. By contrast, the 1.8 percent of firms that employed over 3,000 workers accounted for 27% of total employment.

time period, we also have data for 28 engineering sections.¹¹ Table 3 indicates the average number and standard deviation of workers (summed across all occupations and both payment methods) in each district over the entire period of study and over the Depression years. There are wide variations in these numbers, ranging from 1800 in London to 57 in Wigan.

Table 4 presents a summary of the hours' statistics for the whole period. Average weekly total and overtime hours of timeworkers are higher than their pieceworker equivalents. However, it is clear from the large standard deviations that there were wide variations around these means. Over the entire period, pieceworkers averaged 0.5 hours above the maximum 47 standard weekly hours and timeworkers 2.1 hours above. During the Depression years (1930-33) the respective deviations were -1.8 and -0.5 hours while in the post-Depression years (1934-37) they were 1.8 and 3.7 hours. While on average short-time workweeks applied during the Depression years, we note that average overtime remained positive throughout. This is because some engineering districts worked positive average overtime even during the depth of the economic cycle. Differences in working time at district level for a sample of five districts are illustrated in Figure 2 in respect of timeworkers. In the relatively prosperous midlands and southern districts of Coventry and London – where the modern light engineering, automotive and aircraft firms clustered – average weekly hours always exceeded the maximum standard hours. In the north, large cities like Liverpool averaged hours slightly below 47 during the

¹¹ We do not have section-level statistics by district. Including first differencing, district-level breakdowns are available for the whole 1927 – 1937 cycle. The section-level data are only available from 1930 and so allow analysis from 1931 to 1937. We have undertaken all the later empirical work at section level, obtaining results that are largely in line with our findings based on the full cycle of district-based data. We concentrate here on our superior data set.

trough years. Other northern districts, like Dundee and Halifax, experienced extremely large reductions in hours below the 47 standard hours ceiling. Figure 3 shows the share of overtime within total hours for three important occupations – time-rated turners, sheet metal workers, and labourers. The shares are strongly procyclical.

Table 5 shows relative weekly hours reductions in respect of our 51 districts divided into northern and midlands/southern groups (see Table 2) between 1929 and 1932 as well as respective changes in the share of overtime within total weekly hours. In 1929, timeworkers' weekly hours in the north, at 48.1, averaged 1.1 hours of overtime. At the same time, the average workweek in the south/midlands was 51.0 hours, or an average of 4 weekly hours of overtime. By 1932, weekly hours had reduced by 9.1% among northern timeworkers and represented average short-time working of 3.3 weekly hours. In the south/midlands, weekly hours of timeworkers reduced by 6.5% leaving average weekly hours above the maximum length of the standard workweek. In terms of the share of overtime within total weekly hours, in 1929 northern districts, at 4%, had half the share of southern/ midland districts. By 1932, overtime had been virtually eliminated in the north but still averaged a 3.3% share in the south/midlands. Similar, though somewhat less pronounced hours effects are displayed among pieceworkers.

Against the background of manufacturing unemployment, Figure 5 provides an aggregate summary of pieceworkers' and timeworkers' hours and pay (nominal and real) as well as final output and retail price deflators over the period 1927 to 1937. Average weekly hours of both groups are strongly procyclical. On the downside of the cycle and towards the

end of the cycle, pieceworkers' weekly hours were considerably below those of timeworkers. Final output and retail prices fell significantly between 1928 and 1934 – by 13.5% and 12.1%, respectively. Nominal hourly earnings of pieceworkers declined during the early years of the Depression while equivalent earnings of timeworkers were flat. Price deflation ensured that average real hourly earnings of pieceworkers were very slightly positive in the early years while those of timeworkers displayed more appreciable growth. Due to the large aggregate downward movement in weekly hours, nominal weekly earnings of both groups are clearly procyclical, although somewhat less markedly so in the case of timeworkers. Real weekly earnings of pieceworkers appear procyclical at this aggregate level. For timeworkers, real weekly earnings fell slightly between 1929 and 1930 and thereafter were flat before displaying annual growth.¹²

As identified in Table 2, we have matching unemployment rates for 28 of our 51 engineering districts.¹³ These include virtually all the main centers of engineering, metal

¹² Table 4 shows the piecework-timework hourly earnings differentials for the period, together with the changes in weekly hours and real weekly earnings for the two groups of workers. Average hourly earnings of pieceworkers were 25% higher than timeworkers over the period. A positive earnings differential is a common finding in the literature (e.g. Pencavel, 1977; Seiler, 1984). Note, however, that this aggregate figure is not comparing like-with-like jobs. One major influence is structural. There was a greater incidence of pieceworking in the more modern/higher wage firms located in southern/midland districts. In our complete data, 43% of workers in northern districts worked on piece rates compared to 63% in south/midlands districts. In general, however, the differential is broadly similar to other findings. For example, Ainsworth (1949, Appendix VII) finds a piecework-timework differential of 30% in 1938 for British metal, engineering and shipbuilding industries.

¹³ Most of the district unemployment rates are obtained from Hart and MacKay (1975). They were constructed to coincide with EEF districts by combining data on male unemployment and total insured workers taken from the Local Unemployment Index. A few district series are obtained from issues of the Ministry of Labour Gazette.

working, automotive and aircraft industries and comprise 84.8% of the total EEF membership over our study period. Figure 5 shows, for the same sample of districts as in Figure 2, wide diversities among local unemployment rates. London and Coventry rates never exceeded 20% while Dundee and Halifax reached rates in excess of 35%.

4. Payment methods, hours of work, and district unemployment breakdowns

We now examine the potential value added of the EEF data. The discussion is supplemented by an Appendix that offers a slightly more formal representation of several key points raised.

Rates of pay versus hours of work adjustments

Why might we expect adjustments of working hours to be relatively more important than adjustments of hourly rates of pay in the determination of earnings changes in our inter-war payroll data? There are three main reasons.

- (a) Compared to altering wage rates and piece rates, changing weekly hours of work provided a direct and simple firm-level means of adjusting labour inputs and labour costs to large and rapid changes in product prices and product demand. Wage rate setting was subject to a three-tier bargaining process, embracing national-¹⁴, district-, and firm-level employer-

¹⁴ Engineering pay setting during WWI had a major bearing on tendencies towards national-level bargaining in later years. The National Wages Agreement of 1917 introduced an arbitration system that adjudicated three times a year in respect of national uniform wage increases as well as engineering district rates. Although the Agreement ceased in 1920, national-level bargaining continued up to 1948. Also during WWI, a bonus was granted to engineering workers due to the increased cost of living during the war. This was intended to be

union negotiations. National agreements determined annual standard time rates for skilled fitters and labourers. These were then used to establish relative wages for other skill groups. But subsequent district-level and firm-level bargaining produced a multiplicity of deviations from these national rates in order to accommodate local market conditions. Even with piece rates, involving a far more complex remuneration structure, there were national-level attempts at establishing pricing guidelines.¹⁵

(b) Weekly manufacturing industry hours in inter-war Britain were high relative to the post-war era. This offered employers considerable scope to maintain viable production levels while at the same time effecting significant reductions in the length of the workweek and, therefore, in the sizes of their payrolls. While workers' weekly take home pay suffered as a result of lower rates of utilisation of labour input, rapid price reductions (see Figure 4) combined with a relatively sluggish process of reaching nominal pay settlements helped maintain the levels of real hourly pay. Further, robustness of real hourly pay may in part have resulted from working time cuts combined with diminishing returns in average daily and/or weekly hours.

a temporary measure but, although significantly reduced in 1922, it continued to be paid over the inter-war period.

¹⁵ Based on a worker with 'average ability', national agreements established a percentage mark-up that a pieceworker might be expected to earn compared with the standard time rate within the same occupation. As with time rates, however, local conditions dictated that piece rates, as well as piece rate - time rate differentials, varied substantially within firms, across firms and through time.

(c) For many firms, hours cuts offered large marginal falls in per unit labour costs because overtime hours were remunerated at highly favourable rates.¹⁶

Piece work and time work

Between 1927 and 1937, 53% of the British EEF workforce was paid piece rates and 47% time rates. In fact, within the industrial sectors covered by the EEF, piecework was also an important payment method elsewhere in Europe at this time.¹⁷ There are four strong reasons for separating timeworkers and pieceworkers in the study of wage cyclicity.

i) Since in the short-term piece-rated pay is linked more closely to output than time-rated pay, we might expect the former to exhibit more responsiveness to business cycle fluctuations than the latter. Based on the Panel Study of Income Dynamics (PSID), Devereux (2001) finds that hourly earnings responses of individuals whose pay is linked directly to output (including piece-rates) are significantly more procyclical than those of

¹⁶ Throughout all EEF member firms, weekly standard hours were divided into 'standard days' (5 weekdays and Saturday mornings) and overtime pay applied to daily hours in excess of the laid-down standard daily hours. Both timeworkers and pieceworkers received premium pay for overtime hours. The calculation for a pieceworker was based on a mark-up of his so-called minimum piecework standard. From 1920 to 1930, overtime was typically paid at time and a half 'basic' rates if worked on Mondays to Saturdays and at double time for Sundays and public holidays. From 1931 to 1946, the first two hours of daily overtime were paid at time and a quarter and subsequent hours at time and a half. The rules of overtime payments are described in detail in Knowles and Hill (1954).

¹⁷ The British Ministry of Labour Gazette (January 1933, p. 13) reports on a large enquiry, covering 214,000 workers and undertaken in October 1931 by the German Federal Statistical Office. It covered pay and hours in the German metal and engineering industries within 502 plants in 103 localities. It is reported that 65% of skilled and semi-skilled workers and 23% of unskilled workers were on piece-rates. In the October 1931 EEF returns, the respective percentages are 59% and 16%.

hourly paid and salaried workers. Based on pre- and post-war EEF data, Hart (2008) also finds significantly greater inter-war hourly wage procyclicality among pieceworkers compared to timeworkers, though less pronounced than in Devereux's study.

- ii) As illustrated in Appendix (A), there is a potential problem of workforce composition bias in the estimation of wage cyclicality. If lower ability, lower paid workers are more likely to be laid off during a recessionary downturn and dominate new hiring during the subsequent upturn then this introduces a countercyclical bias when using aggregate wage measures. *Ceteris paribus* the problem of composition bias may be greater among pieceworkers than timeworkers. Piece work introduces a requirement to monitor each individual's output per period and thereby provides records on which systematically to rank employees, or work groups, by productive performance
- iii) Procyclical working hours of timeworkers correlate positively with both weekly pay and, given overtime working, hourly pay.¹⁸ In other words, the intensive margin effects of hours on the weekly and hourly pay of timeworkers are unequivocally procyclical. In contrast, the intensive margin effects on the cyclicality of piecework pay are uncertain.

¹⁸ Let hourly earnings be expressed as a geometric average, with w representing the standard hourly rate and the overtime premium fixed at k_0 (e.g. one-and-a-half times the standard rate). We have $e = w^\lambda (k_0 w)^{(1-\lambda)}$ where $\lambda = h_s/h \leq 1$ and where $(1 - \lambda)$ is the share of standard weekly hours (h_s) to total hours. Let the rate of unemployment, U , proxy the cycle. Then, taking logs, rearranging, and expressing in terms of time t , differentiation with respect to U_t yields: $d \log e_t / d U_t = d \log w_t / d U_t + \log k_0 [d(1-\lambda) / d U_t]$. Since the share of overtime, $(1-\lambda)$, is procyclical this increases the procyclicality of hourly wage earnings compared with hourly wage rates.

They depend on a combination of length of working hours and effort per hour and, therefore, on whether these two variables act as complements or substitutes.¹⁹

iv) As illustrated in Appendix (B), the problem of composition bias among skilled workers may be exacerbated due to intensive margin effects. During a cyclical downturn, actual pay of skilled workers may be less responsive to the cycle than that of the less skilled if firms show a propensity to hoard skilled labour inputs in order to protect sunk investments.²⁰ However, this effect is likely to be less potent in the case of piece work where pay relates directly to actual productivity per period. In other words, the distinction between paid for and effective working time is less meaningful when remuneration is linked directly to performance.

National bargaining, district bargaining, and the cycle

Given some degree of national bargaining in the EEF, we follow most of the wage cyclicity literature by using the national unemployment rate to represent the business cycle. However, we know that for both wage rates and piece rates local bargaining contributed importantly to final pay settlements.²¹ Older traditional engineering industries (such as textile

¹⁹ This problem has been analysed more formally via a labour supply model (Pencavel, 1977) and a union-employer bargaining model (Hart, 2008).

²⁰ For example, skilled fitters in the EEF would normally have served a 5-7 year apprenticeship in sharp contrast to labourers who required minimal training.

²¹ Knowles and Hill (1954) succinctly summarise the position for each payment method. In the case of time rates, they conclude: "All rates fixed by national agreement are essentially minima, the national-agreed differentials may be disturbed or even inverted by firms paying more than the minima all round". For piece rates, they conclude: "Owing to the immense number of different processes and operations in so heterogeneous an industry, as well as to the rapidity of

engineering, heavy engineering, marine engineering) were concentrated in the north of Britain, with specific industries tending to cluster in specific districts. Midland and southern engineering districts, by contrast, enjoyed significant concentrations of modern industries (car manufacture, aircraft construction, related light engineering), again with high degrees of specific geographical clustering. So, in important respects, local collective bargaining was conducted in distinctly different product and labour markets. At least in the short-run, capital and labour mobility were not serious concerns due both to the severity of the Depression and to occupational and skill mismatches. Under these circumstances, we would expect that local conditions played an important – perhaps the predominant - role in bargaining outcomes over pay. Accordingly, we also study the influence of district unemployment rates on pay and hours cyclicality.

5. Estimation and Findings

(a) Estimation

Given the arguments in Section 4, our wages and hours regressions are undertaken separately for pieceworkers and timeworkers. Estimation for each of these pay groups is carried out in respect of average weekly hours, average real weekly earnings, and average real hourly earnings. Additionally, in the case of timeworkers, we also include average real standard hourly earnings, which exclude overtime. Again following discussion in Section 4, estimation is undertaken in respect of a single aggregate measure of the cycle – the EEF national aggregate unemployment rate shown in Figure 1(b) – as well as using EEF district unemployment rates.

technical development, any general control over piece-work earnings can be no more than minimal...”

We illustrate the estimating equations with reference to the real weekly earnings of pieceworkers, which we label E^P .

Our first estimation using national unemployment rates is close to the specifications of equations (2) and (3). For occupation j in district r at time t , the step 1 estimating equation is given by

$$(5) \quad \Delta \log E_{jrt}^P = d_j + d_r + \sum_{t=1}^T \eta_t d_t + u_{jrt}$$

where d_j is an occupation dummy, d_r is a district dummy and where d_t is a time dummy equal to 1 if the observation is from year t , and u_{jrt} is an error term. The estimated coefficients on the time dummies, $\hat{\eta}_t (t = 1, \dots, T)$, are then regressed in step 2 on the change in the national unemployment rate and a time trend, $YEAR_t$, or

$$(6) \quad \hat{\eta}_t = \beta_1 + \beta_2 \Delta U_t + \beta_3 YEAR_t + v_t.$$

We estimate (4) by OLS and (5) by WLS where the weights in the second stage are the number of individuals represented in each year. Again, we compare outcomes using consumer price and final output price deflators.

Our second specification focuses on area-specific bargaining and therefore incorporates district unemployment rates as the representation of the cyclical influences. In this instance, price changes are controlled for through the fact that the regressions incorporate both industry and time fixed effects. Since we are using occupational breakdowns, we continue to have a clustering problem using district rates. Within a given district different occupations may share common components of variance that are not captured by the district rate.

So, we again adopt the 2-step method. We have in step 1

$$(7) \quad \Delta \log E_{jrt}^P = d_j + \sum_{t=1}^T \sum_{r=1}^R \psi_{rt} d_{rt} + \varepsilon_{jrt}$$

where d_j is an occupational dummy, d_{rt} is a district dummy that takes the value of 1 for district r at time t (over R districts and T time periods) and ε_{jrt} is an error term. In step 2, estimates of ψ_{rt} are regressed on the change in district-level unemployment rates (ΔU_{rt}) plus section and time intercepts

$$(8) \quad \hat{\psi}_{rt} = b_1 \Delta U_{rt} + d_r + d_t + v_{st} .$$

Therefore, we fully account for occupation, district, and time fixed effects. Examples of district effects include industrial composition, the vintage of capital, occupational skill-mix, the strength of union representation. We estimate (6) by OLS and (7) by WLS where the weights in the second stage are the number of individuals in each district in each year.

(b) General findings

Starting with the single national EEF unemployment rate, the top half of Table 6 presents separate timeworker and pieceworker estimates of cyclicity based on equations (5) and (6). No significant differences are found between choices of deflator. Weekly hours and real weekly earnings are strongly procyclical and not statistically different between the two pay groups. A one point increase in the rate of unemployment is associated with a 1 percentage reduction in weekly real earnings. These estimates are on a par with the modern North American and European micro estimates with respect to the hourly earnings of job stayers (Pissarides, 2009, Tables II and III). Real hourly earnings are also procyclical and not significantly

different between the two pay groups. However, the pieceworker estimates are especially well fitted and indicate that a one point increase in the rate of unemployment is associated a 0.3 percentage reduction in real hourly earnings. In the case of timeworkers, since real standard hourly pay of timeworkers is found to be acyclical it is clear that earnings procyclicality is driven by hours procyclicality.

Equations (7) and (8) incorporate district unemployment rates and focus on area-specific departures from the national unemployment effect. Results are shown in the lower half of Table 6. Weekly hours and real weekly earnings remain strongly procyclical for both timeworkers and pieceworkers and again there are no significant differences in outcomes between these payment methods. However, their degrees of cyclicity are reduced by between 30% and 50% compared to their equivalents using national-level unemployment. This direction of finding is not confined to this study. Using the Panel Study of Income Dynamics to estimate real wage cyclicity in the U.S., Devereux (2001) reports that replacing the national unemployment rate with state unemployment rates produces generally lower estimated cyclicity. Real hourly earnings procyclicality for pieceworkers remains robust and compares in magnitude with results using the national-unemployment rate. However, the degree of cyclicity for pieceworkers is now found to be significantly different from that of timeworkers. The latter estimates indicate acyclical hourly earnings for timeworkers when estimated at the local level.

Two sets of results stand out in Table 6. In the first place, real weekly earnings are much more procyclical than real hourly earnings. At least in the case of timeworkers we know that

the real standard hourly rate of pay was unresponsive to the cycle. This left employers with two alternative ways to adjust their real payroll costs. They could reduce the length of the standard workweek and/or the share of overtime hours within total hours. We further investigate these two mechanisms below. In the second place, although the elasticities are not large, the hourly earnings of pieceworkers are significantly more procyclical than their timeworker equivalents in the area-specific regressions. Like timeworkers, pieceworkers were paid overtime rates for hours in excess of the maximum 47 hours standard workweek. So, the overtime effect on wage cyclicity applied to both groups. However, pieceworker's intensive margin pay is conditioned not only by the length of working hours but also by work intensity per period.

Composition biases?

Estimates of wage cyclicity using aggregate data may be downwardly biased due to employment compositional effects. At least in the early stages of the Depression, employers may have reduced disproportionately their stocks of lower skilled and/or less able workers in order to preserve sunk investments in apprenticeship training as well as the general quality of human capital. To the extent that low skilled workers dominated subsequent unemployment numbers, they were likely to have been disproportionately hired during the economic recovery stages. One potentially major curb on such a firing and hiring strategy in inter-war Britain was the fact that the manufacturing workforce was heavily unionized.

The problem of composition bias is dealt with in individual-level panels by differencing wage-unemployment equations in order to control for the first-order effects on wages of such

features as an individual's ability, work application, motivation, educational background (Bils, 1985; Solon, Barsky and Parker, 1994). Our most disaggregated units are blue collar pieceworkers or timeworkers by occupation and by engineering district. We cannot, therefore, control for personal attributes that may influence firms' decisions on who to dismiss and who to retain during the downturn of the cycle. But we can at least go further than previously possible for this time period. First, our occupational wages are delineated to some considerable degree by skill level, from skilled fitters to labourers. For example, as shown in Table 2, we can differentiate not only between fitters and other core occupations but also between skilled fitters and fitters other than skilled. Second, we are able to distinguish between pieceworkers and timeworkers. More able workers are likely to self select into piece work perceiving that an incentive compatible payment system is likely better to reward their relative work advantages (Lazear, 1986; Brown, 1990). Third, educational background did not display wide variations across the blue collar workforce during the 1920s and 1930s, with the large majority of workers receiving only basic school education, leaving school at the minimum age of 14.²²

While we would expect to find that the wage bias resulting from workforce composition effects would be countercyclical this does not necessarily imply that greater disaggregation would necessarily lead to the observation of greater wage procyclicality. Another form of composition bias, related to firms rather than workers, may run in the opposite direction. So,

²² From the 1979 British Labour Force Survey, we can establish that for those workers under the age of 18 between 1929 and 1937, 65% left school at age 14, 13% at age 15 and 5% at under the age of 14. It is unlikely that manufacturing blue collar workers accounted for more than a small fraction of the remaining 17%.

for example, if high wage firms are more sensitive to fluctuations in the business cycle then this would lead to procyclical biases within industry-level aggregation while firm-level disaggregation may lead to *lower* procyclicality (Chirinko, 1980; Barsky and Solon, 1989).

It is clearly of interest to find out the effects on estimated cyclicity of aggregating our data to the level of the complete EEF company membership. For pieceworkers and timeworkers separately, we constructed aggregate measures of our wage and hours variables by time period, weighting by the number of individuals employed each year. Thus, our complete data for each pay group are reduced to 11 annual observations. Of course, we are limited to using the national unemployment rate to represent the cycle. Taking the real weekly earnings regression for pieceworkers as an example, we have

$$\Delta \log E_t^P = c_0 + c_1 \Delta U_t + c_2 YEAR_t + \varepsilon_t.$$

Results are shown in Table 7. In the event, outcomes are in line with the estimates shown in Table 6. Weekly hours and earnings are strongly procyclical, as are the hourly earnings of pieceworkers. These findings are reflective of a similar exercise undertaken by Bils (1985) who, when aggregating his real wage data along similar lines, found that his estimates of wage procyclicality remained undiminished. They suggest that compositional biases are probably not strongly influential on findings in the EEF data.

(c) The role of working time and the north-south district dichotomy

There are two hours' effects on pay cyclicity. First, cuts in the length of the standard workweek serve to reduce weekly earnings while leaving average hourly pay unaffected. Second, falls in the share of overtime hours reduce hourly pay because overtime is

remunerated at a premium rate. Dividing districts into northern and southern/midland may help cast more insight on these two pay repercussions. As shown in Table 4, during the Depression years northern districts experienced greater falls in standard hours compared to southern/midlands districts. By contrast, overtime working comprised a larger share of weekly hours in the latter compared to the former group of districts and so may have provided a more important buffer to cyclical fluctuations.

Estimation was undertaken with respect to these two district groupings. Again, we distinguish between national and district unemployment effects. Results are presented in Table 8. Using the national unemployment rate, there are no significant differences between north and south/midlands outcomes and, moreover, findings remain strongly in line with outcomes in Tables 6 and 7. District-level results produce modifications to earlier findings. First, contrary to northern districts, estimated weekly hours are found to be acyclical in the southern/midland districts. This is reflective of Figure 2 where it is shown that weekly hours in London and Coventry – two of the largest districts in the south and midlands with high concentrations of modern engineering and metal working activities – displayed mild weekly hours reactions to the cycle and continued to average significant overtime working throughout the Depression. In line with these hours regressions, estimated procyclicality of real weekly earnings is weaker in the south/midlands than in northern districts. Second, real hourly earnings procyclicality of pieceworkers in southern/midland districts – with a coefficient of -0.64 - were considerably higher than in the north. Although less pronounced, the same relative effects applies to timeworkers. At least in part, this is due to the fact that, in the former districts overtime hours

as a share of total hours was more significant and acted more effectively as a pay buffer to downturns in production activity.

8. Conclusions

Measuring adjustments in the price of labour services on the basis of annual pay averaged over highly disaggregated manufacturing industrial breakdowns reveals, at best, weak procyclical real wage responses during the Great Depression. The same conclusion applies to the real hourly wage earnings of time-rated workers in engineering and metal working industries who are broken down by detailed blue-collar occupations and by travel-to-work geographical districts. Somewhat stronger, though still quite modest, indications of procyclical real hourly earnings is found among piece-rated workers using these latter breakdowns. It should be added that in metal and engineering industries far greater proportions of workers were paid on piece-rate systems than is the case today. On aggregate, therefore, this offered an important source real pay responsiveness to the cycle, and one that has not been previously noted in the earlier literature.

However, and especially in relation to the Great Depression, annual and hourly pay measures share a common short coming. They fail to capture adequately the fact that employers altered weekly paid-for hours as the principal means of adjusting labour costs to the prevailing economic conditions. A critical related consideration is that these hours' responses were uneven across geographical areas. For example, they were much more important to employers in traditional engineering and metal working firms that were located,

predominantly, in northern districts. Changes in real annual pay, even highly disaggregated by manufacturing subdivisions, fail to reflect adjustments in paid-for hours and miss the locational dimension. Changes in real hourly pay reflect the unit price effects of changes in the share of overtime to total worked hours but are unaffected by the more quantitatively important cuts in the standard workweek. It is real weekly wage earnings that matter. In fact the finding of a one point increase in the national rate of unemployment associated with a one percent real weekly wage reduction is highly reflective of modern European and North American micro findings in respect of hourly real pay.

So why were adjustments in real weekly pay relatively important during the Great Depression and adjustments in hourly pay relatively important today? There are at least three strong reasons. First, national wage agreements in the private sector – aided and abetted by a strong union culture – played a more important role in earlier times. Firm-based hours adjustments offered a less constrained means of altering labour costs, especially during a time of large unanticipated product demand changes. Second, weekly hours of blue collar workers were significantly higher in the 1920s and 1930s compared to present times. Hours could be reduced quite significantly while still providing employees with a living wage due in part to the fact that real hourly pay was left more or less unaffected. Third, and consequentially, hours' adjustments provided an efficient means to employers of simultaneously adjusting both pay and output to exceptional cyclical demand fluctuations.

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Appendix: Wages, Hours and the Cycle

Within a simple framework, we bring together here the key variables and concepts relating to the discussion in Section 4. Thus, we consider a representative firm that employs two homogeneous groups of workers. Group 1 consists of skilled and productive workers and group 2 comprises less skilled and less productive workers. All workers are time rated. At time t , each worker in group 1 is paid a standard hourly wage, w_{1t} and each worker in group 2 receives w_{2t} . The skill differential is reflected by $w_{1t} > w_{2t}$.

(A) Wages, hours, and workforce composition bias.

For simplicity, let all workers work the same total hours and the same length of weekly overtime. Each worker's total weekly hours of work, h_t , are divided into two parts, or

$$(i) \quad h_t = h_{s_t} + (h_t - h_{s_t})$$

where h_{s_t} represents standard weekly hours and where $(h_t - h_{s_t}) \geq 0$ represents overtime hours. Further, all workers receive compensation for each hour of overtime at a constant mark-up, k ($k \geq 1$). In fact, this is a simplification that closely approximates the system of overtime remuneration across EEF member firms.

Each skill group's geometric mean hourly wage rate is

$$(ii) \quad \hat{w}_{jt} = (w_{jt})^{\lambda_t} (k \cdot w_{jt})^{1-\lambda_t} \quad (j = 1, 2)$$

where $\lambda_t = h_{s_t}/h_t$. Then, taking logs, we have

$$(iii) \quad \log \hat{w}_{jt} = \log w_{jt} + (1 - \lambda_t) \ln k .$$

The geometric mean weekly earnings across all workers in the firm is

$$(iv) \quad E_t = (\hat{w}_{1t})^{\gamma_t} (\hat{w}_{2t})^{1-\gamma_t} .h_t$$

where $\gamma_t = H_{1t}/H_t$, or group 1's share of total payroll hours (i.e. $H_t = \Sigma h_t$ over all workers and $H_{1t} = \Sigma h_{1t}$). Hence

$$(v) \quad \log E_t = \log \hat{w}_{2t} + \gamma_t (\log \hat{w}_{1t} - \log \hat{w}_{2t}) + \log h_t .$$

Let the state of the business cycle at time t , be represented by the national unemployment rate, U_t . Substituting (iii) into (v) and differentiating with respect to U_t we have

$$(vi) \quad \frac{d \log E_t}{dU_t} = \frac{d \log w_{1t}}{dU_t} (\gamma_t) + \frac{d \log w_{2t}}{dU_t} (1 - \gamma_t) + \frac{d \log \gamma_t}{dU_t} (\log w_{1t} - \log w_{2t}) + \frac{d \log h_{st}}{dU_t} - \frac{d \lambda_t}{dU_t} (\log k) .$$

In the context of the Great Depression years, it is difficult to take a strong *a priori* view concerning the cyclicity of standard wages - i.e. $d \log w_{jt} / dU_t$ ($j = 1, 2$). By contrast, we would expect that $d \log \gamma_t / dU_t > 0$ or that the share of skilled to total workers would be countercyclical. This represents a workforce composition bias. The last expression in (vi) would be expected to be procyclical or $d \lambda_t / dU_t < 0$: the share of overtime to total hours varies positively with the cycle. As for the penultimate expression, we would anticipate that it is either procyclical or acyclical, i.e. $d \log h_{st} / dU_t \leq 0$. For mild recessions, overtime hours may act as a buffer that

soaks up the fluctuations in business activity leaving standard hours constant. In more severe recessionary periods – and certainly during the Great Depression- standard hours would themselves reduce as short time working schedules are introduced.

We can easily adjust the set-up here to reflect differential overtime hours between group 1 and group 2 workers. Outcomes would be expected to be conditioned by the degree of complementarity between skilled and unskilled workers. For example, group 1 workers may experience less elastic weekly hours responses to cyclical fluctuations in which case we may observe both extensive and intensive margin compositional bias effects. As business activity declines group 1's share of the total payroll may rise due to (a) a higher propensity to layoff group 2 workers, and (b) group 1's increased relative share of overtime hours paid for at a premium rate.

(B) Paid-for and effective hours

So far we have assumed that there is no slack time. What if we were to introduce the notion that worsening business activity may result in a divergence between paid-for hours and effective hours? The best known motivation of such an outcome is the labour hoarding hypothesis (Oi, 1962). Firms may be prepared to allow underutilisation of labour inputs, at least in the short-run, if they calculate that the marginal costs associated with falls in hourly productivity are less than the anticipated marginal costs of losses of human capital due to separation. Suppose that, for this type of reason, the industry is risk averse about losing skilled workers. By contrast, and for simplicity, it is assumed that the firm does not allow reductions in hourly productivity among less skilled workers because separation costs in this case are perceived to be relatively low.

Again, we concentrate on time rated workers. Since overtime working and labour hoarding are unlikely to occur contemporaneously, we assume $(h_t - h_{st}) = 0$ in (i) and so $h_{st} = h_t$. Let $h_{1t} \geq h_{1t}^e$ where h_{1t}^e is effective hours worked of skilled workers and h_{1t} is actual, or paid-for, hours.

The mean hourly wage rate of the skilled group is

$$(vii) \quad \tilde{w}_{1t} = (w_{1t})^{\theta_t} (\alpha \cdot w_{1t})^{1-\theta_t} \quad (\alpha \leq 1)$$

where $\theta_t = h_{1t}^e / h_{1t} \leq 1$ and the constant α recognises that unproductive hours may be remunerated at less than the standard hourly wage rate.

Re-expressing (vii) in logs:

$$(viii) \quad \log \tilde{w}_{1t} = \log w_{1t} + (1 - \theta_t) \log \alpha.$$

Average weekly earnings across both work groups are given by

$$(ix) \quad E_t = (\tilde{w}_{1t})^{\gamma_t} (w_{2t})^{1-\gamma_t} \cdot h_t. \text{ }^{23}$$

Logging (ix) and using (viii) gives

$$(x) \quad \log E_t = \gamma_t \log w_{1t} + (1 - \gamma_t) \log w_{2t} + \gamma_t (1 - \theta_t) \log \alpha + \log h_t.$$

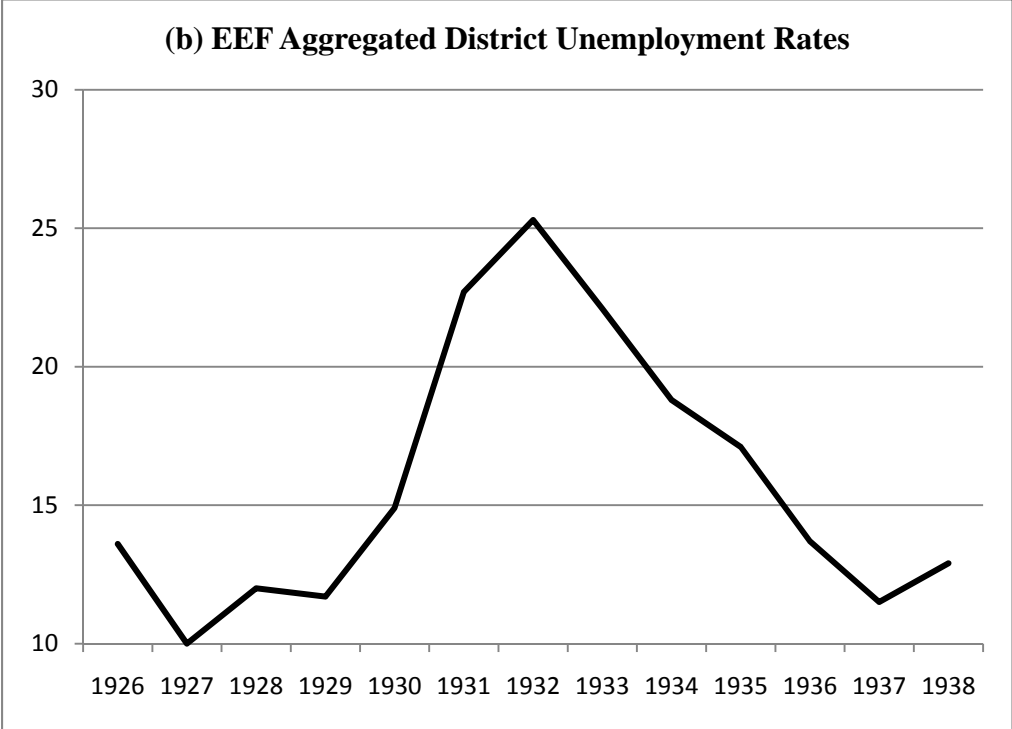
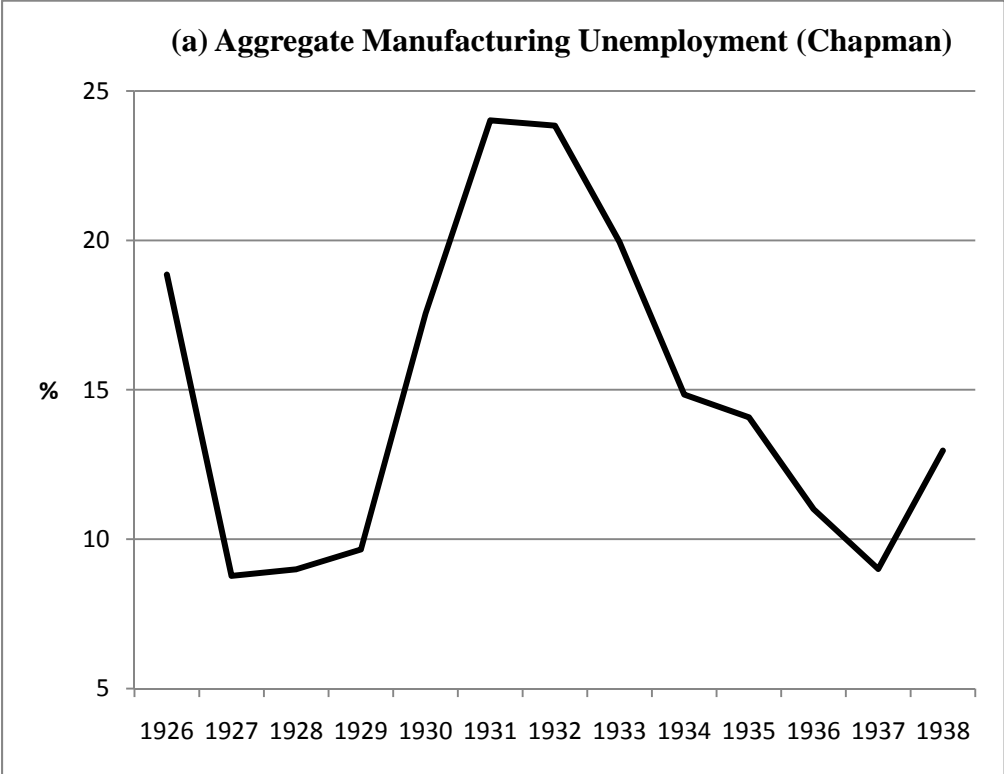
Differentiating (x) by U_t produces

²³ We again use γ_t to represent group 1's share of total payroll hours though we note that group 1's hours comprise the addition of effective and hoarded hours.

$$(xi) \quad \frac{d \log E_t}{dU_t} = \frac{d \log w_{1t}}{dU_t}(\gamma_t) + \frac{d \log w_{2t}}{dU_t}(1 - \gamma_t) + \frac{d \log \gamma_t}{dU_t} \{(\log w_{1t} - \log w_{2t}) + [(1 - \theta_t) \log \alpha]\} \\ - \frac{d \log \theta_t}{dU_t}(\gamma_t \cdot \log \alpha) + \frac{d \log h_t}{dU_t}.$$

The key outcome is that, compared to expression (iv), allowing skilled paid for hours to diverge from effective hours adds to the problem of composition bias. First, and recalling that $dy_t/dU_t > 0$, the bias is now reflected not only through $w_{1t} > w_{2t}$ but also by the term $[(1 - \theta_t) \log \alpha] \geq 0$, which represents payment to skilled workers during slack time. Second, $-d\theta_t/dU_t \geq 0$ represents a countercyclical hours' effect on earnings; the proportion of slack to total hours increases during a downturn. In summary, a rise in unemployment may associate on the intensive margin with increases in (a) the skilled wage above its effective rate and (b) skilled workers' share of total hours through the creation of a positive gap between paid-for and effective hours.

Figure 1 National-level unemployment rates, 1926 – 1938



**Figure 2 Weekly hours of time-rated workers (selected districts),
1927-1937**

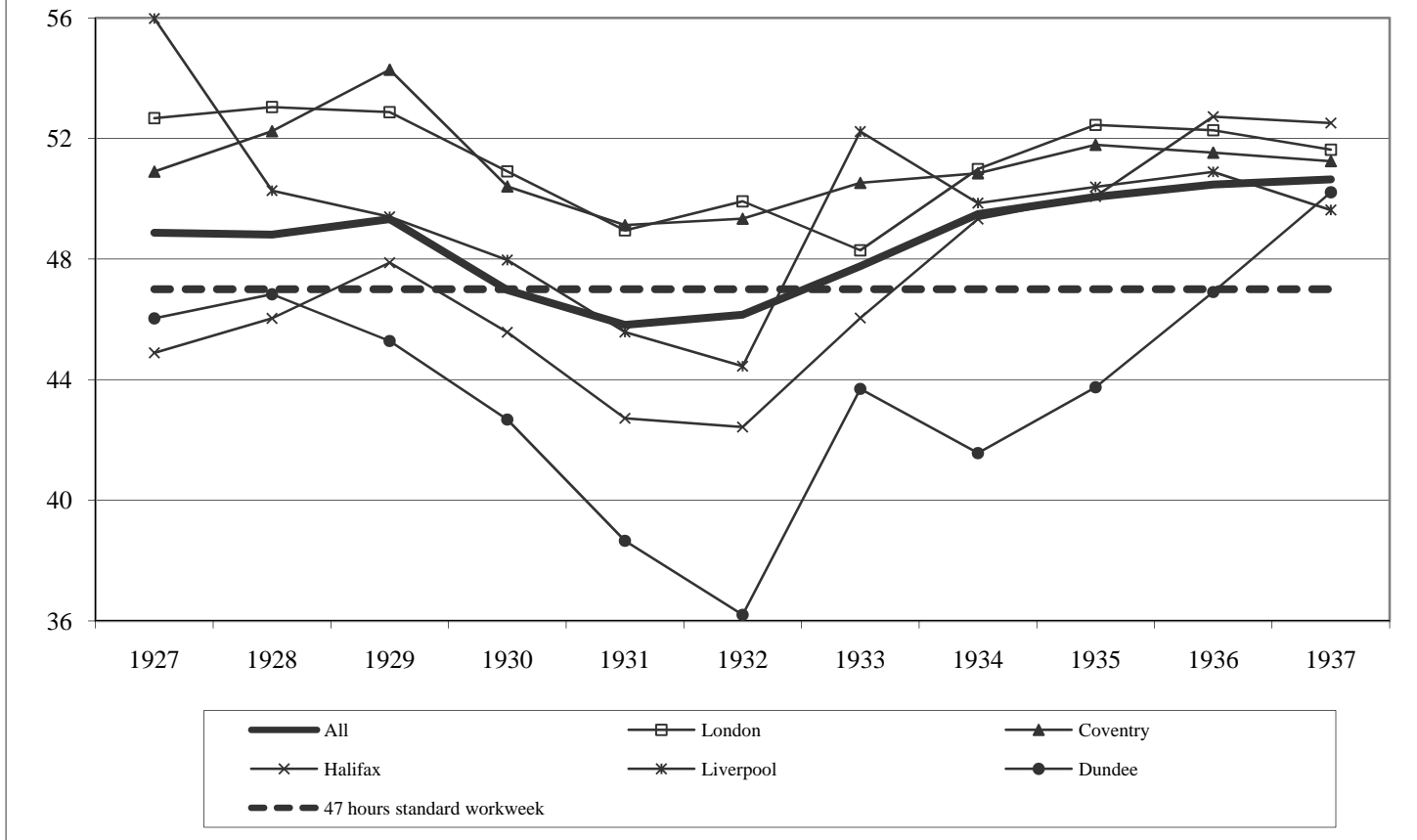


Figure 3 Time-rated workers' share of overtime within total weekly hours in selected occupations, 1927-1937

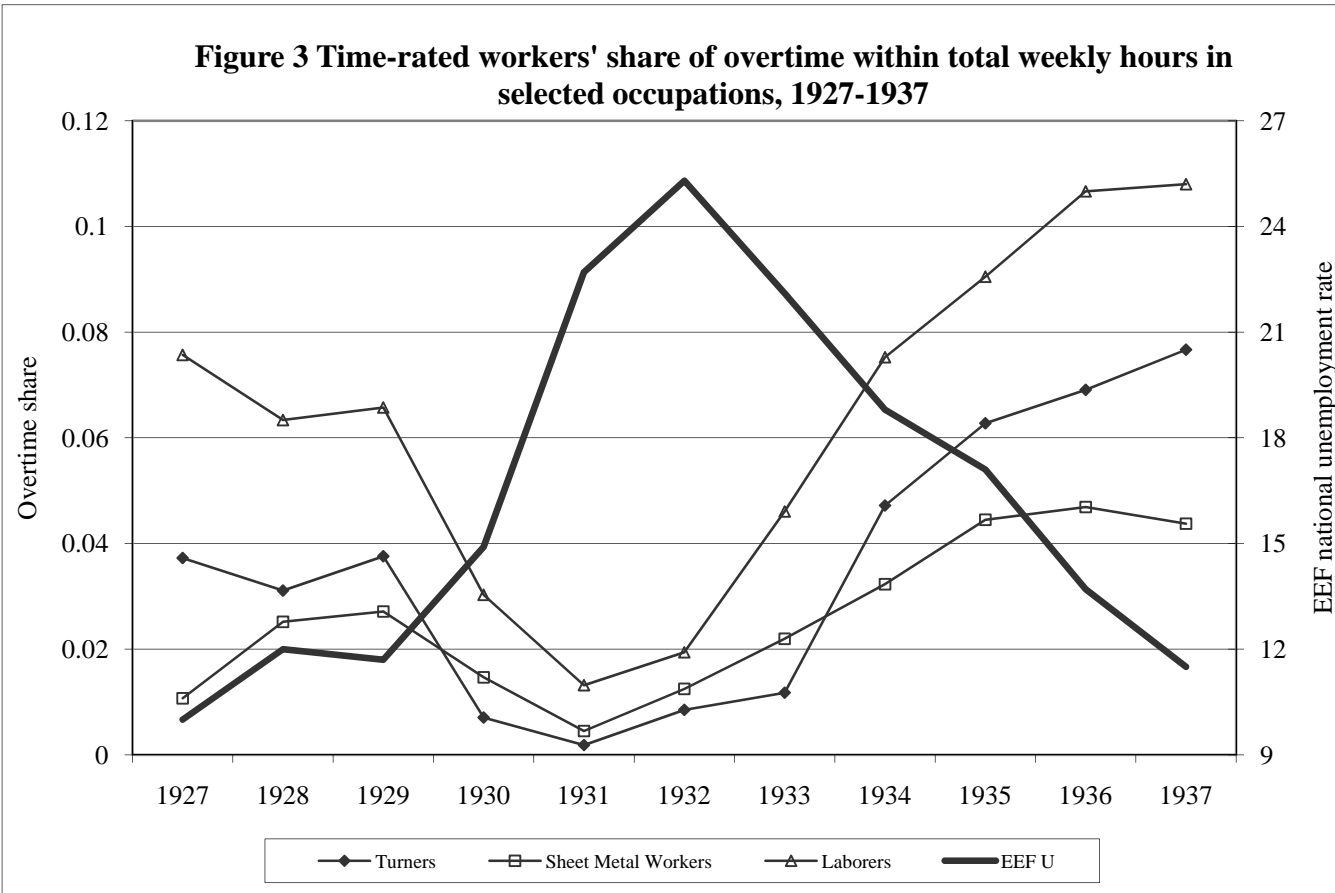


Figure 4 Aggregate hours, prices, wages, and unemployment, 1927-1937 [timeworkers = t/w; pieceworkers = p/w]

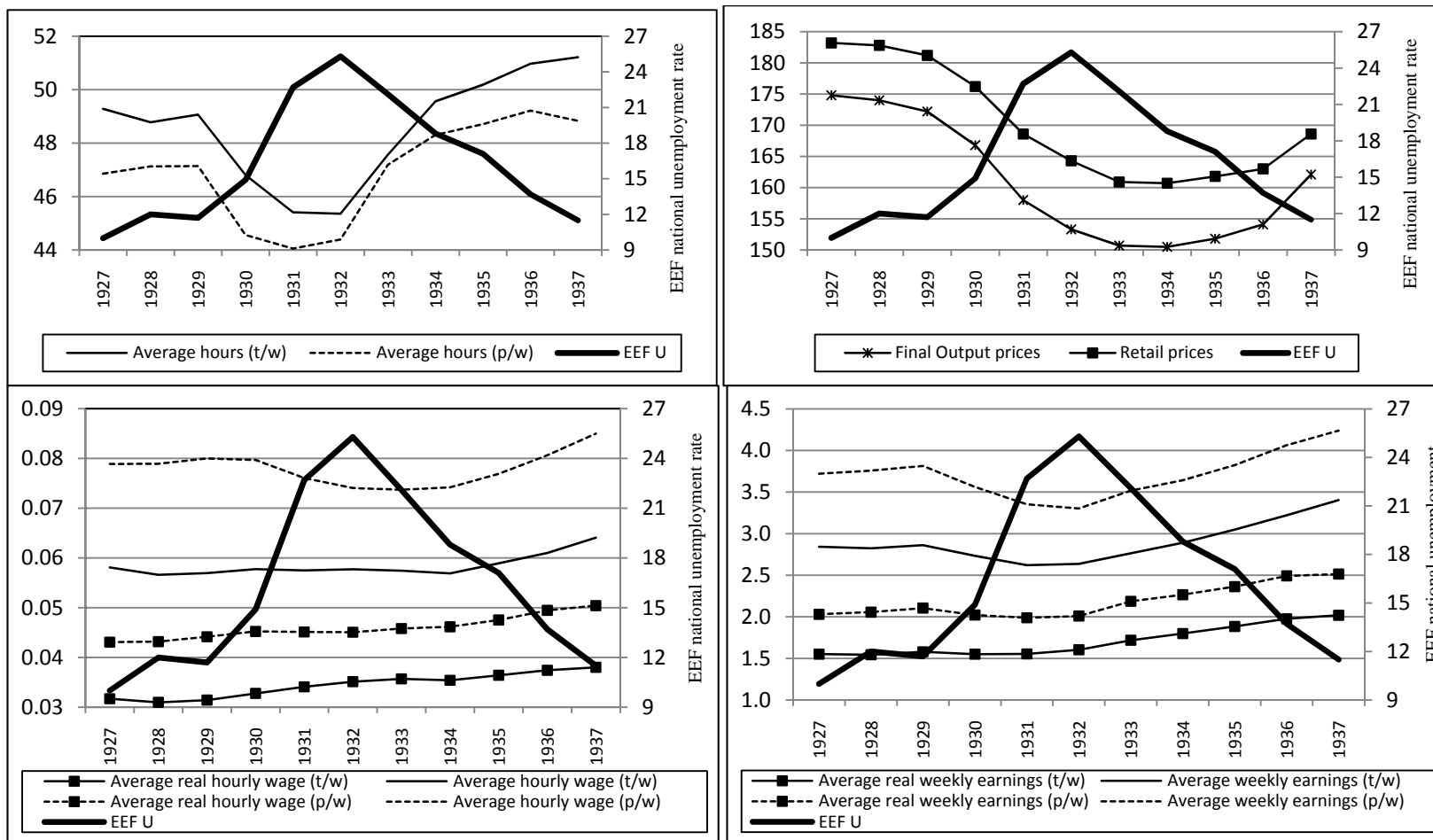


Figure 5 Unemployment rates in selected EEF districts, 1927-1937

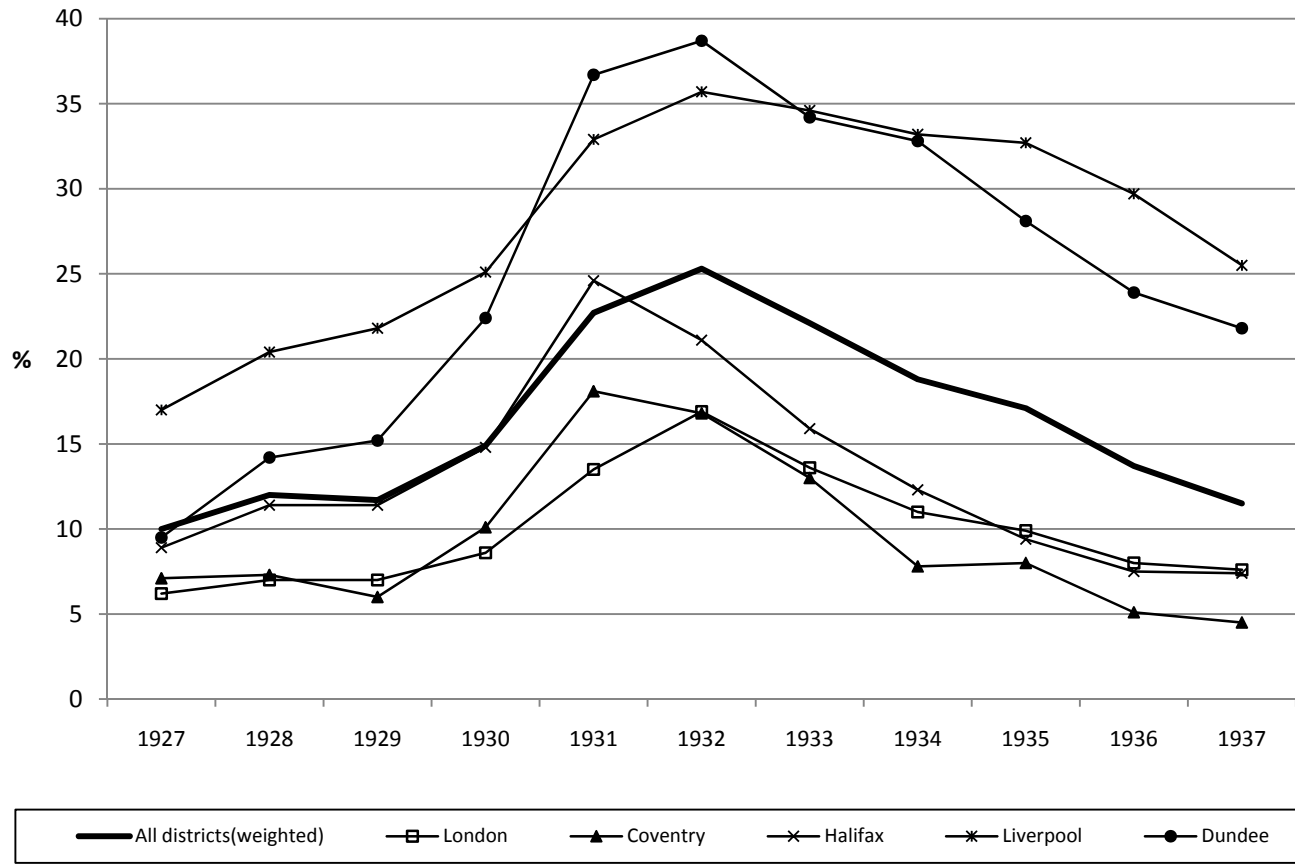


Table 1 Real wage cyclicality by manufacturing industries (annual pay), 1927– 1937: Chapman data

	Wage change-unemployment estimate	Wage change-unemployment estimate	Unemployment Rate	No. Obs.
	Consumer price index deflator	Final output price deflator		
Aggregate, all industries	-0.090 (0.098)	0.048 (0.194)	National	11
Aggregate, manufacturing	-0.057 (0.056)	-0.059 (0.079)	All manufacturing	11
14 Manufacturing industries (main industrial headings)	-0.109* (0.063)	0.186** (0.071)	All manufacturing	154 (11)
36 Manufacturing industries (sub headings)	-0.141 (0.078)	0.178** (0.060)	All manufacturing	396 (11)
	Price deflation through cross-section and time series dummies			
14 Manufacturing industries (main industrial headings)	-0.050* (0.025)		By 14 industrial headings	154
36 Manufacturing industries (sub-headings)	-0.062* (0.025)		By 36 sub-headings	396

Robust standard errors in brackets with ** (*) indicating 0.01(0.05) significance on a two-tail test.

Industries: Treatment of non-metalliferous mining products (not coal): Bricks, cement etc; China , earthenware; glass; **Chemicals: Metal Manufacture:** iron and steel; non-ferrous metals, smelting; **Engineering,shipuilding and electrical goods:** shipbuilding naval dockyards; mechanical engineering; ordinance factories; electrical engineering; **Vehicles:** vehicle manufacture; railway shops; motor vehicle repair; **Metal goods n.e.s.:** brass manufacture; other metal goods; **Precision instruments, jewelry, etc:** **Textiles:** cotton spinning, doubling etc.; woollen and worsted; rayon, nylon etc. production, weaving, silk; linen, soft hemp, jute; hosiery and other knitted goods; textile finishing; other textile trades; **Leather, leather goods and fur:** **Clothing:** clothing trades; manufacture and repair of boots and shoes etc.; **Food, drink and tobacco:** food; drink; tobacco; **Manufactures of wood and cork:** timber trades; furniture; **Paper and printing:** paper and board, wallpaper; printing works, H.M. Stationary Office; paper, publishing and other paper using trades; **Other manufacturing industries.**

Table 2 Industries, Occupations, Engineering Sections and Engineering Districts covered in the Inter-War EEF Payroll Data

<p>Industries covered by EEF membership (Using Ministry of Labour classifications)</p>	<p>Heating and Ventilation Apparatus; Scientific & Photography; Motor Vehicles, Cycles & Aircraft; Metal; Industries not separately specified; Constructional Engineering; Iron & Steel Tubes; Stove, Grate, Pipe etc & general Iron Founding; Explosives; Hand Tools, Cutlery, Saws, Files; Marine Engineering; Brass, Copper, Zinc, Tin, Lead etc.; General Engineering; Brass and Allied Metal Wares; Watches, Clocks, Plate, Jewellery etc.; Wire, Wire Netting, Wire Ropes; Steel Melting & Iron Puddling, Iron & Steel Rolling and Forging; Bolts, Nuts, Screws, Rivets, Nails etc.; Tin Plate; Carriages , carts etc.</p>
<p>Occupations</p>	<p>Coppersmiths; Fitters; Fitters (other than skilled); Fitters (skilled); Toolroom Fitters; Machinemen (rated at or above fitter's rate); Machinemen (rated below a fitter's rate); Moulders; Moulders (loose pattern); Patternmakers; Platers/Riveters/Caulkers; Sheet Metal Workers; Turners; Labourers.</p>
<p>Engineering Sections</p>	<p>Agricultural engineering; Aircraft manufacture; Allied trades; Boilermakers; Brassfounders; Construction engineering; Coppersmiths; Drop forgers; Electrical engineering; Founders; Gas meter makers; General engineering (heavy); General engineering (light); Instrument makers; Lamp manufacture; Lift manufacture; Locomotive manufacture; Machine tool makers; Marine engineering; Miscellaneous; Motors: cars, cycles etc.; Motors (commercial); Scale, beam etc. makers; Sheet metal workers; Tank and gasholder makers; Telephone manufacture; Textile machinery makers; Vehicle builders.</p>
<p>Engineering Districts §</p>	<p>Aberdeen; Barrow; Bedford*; Belfast Marine; Birkenhead; Birmingham*, Blackburn; Bolton; Border Counties; Bradford; Burnley; Burton*, Cambridge, Chester, Coventry*; Derby*; Doncaster; Dublin, Dundee; East Anglia*; East Scotland; Grantham*; Halifax; Heavy Woollen; Huddersfield; Hull; Keighly; Kilmarnock; Leeds; Leicester*; Lincoln*; Liverpool; London*; Manchester; North East Coast; Northern Ireland; North Staffs*, North West Scotland, Nottingham*; Oldham; Otley; Outer London*; Peterborough*; Preston; Rochdale; St Helens; Sheffield; Shropshire*; Wakefield; West of England*; Wigan.</p>

Note: § **Bold face** denotes districts for which we have matching unemployment rates. * denotes southern or the midlands districts; the remainder are northern districts.

Table 3 Comparisons of EEF weekly and hourly earnings (in shillings) as supplied to Ministry of Labour and as available in current data set: adult males in 1931, 1932 and 1934

	Average weekly earnings*		Average weekly earnings**		Average weekly earnings***		Average hourly earnings**		Average hourly earnings***	
	MoL	Data Set	MoL	Data Set	MoL	Data Set	MoL	Data Set	MoL	Data Set
	Mar-31	Oct-31	Mar-32	Oct-32	Oct-34	Oct-34	Mar-32	Oct-32	Oct-34	Oct-34
<u>Time Workers</u>										
Fitters	61.9	61.7	62.8	62.2	67.3	66.7	1.34	1.34	1.34	1.33
Turners	56.9	56.3	58.3	57.8	64.3	64.5	1.31	1.31	1.32	1.32
Moulders	54.8	56.5	57.3	56.2	61.2	61.2	1.33	1.36	1.33	1.33
Patternmakers	63.3	62.2	62.8	61.2	65.3	65.3	1.40	1.39	1.39	1.39
Labourers	44.2	44.2	45.1	44.6	48.5	48.6	0.96	0.96	0.96	0.96
All Time Workers	54.0	52.0	55.0	52.7	58.9	57.4	1.18	1.16	1.18	1.16
All Piece-rated workers	66.5	65.9	65.9	66.7	72.8	73.0	1.48	1.50	1.51	1.51

Sources: *Ministry of Labour Gazette (MoL) Feb 1932 page 45; **MoL Feb 1933 page 43; MoL Mar 1935 page 87.

Table 4 Summary statistics of EEF payroll data

	1927 – 1937		1930 - 1933		1934 - 1937	
	Piecework	Timework	Piecework	Timework	Piecework	Timework
Mean number of workers per district (standard deviation)	357 (605)	316 (671)	265 (510)	251 (509)	402 (690)	297 (675)
Percentage pieceworkers to total workers	53		51		57	
Mean percentage difference in piecework and timework average hourly earnings	24.9		23.7		23.0	
Average total weekly hours	47.5 (3.6)	49.1 (3.8)	45.2 (3.7)	46.5 (3.7)	48.8 (3.8)	50.7 (2.8)
Average weekly overtime hours	1.5 (1.8)	2.8 (2.4)	0.5 (1.2)	1.0 (1.6)	2.2 (1.8)	3.9 (2.3)
Mean Δ log (weekly hours)	0.6 (7.1)	0.9 (8.6)	0.2 (9.3)	-0.8 (8.1)	0.4 (5.5)	1.5 (4.3)
Mean Δ log (real weekly earnings)	3.1 (8.3)	3.7 (7.1)	1.8 (10.2)	1.5 (8.5)	3.7 (7.2)	4.5 (4.9)

Table 5 Weekly hours and overtime shares by northern and southern/midland districts: 1929 and 1932

	TIMEWORKERS			PIECEWORKERS		
	1929	1932	% Change	1929	1932	% Change
WEEKLY HOURS						
Northern Districts	48.1	43.7	-9.1	46.3	43.0	-7.1
South/Midland Districts	51.0	47.7	-6.5	48.0	45.6	-5.0
SHARE OF OVERTIME (%)						
Northern Districts	3.9	0.3	-	2.4	0.1	-
South/Midland Districts	8.1	3.3	-	3.6	0.5	-

Note: for districts in the north and in south/midlands, see Table

Table 6 Real pay cyclicity of timeworkers and pieceworkers, 1927-1937: EEF data

	Standard hourly wage		Hourly earnings		Weekly hours	Weekly earnings	
	<i>Consumer price index deflator</i>	<i>Final output price deflator</i>	<i>Consumer price index deflator</i>	<i>Final output price deflator</i>		<i>Consumer price index deflator</i>	<i>Final output price deflator</i>
	Estimates of ΔU using national EEF unemployment rates						
Time-rated workers	-0.065 (0.210)	0.019 (0.218)	-0.225 (0.245)	-0.140 (0.256)	-0.926** (0.313)	-1.151** (0.464)	-1.067* (0.482)
Piece-rated workers	-	-	-0.322** (0.071)	-0.246** (0.080)	-0.729* (0.349)	-1.050** (0.382)	-0.974* (0.402)
Significant difference?	-	-	No	No	No	No	No
	Estimates of ΔU using EEF district unemployment rates						
Time-rated workers	-0.0004 (0.035)		-0.062 (0.032)		-0.527** (0.138)	-0.589** (0.134)	
Piece-rated workers	-		-0.288** (0.062)		-0.482* (0.209)	-0.770** (0.227)	
Significant difference?	-		Yes*		No	No	

Notes: Robust standard errors in brackets with ** (*) indicating 0.01(0.05) significance on two-tail test. Price deflators are obtained from Feinstein (1972, Table 61). Using national unemployment, there are 4286 observations in step 1 estimation and 11 observations in step 2 (i.e. 4286, 11). The equivalent numbers for timeworkers are (2410, 11) and for pieceworkers 2410, 11). Using district unemployment rates, there are (3589, 305) observations for total workers, (1876, 305) timeworkers, and (1713, 285) pieceworkers.

Table 7 Real pay cyclicality based on aggregated EEF data, 1927-1937

	Standard hourly wage		Hourly earnings		Weekly hours	Weekly earnings	
	<i>Consumer price index deflator</i>	<i>Final output price deflator</i>	<i>Consumer price index deflator</i>	<i>Final output price deflator</i>		<i>Consumer price index deflator</i>	<i>Final output price deflator</i>
Time-rated workers	-0.180 (0.357)	-0.097 (0.366)	-0.389 (0.397)	-0.306 (0.408)	-0.786** (0.204)	-0.957** (0.365)	-0.874* (0.382)
Piece-rated workers	-	-	-0.342** (0.081)	-0.265** (0.080)	-0.566* (0.258)	-0.891** (0.245)	-0.814** (0.264)
Significant difference?	-	-	No	No	No	No	No

Notes: Robust standard errors in brackets with ** (*) indicating 0.01(0.05) significance on two-tail test. Price deflators are obtained from Feinstein (1972, Table 61). Wages and hours data are disaggregated to national annual observations and the national unemployment rates shown in Table 1 measure the cycle. There are 11 observations in each regression and OLS estimates are weighted by numbers of workers in each year.

Table 8 Real pay cyclicity of timeworkers and pieceworkers by EEF northern and southern/midland districts, 1927-1937

	Standard hourly wage		Hourly earnings		Weekly hours		Weekly earnings	
	<i>Northern Districts</i>	<i>Southern/Midland Districts</i>	<i>Northern Districts</i>	<i>Southern/Midland Districts</i>	<i>Northern Districts</i>	<i>Southern/Midland Districts</i>	<i>Northern Districts</i>	<i>Southern/Midland Districts</i>
	Estimates of ΔU using national EEF unemployment rates^s							
Time-rated workers	-0.138 (0.270)	0.037 (0.115)	-0.280 (0.300)	-0.162 (0.160)	-0.976** (0.337)	-0.815** (0.301)	-1.256* (0.506)	-0.977* (0.422)
Piece-rated workers	-	-	-0.302** (0.089)	-0.283** (0.072)	-0.747 (0.439)	-0.692** (0.261)	-1.049* (0.501)	-0.975** (0.241)
	Estimates of ΔU using EEF district unemployment rates							
Time-rated workers	0.018 (0.037)	-0.161 (0.117)	-0.043 (0.030)	-0.163 (0.094)	-0.601** (0.191)	-0.112 (0.237)	-0.643** (0.184)	-0.276 (0.237)
Piece-rated workers	-	-	-0.240** (0.058)	-0.638** (0.189)	-0.668* (0.318)	0.137 (0.324)	-0.909** (0.321)	-0.502 (0.425)

Notes: Robust standard errors in brackets with ** (*) indicating 0.01(0.05) significance on two-tail test. ^s Using consumer price index as deflator. See Table 2 for definitions of the make up of two district groups. Using national unemployment, there are 1894 observations for northern districts in step 1 estimation and 11 observations in step 2 (i.e. 1894, 11). For timeworkers in southern/midland districts we have (943 (11)). The respective numbers for pieceworkers are 1280 (11) and 1053 (11). Using district unemployment rates (north), (south/midlands) we have: timeworkers (1129, 185), (678, 109); pieceworkers (845, 169), (791, 105).