OXFORD

# Labour productivity during the Great Depression and the Great Recession in UK engineering and metal manufacture

## Robert A. Hart

Division of Economics, University of Stirling, Stirling FK9 4LA, Scotland; e-mail: r.a.hart@stir.ac.uk

## Abstract

This article compares UK labour productivity during the Great Depression (GD) and the Great Recession (GR) in engineering, metal working, and allied industries. Over the downturn of the GD cycle, hourly labour productivity was countercyclical. Over the GR downturn, hourly productivity was procyclical. The combined flexibility of workers and hours, together with short-run diminishing returns, is argued to be the main drivers behind the GD productivity outcomes. There was less workers and hours responsiveness in the GR downturn. These differences are linked to educational and human capital arguments. Employers' real-wage costs feature importantly in both depressions. In the GD, real hourly product wages rose steeply serving to encourage shorter work weeks, which produced positive impacts on average hourly labour productivity. Unusually, high-labour supply pressures in the GR acted to reduce real hourly product wages serving to protect the jobs of less efficient workers and to lower average hourly labour productivity.

## 1. Introduction

This article compares the UK performances of hourly labour productivity during the Great Depression (GD) and the Great Recession (GR). It concentrates on engineering, metal working, and allied industries (henceforth EMA industries). Vehicle and aircraft manufactures predominate within allied industries. My central focus is on the question of why the behaviour of labour productivity over these two historically major recessions differed so markedly. First, over the 1929 peak-to-trough period of the GD hourly labour productivity was countercyclical, remaining above its 1929 starting level. Commencing in 2007Q4/2008Q1, peak-to-trough hourly labour productivity in the GR was strongly procyclical. Secondly, the favourable productivity performance during the GD relates to the peak-to-peak business cycle from 1929 to 1935 and maintained in the years that followed. The less favourable productivity experience in the GR not only concerned the initial peak-to-peak

business cycle but also subsequently recurred and persisted in the years that followed. The term 'productivity puzzle' essentially relates to this persistence.

Productivity outcomes in the GD were principally conditioned by the combined high degrees of flexibility of employment and hours of work together with diminishing short-run returns to both factor inputs. I argue that inadequate school backgrounds combined with the acquisition of general on-the-job work skills for most of the EMA workforce were key factors behind a low propensity for firms to retain excess employment during the GD downturn. Relatively strong hourly productivity was also achieved through large cutbacks in weekly hours undertaken by employers to offset rises in real hourly product wage costs resulting from the severe output price deflation between 1929 and 1934.

Labour productivity problems during the GR consisted of both cyclical and more persistent elements (Barnett *et al.*, 2014). Hourly labour productivity fell in the initial peak-to-trough period with employers showing quite high propensities to retain labour inputs in excess of production requirements. I argue that an important reason for this stemmed from a better educated workforce in modern EMA industries. In contrast to the GD period, there was a 2-year increase in the school leaving age together with a far wider provision and take-up of school, college, and workplace training through engineering, metal working, and computing courses of direct relevance to EMA industrial requirements. Crucially, successful course completions resulted in certificated qualifications that signalled to would-be employers the levels of job applicants' commitment, skill attributes, and future potential. However, cyclical labour retention in EMA industries was arguably not the most important reason for poor overall productivity performances. Unusually, high levels of labour supply in the longer term, extending well beyond the initial business cycle shock, served to depress product wages and thereby decreased the propensities of employers to lay-off less efficient workers and close down low-performance businesses (Blundell *et al.*, 2013; Disney *et al.*, 2013).

Why concentrate on EMA industries? The most commonly adopted measure of labour productivity in the literature is productivity per hour. This requires information on real output, employment, and actual weekly hours of work. The hours' variable was not generally available in the UK until the 1940s. Fortunately, detailed interwar UK payroll statistics of EMA member companies in the Engineering Employers' Federation (EEF) allow construction of the required hour measurement (Hart, 2019). Matching data for output and employment are available from Feinstein (1972). Comparable statistics for EMA industries in the GR period are provided by the Office for National Statistics (ONS). They cover three sectors—Basic Metals and Metal Products, Machinery and Equipment, and Transport Equipment.

Section 2 discusses per-worker and hourly labour productivity in terms of the distinction between countercyclical and procyclical changes in employment and working time. Labour productivity measurement and data are described in Section 3. Section 4 compares and contrasts the GD and GR per-worker and hourly productivity cycles. Reasons for the different hourly productivity experiences in the two eras are considered in Section 5. Section 6 concludes.

## 2. Countercyclical versus procyclical labour productivity

Countercyclical hourly labour productivity in the GD has featured in US research. Bordo and Evans (1993) find that hourly productivity in US manufacturing industry was

countercyclical between 1929Q3 and 1933Q1. They also find countercyclical hourly productivity in the petroleum, leather, and paper/pulp industries. Bernanke and Powell (1984) calculate productivity trough-to-peak ratios (1933Q1compared with 1929Q3) for eight US industries. They find that for three manufacturing industries—paper, leather, and lumber—the ratios are greater than 1. It should be added that countercyclical productivity featured in no more than half of the manufacturing industries of these studies.

Procyclical labour productivity has featured prominently in most international studies since the early 1960's (for discussion, see Fay and Medoff, 1985; Hart and Malley, 1999; Biddle, 2014). Thus, the same finding in relation to the business cycle triggered by the UK's 2007/8 financial crisis is perhaps unsurprising.[1] However, the persistent nature of the UK recent productivity problems—stretching well beyond the initial peak-to-peak business cycle—differs considerably from the experiences of earlier post-war recessions. Consideration of this issue is left to Section 5, while discussion here concentrates on the cyclical features of labour productivity.

Labour productivity is measured here in two well-known ways. These are (i) productivity per worker, i.e. real output divided by employment ($Q/E$) and (ii) hourly productivity, i.e. real output divided by labour hours ($Q/H$ with $H = E.h$ and $h$ = average actual weekly hours of work). While $Q/H$ is the superior and most widely adopted measure, it proves informative to cover both productivity constructs in the developments that follow.

Countercyclical labour productivity is dependent on two labour market requirements. First, that labour is a freely variable factor input. Secondly, that the average product of labour exhibits decreasing short-run returns. Mitchell (1913) pinpointed three potentially important driving forces behind an expected outcome of decreasing returns. These cover both extensive and intensive labour margins.

i.  On the labour demand side, during the peak-to-trough period of the cycle, employers are likely to lay off their least efficient workers, thereby enhancing average productivity across the surviving workforce. During the post-trough recovery period, as output and employment expand, average productivity would be expected to fall due to the need to hire or re-hire workers with lower average productive potential.
ii.  On the labour supply side, given high transaction costs of finding equivalently paid employment as the recession deepens, workers may be encouraged to attempt to improve their work performances in attempts to avoid dismissal. During subsequent market expansion, the probabilities of finding suitable alternative employment are increased and fear of job loss reduced.
iii.  Cuts in weekly hours during the peak-to-trough period may serve to enhance hourly worker productivity through easing the negative impacts of long daily/weekly hours on work concentration and effort. During the upturn, these adverse work pressures will re-establish as weekly hours increase.

In terms of (i), there are reasons for expecting that in both the GD and GR contractions employers' controls over lay-off decisions were considerably strengthened due to declines in both union membership and the incidence of collective bargaining. Also, especially in the GD, closures of inefficient factories would have acted to improve average labour

---

1   Interestingly, an emerging US literature has reported strong evidence that countercyclical labour productivity has replaced procyclical productivity movements in the GR period (Mulligan, 2011; Gali and Van Rens, 2021).

productivity across EMA industries. As for (ii), the threats of lay-offs were especially serious in the GD compared to the GR.[2] In the case of (iii), cuts in weekly hours in the GD were more substantial and diminishing returns were enhanced due to significantly longer weekly working hours in that period. In other words, cuts in weekly hours in the GD were likely to improve workers' average hourly performance due to, for example, reductions in work fatigue and stress.

Consider a cost-minimizing firm facing an unexpected short-term product demand fall. Assume a period during which the capital stock is fixed. Initially, let $h$ also be fixed. $E$ is treated as a variable input factor that exhibits decreasing returns. In this case, $Q/E$ suffices to measure short-run labour productivity. In the demand downturn, the firm reduces its workforce size sufficient to minimize the labour costs of meeting its falling output requirements. Decreasing returns serve to increase $Q/E$. As $Q$ and $E$ subsequently recover in the cyclical upturn, $Q/E$ will decrease. Short-run worker productivity is countercyclical. Now, let $h$ also be treated as a variable input factor that exhibits decreasing returns. The firm can meet falling output by an optimal cost minimizing combination of reduced workers and hours. Decreasing returns in both factor inputs would ensure that $Q/H$ is countercyclical.

As for the comparable effects in respect of a procyclical productivity reaction to an unexpected product demand contraction assume that labour retention in excess of cost-minimizing production requirements prevents a fully flexible employment response. This involves an explicit or implicit short-term acceptance by employers of procyclical variations in labour effort

Again, real output falls unexpectedly with $h$ assumed fixed. Hoarding labour in the downturn phase of the cycle results in a fall in $Q/E$. In effect, this results from a reduction in average work effort per period. Immediately following the cyclical trough, $Q/E$ rises due to the increasing returns to dishoarding. In the longer term, as new employees are hired, decreasing returns may set in. Cyclical employment productivity is predominantly procyclical.[3] If $h$ is allowed to vary in the hoarding firm, the peak-to-trough observed fall in $Q/E$ would overestimate the 'true' productivity reduction by failing to account for the reduction in labour input due to shorter working hours. In graphs of labour productivity with respect to time, a pronounced reduction in weekly hours is likely to cause $Q/H$ to lie above $Q/E$ during the peak-to-trough period. In the upturn of the cycle, the dishoarding effect of improved effort per hour would enhance the upward trajectories of both $Q/E$ and $Q/H$. Thereafter, their relative tracks will depend on the comparative sizes of increases in $E$ and $H$ and on their respective magnitudes of decreasing returns.

A special case of countercyclical-versus-procyclical labour productivity outcomes is pertinent to the GD aspects of this article and provides a strong motivation for distinguishing between $Q/E$ and $Q/H$. During the downturn of the cycle, $Q/E$ might exhibit mild procyclicality perhaps due to a relatively modest average hoarding effect. While traditional EMA industries in northern districts of the UK experienced considerable increases in lay-offs and

---

2   The GD peak national unemployment rate in 1932 was 22% compared with a rate of 8% at the GR peak of 2011.

3   It may be the case that short-run increasing returns occur without such effort variations. During economic downturns, a higher proportion of per-period effort might be directed less towards producing current output and more towards set-up activity in anticipation of post-recession output expansion. This may include more time devoted to equipment maintenance and to task-related training programmes.

company closures during the GD, the more modern industries of vehicle and aircraft manufacture and electrical engineering, predominantly located in midland and southern districts, were less prone to lay-off workers. Nationwide, the combined employment experiences produced a modest net peak-to-trough fall in *Q/E*. Reductions in peak-to-trough average weekly hours were strong in both northern districts and midland/southern districts. Overall in the peak-to-trough period, countercyclical effects of reductions in average weekly hours more than offset the procyclicality of output per worker. This resulted in net countercyclical changes in hourly labour productivity.

## 3. Coverage, measurement, and data

Productivity estimates for the GD period are based on annual measures covering all EMA industries. The only available source of information on actual weekly hours for the UK during the interwar period covers these industries.[4] For the GR period, a reasonably strong match is obtained using quarterly data for three sectoral industrial clusters—Basic Metals and Metal Products, Machinery and Equipment, and Transport Equipment. The GD data are annual and the GR data are quarterly.

Full details of data, productivity constructions, and graphs in respect of the GD cycle are given in Hart (2019) and so it will suffice to provide a brief outline here. The EMA industries covered annually for the GD period are listed in Table 1. They comprise the 1948 Standard Industrial Classification (SIC) Orders V (metal manufacture) and Orders VI–IX (engineering and allied industries) (Central Statistical Office, 1948). Data on actual weekly hours of work are provided each October from the payroll records compiled by the EEF, a Federation whose member firms cover these SIC orders (see Knowles and Hill, 1954; Appendix A).[5] This allows construction of an aggregate average actual weekly hours' time series for time workers based on 14 high-, medium-, and low-skilled blue collar occupations within member firms delineated by 51 geographical engineering districts throughout the UK.[6] It is combined with annual real output indices for the same SIC Orders provided by Feinstein (1972, Table 51), which cover gross domestic product at factor cost (1913 = 100) and based on the Index of Industrial Production. Feinstein (1972, Table 59) also provides matching Ministry of Labour employment indices. These cover employment in iron and steel, electrical goods, mechanical engineering, shipbuilding, vehicles, and other metal industries.

For the GR cycle, quarterly and seasonally adjusted indices of *Q/E* and *Q/H* are provided by the UK Office for National Statistics (ONS) (2016 = 100) for the three industrial

---

4   Actual weekly hours at a more macro-level were not available in the UK until the 1940s (see Hart and MacKay, 1975; Mitchell, 1988, p. 96). De Jong and Woltjer (2011, Table 1) do attempt to obtain UK estimates of *Q/H* for total manufacturing in the GD. It appears that they used EEF weekly hours in their calculation based on EMA industries for one or two occupations. This is unlikely to produce an accurate total manufacturing estimate.

5   The complete EEF data set is available in the UK Data Archive: http//www.esds/ac.uk/finding/Data/snDescription.asp?sn==5569.

6   Piecework was commonplace in engineering and metal working during the interwar period. It is shown in Hart (2019) that accounting for both time workers and pieceworkers makes virtually no difference to the shapes of the labour productivity cycles shown here.

**Table 1.** Engineering and metal-working industrial coverage

| GD | |
|---|---|
| Engineering, Metal Working and Allied Industries (SIC, 1948)[a] | Agricultural engineering; aircraft manufacture; allied trades; boilermakers; brassfounders; construction engineering; coppersmiths; drop forgers; electrical engineering; founders; gas metre makers; general engineering (heavy); general engineering (light); instrument makers; lamp manufacture; lift manufacture; locomotive manufacture; machine tool makers; marine engineering; motors: cars, cycles, etc.; motors (commercial); scale, beam, etc. makers; sheet metal workers; tank and gasholder makers; telephone manufacture; textile machinery makers; vehicle builders |

| GR | |
|---|---|
| Basic Metals and Metal Products (Codes 24–25)[b] | Basic iron, steel and ferro-alloy; tubes, pipes, etc., other products of first processing steel; precious and other non-ferrous metals; metal casting; structural metal products; tanks, reservoirs, containers; steam generators; weapons and ammunition; forging, pressing, stamping, etc.; coating of metals; machining; cutlery, tools, hardware; other fabricated metal products |
| Machinery and Equipment (Code 28)[b] | General purpose machinery; agriculture and forestry machinery, metal forming machinery and machine tools; other special purpose machinery |
| Transport Equipment, Codes (29 and 30)[b] | Motor vehicle and trailers; bodies for motor vehicles; parts and accessories for motor vehicles; ships and boat building; railway locomotives and rolling stock; air and spacecraft, etc. machinery; military fighting vehicles; transport equipment nes |

a Based on Engineering Employers' Federation breakdowns.
b From a total of 930 thousand jobs, the respective percentage employment shares of the three GR sectors in 2008Q1 are (in descending order above) 46, 23, and 31%.
*Sources*: GD: correspond with Orders V–IX of the 1948 Industrial Classification.
GR: Office for National Statistics: for fuller details of Codes' coverage see. https://www.ons.gov.uk/file?uri=/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities/uksic2007/sic2007summaryofstructurtcm6.xls.

sectors included here. Table 1 lists the main product headings for each sector together with the sectors' relative workforce sizes at the start of the GR.

In order to gain some initial comparative perspective on magnitudes of changes in the variables comprising the labour productivity measures—i.e. real output, employment, and total labour hours—Table 2 shows their peak-to-tough percentage declines during the GD

**Table 2.** Peak-to-trough percentage changes in real output, employment and total hours

| Industries | Peak | Trough | % Change |
|---|---|---|---|
| GD | | | |
| Engineering and metal working | | | |
| Real output (Q) | 1929 | 1932 | −24.3 |
| Employment (E) | 1929 | 1932 | −19.8 |
| Labour hours (H = E.h) | 1929 | 1932 | −25.8 |
| Total manufacturing | | | |
| Real output (Q) | 1929 | 1931 | −10.8 |
| Employment (E) | 1929 | 1931 | −13.2 |
| GR | | | |
| Basic metals and metal products | | | |
| Real output (Q) | 2007 Q4 | 2009 Q3 | −23.6 |
| Employment (E) | 2008 Q2 | 2010 Q3 | −15.5 |
| Labour hours (H = E.h) | 2008 Q1 | 2011 Q2 | −15.0 |
| Machinery and equipment | | | |
| Real output (Q) | 2007 Q4 | 2009 Q3 | −24.4 |
| Employment (E) | 2008 Q3 | 2010 Q2 | −12.5 |
| Labour hours (H = E.h) | 2008Q3 | 2009 Q2 | −13.0 |
| Transport Equipment | | | |
| Real output (Q) | 2008 Q1 | 2009 Q1 | −20.9 |
| Employment (E) | 2008 Q1 | 2010 Q1 | −6.5 |
| Labour hours (H = E.h) | 2008 Q1 | 2009 Q1 | −9.3 |
| Total manufacturing | | | |
| Real output (Q) | 2008 Q1 | 2009 Q3 | −12.6 |
| Employment (E) | 2007 Q2 | 2010 Q1 | −11.6 |
| Labour hours (H = E.h) | 2008 Q1 | 2009 Q4 | −10.4 |

*Source*: Author's calculations.

and GR business cycles. Output for the GR is the Chained Volume Gross Value Added (GVA) (at 2016 prices).

A peak-to-trough fall in real output of 24% in the GD is virtually the same for GR Basic Metals and Machinery sectors, with Transport Equipment at 21%. There are three important points to note. First, the peak-to-trough employment fall during the GD was more severe than that in the GR. A fall of 19.8% in the earlier period compares with falls ranging from 15.5 to 6.5% across the sectors in the more recent period. Secondly, during the GD peak-to-trough labour hours (H) fell significantly more than employment (E) (25.8% compared with 19.8%). The equivalent H-falls in the GR Basic Metals and Machinery sectors differed little from their equivalent E falls. Thirdly, in Transport Equipment a 9.3% fall in H exceeded the 6.5% fall in E.

Table 2 also shows comparable data for total manufacturing in the two eras, except for H in the GD given an absence of appropriate hours data. For both the GD and the GR in the two eras, EMA industries experienced tougher recessions than their respective average total manufacturing sectors. Percentage output falls were about twice the size of the average for total manufacturing. As for reductions in employment, the GD fared considerably worse the GR. The GD percentage employment fall exceeds that of total manufacturing by 50%. GR employment falls compared with those in total manufacturing are 34% greater in Basic
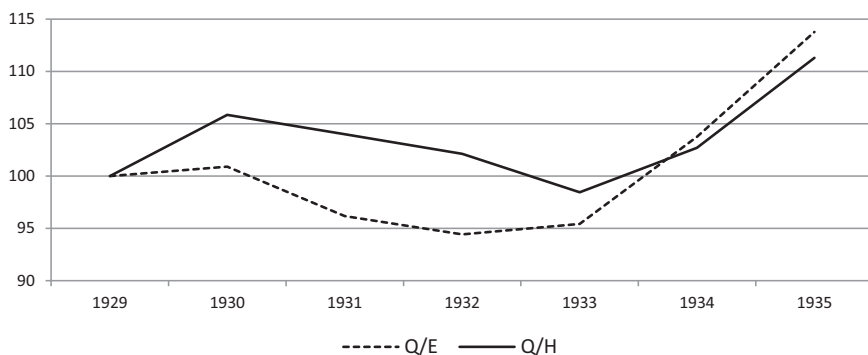
**Fig. 1.** Q/E and *Q/H* in UK engineering and metal working 1929–35 (**1929=100**). *Source*: Hart (2019).

Metals, 8% greater in Machinery, but 44% smaller in Transport Equipment. In terms of la-bour hours, the comparative falls remain similar to those of employment for Basic Metals and Machinery sectors. Transport Equipment falls in labour hours move much closer to those in manufacturing. The cyclical troughs of manufacturing output and employment in the GD occurred 1 year earlier than their equivalents in the EMA industries.

## 4. Labour productivity over the GD and GR cycles

### 4.1    The GD cycle

The GD in the UK started in the second half of 1929.[7] This year marked the peak of a 3-year boom period in respect of both total manufacturing and in the industries studied here (Feinstein, 1972, Table 51). Accordingly, I set 1929 as the starting point of the GD cycle. Figure 1 shows the Q/E and Q/H productivity cycles from 1929 to 1935, with $1929 = 100$. From Table 2, we see that from 1929 peak to 1932 trough, $Q$ fell by 24.3% and $E$ fell by 19.8%, with Q/E in Fig. 1 showing a modest 5.4% reduction. However, peak-to-trough la-bour hours H fell by 25.8% and during the cyclical downturn from 1929 to 1932 $Q/H$ was countercyclical. At the trough in 1932 $Q/H$ was 2.1% higher than its starting level in 1929.[8]

The incorporation of average actual weekly hours, h, defines the difference between $Q/H$ and Q/E. Figure 2 shows these hours for the EMA industries of the EEF, 1929–35. Workers averaged just over 49 weekly work hours in 1929, falling to just over 45 weekly hours in 1932, followed by a steep climb back to reach the starting level by 1934. The im-portant countercyclical influence of introducing average weekly hours into the definition of

---

7   Burns and Mitchell's (1946) work on measuring business cycles gives 1929 Quarter3 as the British pre-depression peak and 1932 Quarter3 as the trough of the cycle.

8   Bordo and Evans (1993) rule out labour hoarding in respect of their similar GD finding of US coun-tercyclical hourly labour productivity: they argue that 'the length and severity of the Great Depression (1929-1933) suggests that the costs of adjusting employment and honoring implicit long-term employment contracts were second-order relative to the losses that many firms and industries experienced'. It is not possible to make such a strong claim with respect to UK employ-ment during the 1929–32 downturn. New industries such as in the automotive and aircraft manufac-turing sectors were less affected by the slump and are likely to have been more risk averse over adjusting workforce sizes.
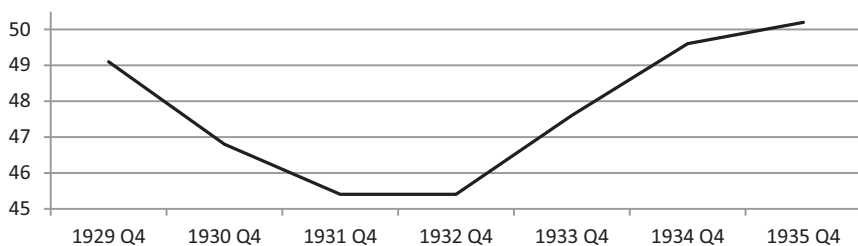
**Fig. 2.** Average actual weekly hours GD engineering/metal sectors. *Source*: Engineering Employers' Federation company payroll statistics.



**Fig. 3.** Gap between the indices of *Q/H* and *Q/E* in Fig. 1. *Source*: Author's calculations.

labour input is best revealed by graphing the gap between $Q/E$ and $Q/H$ in Fig. 1. This is shown in Fig. 3 and closely approximates the inversion of Fig. 2.[9]

## 4.2    The GR cycles

Figure 4 shows the equivalent GR cyclical labour productivity graphs of $Q/E$ and $Q/H$ for the three EMA sectors in Table 1. Comparing the cycles in Figs 1 and 4, there are two major differences between the two eras. First, for both $Q/E$ and $Q/H$, the GR cycles are strongly procyclical. For example, peak-to-trough falls in the Q/H measure of productivity average 20% over the three sectors. Secondly, in Basic Metals and Machinery sectors, comprising about 70% of GR EMA industries, peak-to-trough plots of $Q/H$ and $Q/E$ show little divergence. In contrast, on either side of the Transport Equipment cyclical trough, there is a pronounced positive gap between $Q/H$ and $Q/E$.

Figure 5 shows the graphs of average actual weekly hours (h) in the GR sectors over the periods corresponding to their respective peak-to-peak cycles in Fig. 4. The pronounced V-movement of weekly hours in Transport Equipment relates to the fact that $Q/H$ lies above $Q/E$ throughout the peak-to-peak cycle. As shown in Table 2, the peak-to-trough fall in total hours, H, for this sector is 30% greater than that of employment, E. This translates

---

9   It holds precisely in terms of proportionate (or log) rates of change. Let $P_1 = Q/E$ and $P_2 = Q/H$. The proportionate changes are $\Delta P_1 = \Delta Q - \Delta E$ and $\Delta P_2 = \Delta Q - \Delta E - \Delta h$. So $\Delta P_2 - \Delta P_1 = -\Delta h$, or the negative of the proportionate change in average per worker weekly hours.
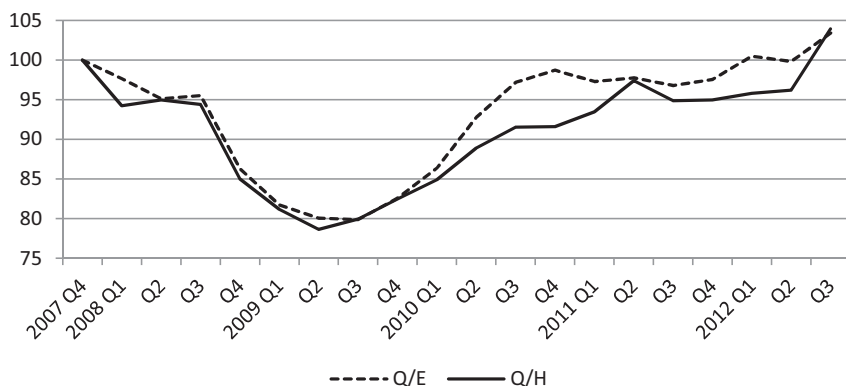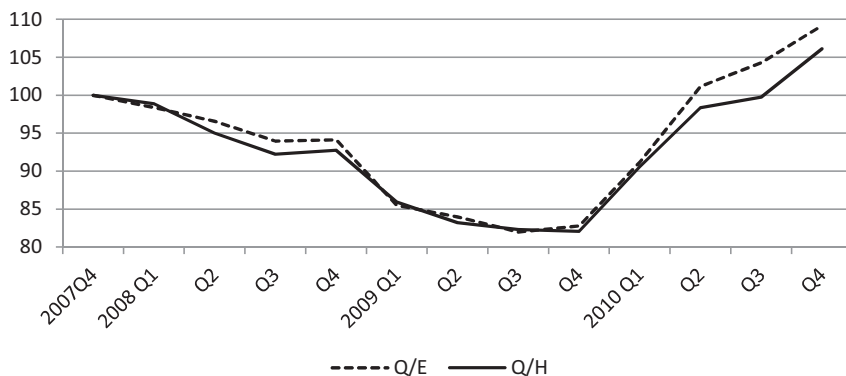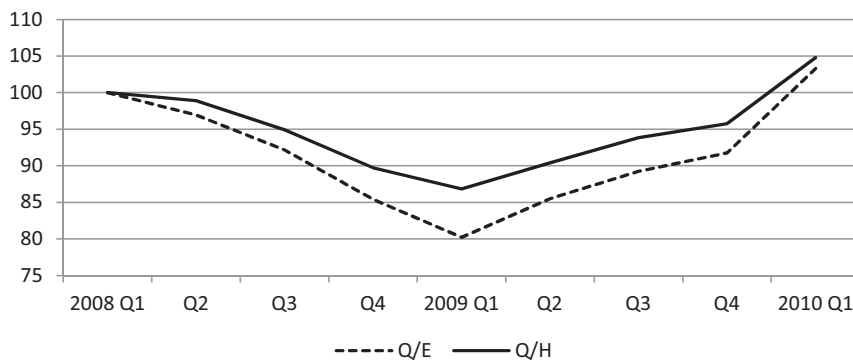
## (a) Basic Metals and Metal Products (2007Q4=100)



- - - - Q/E      —— Q/H

## (b) Machinery and Equipment (2007Q4=100)



- - - - Q/E      —— Q/H

## (c) Transport Equipment (2008Q1=100)



- - - - Q/E      —— Q/H

**Fig. 4.** Q/E and Q/H for three sets of GR industries. (**a**) Basic Metals and Metal Products (2007Q4=100), (**b**) Machinery and Equipment (2007Q4=100) and (**c**) Transport Equipment (2008Q1=100). *Source*: Office for National Statistics.
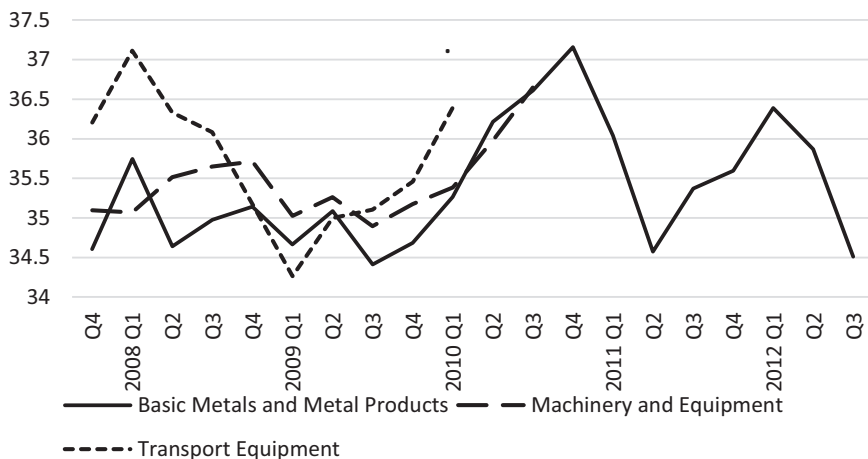
**Fig. 5.** Average weekly hours over the GR cycles. *Note*: the length of each graph corresponds with the peak-to-peak cycles in Fig. 4. *Source*: Office for National Statistics.

into lower reductions in hourly labour productivity than in productivity per worker. In contrast, peak-to-trough changes in weekly hours in Basic Metals and Machinery sectors are relatively modest—as revealed by the comparative peak-to-trough falls in E and E.h in Table 2—resulting in closely related falls in $Q/H$ and $Q/E$.

With an eye to later discussion, it is useful to report on the longer-term progress of $Q/H$ during the GR. Figure 6 shows this annually from 2007 to 2016. There is a sharp contrast in the fortunes of Basic Metals and Machinery sectors on the one hand and Transport Equipment on the other. Transport Equipment displays sustained productivity improvement from the start of the upturn in 2009 to the start of 2013 with a more gradual rise thereafter. After regaining their 2007 $Q/H$ productivity levels, both Basic Metals and Machinery sectors not only fail to make further progress but in fact from 2013 to 2016 fall back to levels lower than the 2007Q4 starting point.
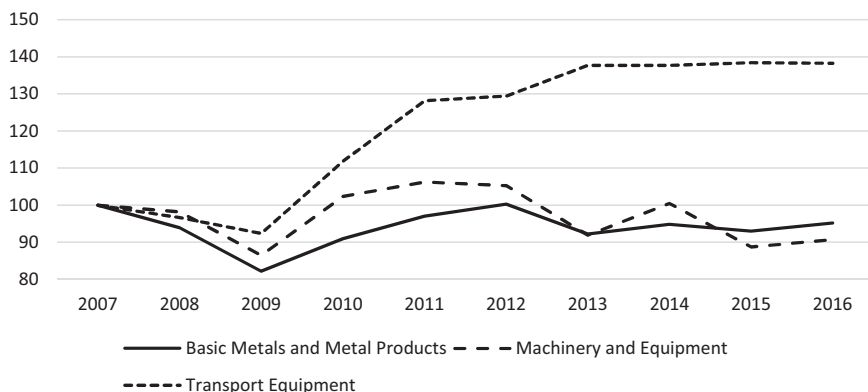


**Fig. 6.** Q/H in the GR, 2007 to 2016 (annual data, 2007 = 100). *Source*: Office for National Statistics.
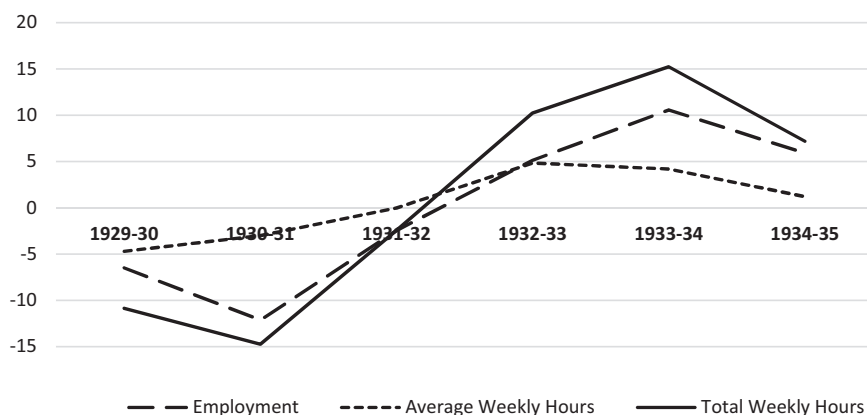
**Fig. 7.** Annual percentage rates of change in employment, weekly hours and total hours over the GD cycle. *Source:* Author's calculations.

## 5. What accounted for labour productivity differences between the GD and the GR?

Concentrating on employment, working time and real product wages, this section highlights several essential contributory factors that help explain the productivity differences between the GD and the GR.

### 5.1   The GD

*5.1.1   Workers and hours*   Freely variable employment and work hours combined with short-run diminishing returns are key to achieving countercyclical labour productivity. In EMA industries during the GD, labour inputs on both extensive and intensive margins behaved very flexibly in downturn and upturn phases of the GD cycle. As shown in Fig. 7, employment fell by 6.5% in 1929–30 and by a further 5.5% the following year. In the recovery stage, employment rose by 5.1% in 1932–33 and by a further 5.5% the following year. Average weekly hours declined by 4.7% between 1929 and 1930 followed by a 3% decline the following year. So, on firms' intensive margins, cuts in working time were both speedy and large.[10] At the start of the recovery in 1932–33, average weekly hours increased by 4.8% and by a 4.2% the following year.

A preponderance of general skills among engineering and metal workers with associated low transactions costs to employers of changing employment levels was an important factor behind flexible employment responses. The highest skilled workers, so-called journeymen, were fully apprenticed blue collar workers. Most apprentices left school at the minimum leaving age of 14 years. Virtually, all started their apprenticeship training between the ages

---

10   Falls in average weekly hours resulted both from a reduction or elimination of overtime working and, more significantly, from the introduction of short work weeks. Both reactions were especially strong in the northern engineering districts of England as well as in Scotland and North Ireland where older and more traditional metal working and engineering firms predominated (see Hart and MacKay, 1975).

of 14–16 years. This meant that they had no school qualifications since the earliest secondary school exams (confined to selective grammar schools) were at the age of 16 years. Apprenticeship training was typically confined to a single trade—e.g. fitters, turners, boilermakers, patternmakers, iron moulders. Acquired skills were equally valuable to competing firms. The net costs of training were modest.[11] A low incidence of firm-specific training reduced firms' incentives to retain workers whose marginal product fell below the going wage rate.[12] There is econometric evidence of strong procyclical adjustments in the employment of journeymen in EMA industries from 1929 to 1938.[13]

Were there diminishing short-run returns to employment such that peak-to-trough lay-offs involved a higher than proportional number of less efficient workers? The answer is 'probably yes' and especially in respect of the traditional EMA industries of northern districts. In the first place, unions were considerably weakened through large losses of membership and the potential for unilateral decision making by employers was enhanced.[14] Certainly, there were ample opportunities to improve the average productivity of the employment stock in EMA industries during the GD 'as many firms had been rationalized or merged or put out of business by the slump' (Wigham, 1973, p. 134).[15] Secondly, workers' awareness of rapidly growing lay-offs and unemployment in their local engineering districts may well have encouraged greater work application and effort in order to reduce their own lay-off probabilities. Between 1929 and 1932, average unemployment rates in the UK rose from 11.7% to 25.3% across 28 EEF engineering and metal working districts (Hart and MacKay (1975, Table A.5).[16]

11  An apprenticeship lasted for between 5 and 7 years. In the first year, an apprentice typically earned about one-sixth of a journeyman's hourly pay rate and in the final year somewhat less than one-half (Hart, 2005). For much of their time, on-the-job training consisted of learning-by-doing alongside fully apprenticed journeymen. By the final year of their apprenticeship, they were commonly performing unsupervised job tasks equivalent to those of a journeyman in the same trade. Such pay differentials and work activity are compatible with Becker's (1962) human capital proposition that workers cover the training costs related to general skill acquisition.

12  The greater the specificity of workers' acquired skills, the stronger the employer/worker interests in sharing training costs in order to achieve longer expected employment spells and lower labour turnover. The mutual benefits of sharing costs might involve a post-training wage premium to the worker that is greater than the alternative wage, while the firm gains a longer expected period of employment tenure thereby providing more time to amortize the fixed employment cost. This would serve to encourage a degree of labour retention during economic downturns (Oi, 1962).

13  A significant procyclical response among journeymen is captured by the current annual change in unemployment with an insignificant influence of the lagged rate. In contrast, apprentices' procyclical responses exhibited a delay, indicated by a significant one-year lag in the change of unemployment. These findings combined with direct documentary evidence supports the contention that apprentices provided substitute labour for more expensive older journeymen during the GD cycle (Hart, 2005).

14  A major example of this occurred on a large scale in relation to EEF employers' attempts reduce labour costs at the start of the GD. They sought to cut overtime premium payments, nightshift rates and piecework prices (Knowles and Hill, 1954; Wigham, 1973). Eventually, in July 1931, the unions agreed fully to the proposed cuts after the threat by employers of unilateral action.

15  Margo (1992, pp. 3/4) reports on somewhat indirect evidence of layoffs among the least efficient workers in US firms during the GD and also reports on the closure of inefficient plants in the US automotive industries (p. 13).

16  These unemployment rates are reasonably close to the UK administrative rates provided by Denman and McDonald (1996), ranging from 10.4% to 22.1% between 1929 and1932. In contrast,
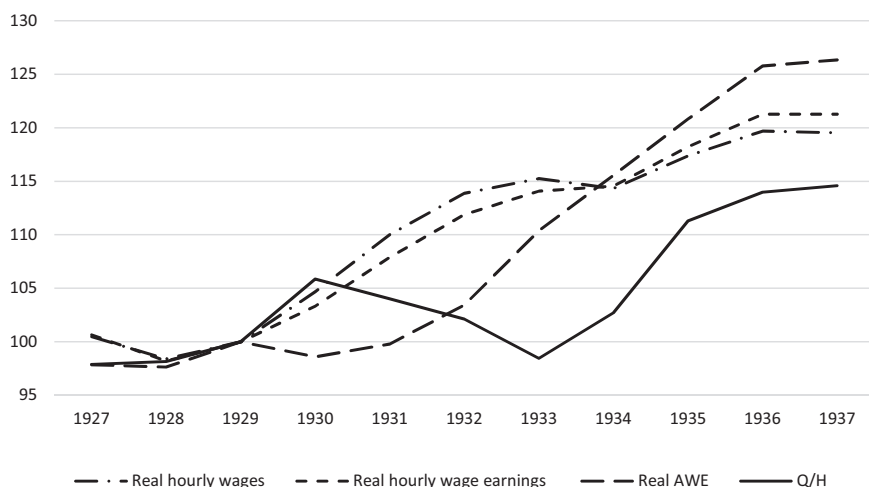
**Fig. 8.** Product wages and Q/H in engineering and metal working, 1927–37. (1929 = 100). *Sources*: EEF company payroll statistics and Feinstein (1972).

Not only were the lengths of weekly hours flexible during the GD but there are strong reasons for supposing that they enhanced labour productivity responses due to diminishing returns. Long weekly hours were the norm in interwar EMA industries. Pencavel (2015, 2018) produces micro-evidence of diminishing returns to long average weekly hours based on British and US datasets. In his study of British munitions workers in WW1, an activity also contained within EMA industries here, and diminishing returns are observed in respect of weekly hours in excess of 44.[17] Based on an augmented Cobb–Douglas production function that allows the elasticity of output with respect to weekly hours to vary with hours and on a standard Cobb–Douglas function subdivided into short-hours and long-hour regimes, Pencavel (2018, see Fig. 7 and Table 4.5) finds that weekly hours above 44 are statistically consistent with diminishing returns. As shown in Fig. 2, peak-to-trough reductions in average weekly hours in GD engineering and metal working occurred in this range of working time. For workers prone to stress and fatigue due to long work hours, significant

unemployment rates during the GR among individuals aged 16 and over (Office for National Statistics, 2017) rose from 5.3% in 2007 to 7.6% in 2009 to a peak of 8.1% in 2011 before entering a long and substantial decline to 3.8% in 2019. In fact, as proxied by unemployment, the UK labour market in the GR fared much better than most European countries (Herz and Van Rens, 2020). It is likely, therefore, that the threat of job loss during the GR was a less potent means of encouraging work effort for the typical EMA employee.

17   One of Pencavel's UK sources of data (Industrial Health Research Board, 1942) investigated aver-age weekly hours and hourly output in a combined sample of two-shift workers in five factories. In May 1940, average weekly hours jumped from 51.6 to 61 between April and June in 1940 due to a state of emergency following material losses linked to the fall of France. Factory workers initially responded with extra effort and weekly output increased. While this reaction was sustained for a short period over the immediate crisis, effort levels soon fell due to fatigue accompanied by time lost through increases in sickness, absenteeism and work injury. Hours were reduced over June and July resulting in improvements in workers' mental and physical well-being and in effort levels, and weekly output.

reductions in weekly hours are likely to have helped to enhance labour productivity through improvements in work performance.

*5.1.2 Real product wages*   Large cutbacks in weekly hours played an important role in preventing hourly productivity reductions during the peak-to-trough period of the GD. Reductions took place in almost all EMA districts. The most significant cost pressure stemmed from a substantial rise in real hourly product wages and served to encourage employers to impose shorter weekly hours.

   Starting in 1929, there was a period of severe price deflation in the UK. Between 1929 and 1934, the real value of workers' hourly consumption wages rose by 11% due to a deflation in the prices of consumer goods and services (Feinstein, 1972, Table 61). Over the same period, the real value of employers' hourly product wages, measured in terms of workers' output, rose by 13% due to a deflation in output prices. This represented exceptionally high average cost increases to employers. Figure 8 shows the graphs of real hourly product wages and real (product) average weekly earnings (AWEs) together with $Q/H$ over the period 1927 to 1935. Starting in 1929, there were marked increases in the indices of real hourly product wages (excluding overtime), and real hourly product earnings (including overtime).[18] In contrast, there is a sharp dip in the index of real AWE in 1929 due to shorter weekly hours. On the labour demand side, employers made two gains from working time reductions. First, the full potential costs of rises in real hourly wage costs were considerably offset by reductions in the weekly wage bill. Secondly, shorter weekly hours helped to bolster hourly labour productivity given the diminishing returns to long weekly hours. The benefits on the supply side were also two-fold. First, more job losses would have occurred in the absence of the hours' cutbacks. Secondly, given the rises in hourly consumption wages, employees experienced only modest reductions in average weekly pay over the peak-to-trough period.

   Figure 8 serves an additional purpose that is germane to later discussion. It shows the paths of real hourly product wages and real AWE for the extended period 1927–37. The 1929–35 GD cycle contained the three key events in respect of hourly productivity and real product wages. These were (i) the countercyclical movement of hourly productivity between 1929 and 1932, (ii) the inflation-induced rises in real hourly wage costs from 1929 to 1934 and (iii) and slowdown in the growth of weekly wage costs due to reductions in overtime working and the imposition of shorter workweeks between 1929 and 1932. A principal driver of continued output and productivity growth from 1935 onwards was extensive UK military re-armament in which EMA industries played the UK's most vital role.

## 5.2   The GR

*5.2.1 Workers and hours*   Hours of work in ERM industries played a far less significant role in influencing hourly labour productivity in the GR compared with the GD. First, we know from Table 2 and Fig. 4 that, compared with their GD equivalents, labour hours in the three GR sectors displayed less flexible responses to the large peak-to-trough falls in

---

18   The hourly earnings index lies below the hourly wage index due to a major decline in the share of overtime working in total work hours and in related overtime premium pay. Overtime rates applied to weekly overtime hours in excess of the standard 47-hour workweek. Hart and MacKay (1975, Tables A3 and A4) show that, for most engineering districts in the UK, overtime working among fitters and labourers in EEF member firms was eliminated by 1932.

output. Downward adjustments in labour hours in the early phases of the GR cycles fell well short of preventing significant reductions in hourly productivity. Secondly, unlike the GD, it is unlikely that GR productivity was significantly influenced by diminishing returns to hours. While Pencavel (2018) found diminishing returns for weekly hours in excess of 44, weekly hours between 43 and 33 were found to be statistically consistent with the hypothesis that hours vary proportionately to output. Figure 5 shows that GR hours movements in the three EMA sectors are contained well within this lower range.

Most blue collar employees in EMA industries during the interwar years left school at age 14 without educational qualifications, and most of those who were apprenticed acquired trade-based general skills. In more recent times, there has been strong demand by EMA industrial employers for relevant academic and vocational qualifications, at both school and higher educational levels. In 1972, the school minimum leaving age was raised to 16 in England and Wales, allowing many of those who wished to leave school at the earliest opportunity to achieve academic and vocational credentials in Ordinary-Level and Higher General Certificate of Secondary Education examinations (O-level and GCSE). Grenet (2013) argues that these qualifications not only acted as a signalling device to potential employers 'but also reflected a substantial improvement in their level of skills'. College courses leading to Higher National Certificates and Higher National Diplomas provide certified attainments—at increasing levels of skill requirements—in a wide range of engineering and metal working courses. For those who wish to progress further, their certificates/diplomas can be used to give exemptions to first and possibly second year levels in relevant University degree courses. A bridge between school qualifications and engineering and metal practical work skills has been provided through work-based awards (National Vocational Qualifications) in which competence-based qualifications are assessed at five levels of skill characteristics.[19]

General skill acquisition has been relatively less important in the current era. Many repetitive job tasks traditionally included within the skill sets of both semi-skilled and fully apprenticed workers have been automated. As examples, automation now features prominently in drilling, milling, fitting, press operating, riveting, welding and tool making. The advent of computer-aided design and manufacture (CAD/CAM) and computer mumerical control (CNC) machining has enabled workers[20] to achieve high levels of production flexibility, diversification as well as opportunities for bespoke specialization in metal and engineering manufacture. This gives rise to more emphasis on firm specific knowledge and skills.

Skill certification from school, higher education, and in the workplace has provided employers with information concerning the ability, work commitment, and developmental potential of new and recent hires and, certainly compared with GD recruitment, help to explain why firms have shown a higher propensity in the 2007/8 recession to retain workers.[21] Based on firm-level data collected by the ONS with a sample of businesses covering

---

19   A change in the regulatory framework of NVQs in 2015 to the Regulated Qualifications Framework (RQF) allows levels of workplace competencies to be approximately matched to academic equivalent qualifications in schools, colleges and other official awarding bodies.

20   College courses include training for jobs such as a CNC machinist or a CAD technician.

21   Richard Lambert (2010), former director of the Confederation of British Industry reports that since the early 1990s to the start of the GR there was a rise from a fifth to a third in the proportion of working age employees who had completed higher education and that in the 10 years before the GR most of the million jobs that had disappeared in the manufacturing sector involved less skilled

the whole UK economy, Barnett *et al.* (2014) show that firms retaining excess labour have been an important factor behind the weak labour productivity performance over the GR cycle. They report that the proportion of firms with 'shrinking output and flat employment' doubled from 11% in 2005–07 to 22% in 2011.

To what degree does such cyclical labour retention account for the falls in labour productivity in the three GR EMA industries here? It is highly probable that the Transport Equipment sector's modest peak-to-trough falls in both employment and labour hours (see Table 2) were due principally to a cyclical retention of existing labour inputs based on expectations of short-term high output recovery and continued productivity improvements in the post-recession period. As shown in Fig. 6, this sector achieved a 4-year period of continuous strong improvement in hourly labour productivity between 2009 and 2013.

Labour retention featured in the Basic Metals and Machinery sectors at the outset of the recession with associated falls in $Q/E$ and $Q/H$. But in these two cases, it is difficult to attribute this as the principal explanation of overall low productivity performances of recent years. As shown in Fig. 6, in both sectors low productivity continued for an extended period beyond the main initial peak-to-peak cycle. Such persistence has given rise to the term 'productivity puzzle'.[22] It relates to a second set of findings in the Barnett *et al.*'s (2014) article. This attributes an additional source of slowdown in GR productivity growth to significant falls in labour reallocation, defined as 'movements in labour brought about by company formation and dissolution, and within-firm productivity improvements'. In terms of company dissolution, the authors report that, compared with earlier recessions, higher than expected proportions of weaker firms have managed to survive the 2007/8 financial crisis. One reason given for this is weak real wage growth.

*5.2.2 Real product wages*   Using the GDP deflator to represent costs to employers, Figure 9 shows real hourly wage earnings and real AWE, together with hourly labour productivity $Q/H$ for the largest of the three GR sectors, Basic Metals and Metal Products over the period 2005Q1 to 2016Q4.

Peak $Q/H$ at the start of the recession occurred in 2007Q4, and all three series in Fig. 9 are indexed to equal 100 at this quarter.[23] From the peak, $Q/H$ fell over 20% to its trough in 2009Q2. After a lag, both hourly and weekly product earnings adjusted downwards. In a broader UK business context, Taylor *et al.* (2014, Fig. 10) show a similar pattern between $Q/H$ and product wages in the peak-to-trough period of the cycle. From 2009Q3 to

process workers. He also reports that following the 2007/2008 downturn, and in comparison with earlier recessions, there has been a greater reluctance among employers to lay-off workers and a stronger willingness to accept temporary productivity reductions among skilled workers.

22   The same term was also applied to the mounting empirical evidence from the early 1960s onwards that, contrary to earlier productivity theories and accompanying (partial) evidence, labour productivity was generally found to behave procyclically (Fay and Medoff, 1985).

23   Prior to 2007Q4, both Q/H and the two product wages had been rising strongly since 2005. In fact, 2002–7 marked a period during in which labour reallocation was driving labour productivity growth both in respect of movements of labour towards higher productivity firms and within-firm productivity improvements (Barnett et al., 2014). Up to the end of 2007, there were solid company positions in terms of cash flows and returns on capital employed (Martin and Rowthorn, 2012, pp. 26–28). The consequent healthy financial positions of many firms at the start of the recession may have strengthened their ability and willingness to retain excess labour over the ensuing downturn (Coulter, 2016).
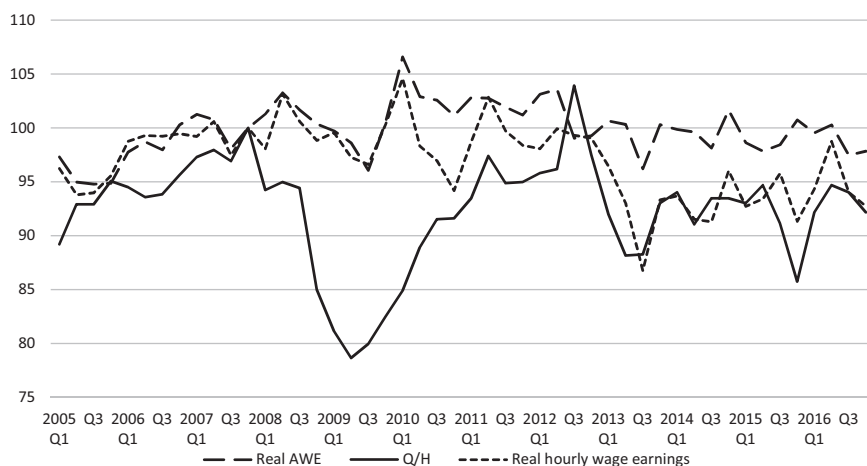
**Fig. 9.** Product wages and Q/H: Basic Metals and Metal Products, 2005–16. (2007 Q4 = 100). *Source*: Office for National Statistics.

2010Q3 hourly productivity recovery was strong—with large rises in weekly hours (see Fig. 5)—and there was an associated positive wage response. Thereafter, the continued upward movement in $Q/H$ to its new peak in 2012Q3 was more tentative and accompanied by a noticeable convergence of the real hourly product wage and $Q/H$. Over the last 4 years to 2016, both $Q/H$ and the average hourly product wage fell considerably below their levels in 2012.

Starting in the 1980s, there has been a long-term decline in the bargaining power of workers due to reductions in union coverage and firm-level collective bargaining (Brown et al., 2008; Bell and Hart, 2020). Why in this case did employers fail to use their market power to effect workforce compositional changes in an attempt to improve hourly productivity? There is evidence that action was taken to remove less efficient workers. Based on an Oaxaca wage decomposition using data from the Labour Force Survey from 2007 to 2012, Blundell et al. (2013) show that (all things being equal) compositional changes would have improved mean log hourly real wages (taken as a proxy for productivity) by 3.3%. The authors note, however, that this compositional effect is slightly lower than equivalent estimates for the two previous, and less severe, recessions of 1980–3 and 1990–3. More importantly, unlike the experience of rising real wages experienced during these earlier recessions, the authors find that, after accounting for a range of within-firm individual and job characteristics, their overall estimated average aggregate wage change is –5.3%.

Disney et al. (2013) argue that the impact of the GR on the magnitudes of firms' labour demand responses—expressed as the number of paid-for hours demanded for given hourly real product wages—differed from previous recessions due to increased labour supply at given hourly real consumption wages. On the basis of working population rates of economic inactivity over 20 quarters following the start of a recession, they show that the rates starting in 2008Q1 remained relatively low compared with those of the 1973 and 1979 recessions and with the second half of the 1990 recession, which displayed a steep inactivity upward trajectory. High labour supply at given real wages would be expected to result in

downward pressure on real wages[24] and in less severe pressure to reduce labour hours. The authors offer a wide range of socio-economic reasons behind these expectations. The financial nature of the recession may have led to an increase in workers willing to supply more hours to compensate for reductions in household wealth. Older workers may have been encouraged to remain longer at work due to low expectations of future earnings growth and/or greater uncertainties over pension returns given, for example a move away from defined benefit schemes. Strong inward migration of foreign workers also played a part in increased labour supply.

Returning to Fig. 9, from 2012Q3 to 2016Q4 both real hourly product wage earnings and hourly labour productivity fell below their levels at the start of the GR in 2007Q4. So, in sharp contrast to the GD experience, low real wages and poor productivity performance persisted considerably beyond the initial peak-to-peak GR cycle (see also Fig. 8). Real product AWE fared somewhat better, fluctuating closely around its 2007Q4 GR starting level. One reason for this was that, despite significant reductions in real hourly wages, average weekly hours of work in the Basic Metals sector increased somewhat in the later period. Between 2005Q1 and the end of the peak-to peak cycle in 2012Q2, average weekly hours averaged 35.4. In the period 2012Q3 to 2016Q4, the average was 36.5. One of the likely influences on the trends was the strong involvement of Central and Eastern European nationals in UK manufacturing.[25]

To the extent to which increased labour supply served to reduce real wage costs, employers would have been able to retain more labour, including those less efficient workers who might otherwise have lost their jobs. It may also have helped low performance firms, or parts of firms, to survive the recession when otherwise they would have ceased trading. Added to this, Pessoa and Van Reenen (2014) argue that falls in real wages have been accompanied by increases in capital costs resulting in a fall in the capital-to-labour ratio which itself would be associated with lower hourly productivity.

## 6. Conclusion

Employment and hours flexibility combined with short-run diminishing returns were the principal factors behind relatively strong hourly labour productivity in EMA industries during the GD. A predominance of general skills among workers in these industries served to reduce the cost of layoffs in the peak-to-trough period. In contrast, employers showed higher propensities to retain excess employment during the initial GR downturn. I argue

---

24  Using ONS labour market data, the authors show that real wage growth in 2012Q3 was 0.7% below its level in 2008Q1. Based on its historical trend (taken to be 10 years before 2008Q1), real wage growth would have been expected to be 10.2% above its 2008Q1 level. They also show (see Figures 3.7 and 3.8) that falling male and female real wages during the 2008 recession contrasted with strong rises in real wages in the 1979 and 1990 recessions for men and women and, additionally, in the 1973 recession for women.

25  Migration to the UK from 10 Central and Eastern European countries followed the accession to the EU of the EU(8) group of countries in 2004 and by the EU(2) pair of countries in 2007. While it is hard to judge the extent to which this influx directly affected the Basic Metals sectors, 8% of workers in UK manufacturing in 2016 were EU(8) nationals. Their occupations included process, plant and machine operatives. Both EU(8) and EU(2) nationals earned lower average wages than UK nationals and worked considerably longer weekly hours (Office for National Statistics, 2017).

that this is explained, at least in part, by the employment of a better educated workforce with certified vocational and educational qualifications.

In both eras, wage costs to the employer exerted important, though different, influence on hourly labour productivity. In the GD, steep rises in real hourly product wages due to the output price deflation between 1929 and 1934 induced employers to reduce weekly wage bills through cutbacks in working hours. This resulted in an important source of countercyclical hourly labour productivity in the peak-to-trough period. Higher labour supply at given real wages in the GR exerted downward pressures on real hourly product wages. Lower wage bills helped protect the jobs of less productive workers and allow the survival of less efficient firms with the effects of lowering average hourly labour productivity.

What were the comparative worker welfare implications of these labour market developments? In large part, the superior GD productivity performance was achieved at the price of severe job losses with little chance for most unemployed workers of short-term re-employment. In the GR, layoffs and unemployment rates were far lower and for those workers who lost their jobs state social welfare support was more comprehensive and generous. There was one feature that served to reduce these welfare differences. Starting in 1933, the economic recovery among EMA industries from the GD cyclical trough turned out to be strong and sustained, resulting in industrial expansion, real weekly and hourly wage growth, and improved productive performance. Such pickup in fortunes was absent in the GR for the majority of workers in EMA industries who experienced downward pressures on their real consumption wages well beyond the period of the initial business cycle.

## Acknowledgement

## References

Barnett, A., Chiu, A., Franklin, J., and Sebastiá-Barriel, M. (2014) The Productivity Puzzle: a Firm-level Investigation into Employment Behaviour and Resource Allocation over the Crisis, Bank of England Quarterly Working Paper No. 495, Bank of England.

Becker, G.S. (1962) Investment in human capital: a theoretical analysis, *Journal of Political Economy*, **70**, 9–49.

Bell, D.N.F. and Hart, R.A. (2020) The Decline of Overtime Working in Britain, IZA Discussion Paper No. 12651, Institute for Labor Economics, Bonn, Germany.

Bernanke, B.S. and Powell, J. (1984) The cyclical behavior of industrial labor markets: a comparison of prewar and postwar eras. Working Paper, No. 1376, NBER Working Paper Series.

Biddle, J.E. (2014) The cyclical behaviour of labor productivity and the emergence of the labor hoarding concept, *Journal of Economic Perspectives*, **28**, 197–211.

Blundell, R., Crawford, C., and Jin, W. (2013) What can wages and employment tell us about the UK's productivity puzzle? Institute for Fiscal Studies Working Paper W13/11, Institute for Fiscal Studies.

Bordo, M.D. and Evans, C.L. (1993) *Labor Productivity during the Great Depression*, National Bureau of Economic Research, Cambridge, MA.

Brown, W., Bryson, A., and Forth, J. (2008) Competition and the retreat from collective bargaining, NIESR Discussion Paper, No. 318, NIESR.

Burns, A.F. and Mitchell, W.C. (1946) *Measuring Business Cycles, NBER Book Series Studies in Business Cycles*, National Bureau of Economic Research, New York.

**Central Statistical Office** (1948) *Standard Industrial Classification*, His Majesty's Stationary Office, London.

**Coulter, S.** (2016) The UK labour market and the 'Great Recession', in M. Myant, S. Theodoropoulou, and A. Piasna (eds) *Unemployment, Internal Devaluation and Labour Market Deregulation in Europe*, European Trade Union Institute, Brussels, 197–227.

**De Jong, H. and Woltjer, P.** (2011) Depression dynamics: a new estimate of the Anglo-American manufacturing productivity gap in the interwar period, *The Economic History Review*, **64**, 472–92.

**Denman, J. and McDonald, P.** (1996) Unemployment statistics from 1881 to the present day, *Labour Market Statistics Group, Central Statistical Office, Special Feature*, 5–18.

**Disney, R., Jin, W., and Miller, H.** (2013) *The Productivity Puzzles, IFS Green Budget*, Institute of Fiscal Studies, London, 53–90.

**Fay, J.A. and Medoff, J.L.** (1985) Labor and output over the business cycle: some direct evidence, *American Economic Review*, **75**, 638–55.

**Feinstein, C.H.** (1972) *National Income, Expenditure and Output of the United Kingdom 1855–1965*, Cambridge University Press, Cambridge.

**Gali, J. and Van Rens, T.** (2021) The vanishing procyclicality of labour productivity, *Economic Journal*, **131**, 302–26.

**Grenet, J.** (2013) Is extending compulsory schooling alone enough to raise earnings? Evidence from French and British compulsory schooling laws, *The Scandinavian Journal of Economics*, **115**, 176–210.

**Hart, R.A.** (2005) General human capital and employment adjustment in the great depression: apprentices and journeymen in UK engineering, *Oxford Economic Papers*, **57**, 169–89.

**Hart, R.A.** (2019) Labor productivity during the Great Depression in UK manufacturing, IZA Discussion Paper, No. 13528. Institute for Labor Economics, Bonn Germany.

**Hart, R.A. and MacKay, D.I.** (1975) Engineering earnings in Britain, 1926–1938, *Journal of the Royal Statistical Society (Series A)*, **138**, 32–50.

**Hart, R.A. and Malley, J.R.** (1999) Procyclical labour productivity: a closer look at a stylized fact, *Economica*, **66**, 533–550.

**Herz, B. and Van Rens, T.** (2020) The labour market in the UK, 2000–2019, *IZA World of Labor (Labor)*, wol.iza.org.

**Industrial Health Research Board** (1942) Hours of work, lost time and labour wastage, Emergency Report No. 2, Medical Research Council, London.

**Knowles, K.G.J.C. and Hill, T.P.** (1954) The structure of engineering earnings, *Bulletin of the Oxford University Institute of Statistics*, **16**, 272–328.

**Lambert, R.** (2010) The labour market and employer relations beyond the recession, Warwick Papers in Industrial Relations No. 93, Industrial Relations Research Unit, University of Warwick, Coventry.

**Margo, R.A.** (1992) Employment and unemployment in the 1930s, Working Paper, No. 4174, National Bureau of Economic Research, Cambridge, MA.

**Martin, B. and Rowthorn, R.** (2012) *Is the British economy supply constrained II, A Renewed Critique of Productivity Pessimism*, Centre for Business Research, University of Cambridge.

**Mitchell, B.R.** (1988) *British Historical Statistics*, Cambridge University Press, Cambridge.

**Mitchell, W.C.** (1913) *Business Cycles*, University of California Press, Berkeley.

**Mulligan, C.B.** (2011) Rising labor productivity during the 2008-09 recession, NBER Working Paper No. 17584, NBER.

**Office for National Statistics** (2017). *International Immigration and the Labour Market*, London, ons.gov.uk.

**Oi, W.Y.** (1962) Labor as a quasi-fixed factor, *Journal of Political Economy*, **70**, 538–55.

**Pencavel, J.** (2015) The productivity of working hours, *The Economic Journal*, **125**, 2052–76.

**Pencavel, J.** (2018) *Diminishing Returns at Work*, Oxford University Press, Oxford.

**Pessoa, P.J. and Van Reenen, J.** (2014) The UK productivity puzzle: does the answer lie in wage flexibility?, *The Economic Journal*, **124**, 433–452.

**Taylor, C., Jowett, A. and Hardie, M.** (2014) *An Examination of Falling Real Wages, 2010–2013*, Office for National Statistics, London.

**Wigham, E.** (1973) *The Power to Manage, a History of the Engineering Employers' Federation*, Macmillan, London.