

# UNEMPLOYMENT AND REAL WAGES IN THE GREAT DEPRESSION

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This article uses a dataset covering ten advanced economies (Australia, Belgium, Canada, France, Germany, Netherlands, Norway, Sweden, United Kingdom and the United States) to explore the role of real wages as an influence on employment and unemployment in the Great Depression and more generally in the 1920s and 1930s. The distinction between employment and unemployment movements during the Great Depression helps to clarify the role of supply side influences on the national heterogeneity of unemployment increases during the Great Depression. We find little general econometric evidence for the idea that movements in product wages had strong influences on employment either during the period of rising unemployment associated with the depression of the 1930s or more generally with the data which exist for the 1920s and 1930s.

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## Introduction

One of the most striking aspects of the recent recession has been that, at least so far, unemployment has risen much less than might have been expected given the contraction to output. With the clear exception of the United States, the increase in unemployment in the advanced countries has been relatively modest and in Germany, despite a large contraction to output, unemployment has scarcely risen at all. The differences with earlier depressions has been emphasised in much of the literature.

A continuing and general area of debate about unemployment is the role of real wages as a causal factor. In this article, using data from a number of advanced economies, we explore the role of real wages as an influence on employment and unemployment in the Great Depression and more generally in the 1920s and 1930s. The paper is therefore a complement to studies such as Holland, Kirby and Whitworth (2010) and OECD (2010) which explore the differences between countries' experiences of employment and unemployment movements in the current depression.<sup>1</sup> A general conclusion from both sets of studies is that wage flexibility and a willingness to adopt part-time working have been important factors behind the generally modest increase in unemployment. We explore the role of real wages in determining the levels of unemployment during the Great Depression.

We begin by providing a review of some of the literature to date. We then discuss the relationship between employment and unemployment movements during the Great Depression. We follow this with a theoretical framework to identify the sort of effects which we would hope to observe on the assumption that real product wages are drivers of unemployment. This is followed by two further empirical sections, the first looking at the relationship between real product wages and productivity, employment and output changes during the period of rising unemployment associated with the Great Depression (which was not, of course, synchronised across the economies we study). The second looks at long-run relationships between real wages and productivity using the time-series data for each country in our sample.

## Interwar unemployment: a survey of the comparative literature

The literature on interwar unemployment is extensive. In this section we provide a review of some of the literature that is relevant to the focus of our paper on the Great Depression episode. The first point to make is that most of the literature deals with national experiences. Eichengreen and Hatton (1988) provide a set of national case studies. More recently the experience of Germany has been considered by Dimsdale *et al.* (2006) and there

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has been extensive research on other economies, including Australia (Dimsdale and Horsewood, 2002) and the Scandinavian economies (Topp, 2008; Grytten, 1995).

A more limited literature has followed a comparative approach. The work by Eichengreen and Sachs (1985) suggests that during the Great Depression the world economy can usefully be divided into a number of distinct policy blocs: those that devalued and came off gold in the early 1930s and the 'Gold bloc', a group of countries that remained committed to the fixed gold parity they had established in the 1920s. The cross-sectional differences in the economic performance of these exchange rate policy zones suggest that devaluation had a positive effect on economic recovery in the 1930s by generating a Keynes effect on real wages – the inflationary effect of devaluation moderated real wage growth in the countries that devalued in the 1930s resulting in favourable supply-side effects on recovery over the period 1929–35. The assumption behind the Eichengreen and Sachs result is that nominal wage inertia propagated the depression and falling employment in the depression years before the policy reactions of devaluation. These results have been shown to be applicable to a wider set of countries in the work of Bernanke and Carey (1996) who extended the Eichengreen and Sachs sample from a 10-country cross section to 22 countries. A key result of Bernanke and Carey is that over the years 1929–31, 1929–32 and 1929–33 real wages moved counter-cyclically – with real wages between 20 and 40 per cent higher than the level of 1929. However, Eichengreen and Sachs and Bernanke and Carey both use wholesale prices as deflators and this choice may drive their results.<sup>2</sup> Indeed the use of wholesale prices as a deflator turns out to be a major problem in the study of the interwar labour market; in terms of the economic theory of the demand for labour it is necessary to consider the cost of labour to the firm and this requires measuring own product real wages. The absence of a suitable price deflator makes it difficult to draw firm conclusions from these early studies. Real wage indices constructed from these deflators show a rapid increase of real wages between 1929 and 1932 before stabilising or falling between 1932 and 1936. However, the use of the wholesale price index as a deflator is seriously flawed; wholesale price indices reflected movements in both input costs and costs of unit value added but it is only the latter that is applicable to the measurement of own product real wages in the economy as a whole. The distortions caused by using these indices are particularly severe in

the interwar period due to the volatility of raw material prices. One recent attempt to deal with this problem is the work of Madsen (2004) who used final product prices to track the path of real wages for twelve countries. When real wages are appropriately measured, the increase of real wages in the depression years was not a general feature of the 12-country experience. Here we proceed along a similar line to Madsen and measure real wages as real earnings deflated by the GDP deflators of ten countries.<sup>3</sup> Because we are mainly interested in unemployment and employment the selection of countries covered by our study is slightly different from Madsen, providing further independent evidence on the question of real wage rigidity.

In general the comparative literature has neglected the supply-side aspects of labour force growth. Such variables have been emphasised in some of the national case studies – for example, Beenstock and Warburton (1986) and Butchart (1997) consider the role of labour force growth and participation rates in the case of Britain. Here we attempt to remedy this by considering these supply-side aspects for a cross-section of countries where we have employment and unemployment data for the interwar period. In normal circumstances and with unchanging labour market conditions one would expect the unemployment rate to fluctuate around the NAIRU (non-accelerating inflation rate of unemployment). However, if the economy does not adapt rapidly to fluctuations in labour supply, then these may be a separate cause of movements in the unemployment rate. Such supply-side effects could be the result of demographic trends; for example, in the case of the UK the proportion of the population of working age increased from 64 per cent in the pre-1913 period to 70 per cent in the interwar period; during 1924–37 while population growth was 0.4 per cent per annum, labour force growth was 1.5 per cent per annum.

Although many of these demographic changes can be described as having long-term origins, or as being induced by exogenous international influences, such as migration restrictions in the new world, we cannot assume that all the observed growth in labour supply was autonomous. Beenstock and Warburton (1986) have argued that interwar labour supply was responsive to real wage trends. Thus, as real wages rose on trend during 1924–37 this generated supply-side effects that compounded the unemployment problem. However, using quarterly data for the interwar period, Hatton (1988) found that although these supply responses were statistically significant, they were small in magnitude;

the adverse supply conditions can best be viewed as a result of long-term demographic factors. In this paper we contribute to the literature by explicitly considering these supply-side effects for a cross-section of the advanced economies focusing on their likely effects during the Great Depression episode.

The role of demand variables in driving the rise of unemployment during the Great Depression has been widely accepted by historians working within both the neoclassical and Keynesian traditions. Bernanke and Carey (1996) note that modelling demand explicitly provides a way of identifying the aggregate supply relationship between real wages and output/employment. The way demand is modelled in the comparative literature is to use industrial production as a proxy measure for aggregate output movements. This is used in Eichengreen and Sachs (1985), Bernanke and Carey (1996) and Bernanke and James (1991). Reinhart and Reinhart (2009) have noted differences between industrial production and GDP when analysing the effects of exchange rate policies and the amplitude of the Great Depression. This is to be expected, as countries display large differences in economic structure; as such, industrial production will provide a poor indicator of macroeconomic movements in the depression period. Here we choose to work with GDP data as the macroeconomic variable of interest because it is the broadest measure of economic activity.

The range of countries for which we have been able to obtain satisfactory data is inevitably somewhat limited. However, we are able to look at the experiences of Australia, Belgium, Canada, France, Germany, the Netherlands, Norway, Sweden, the United Kingdom and the United States. We focus our attention first of all on the purely statistical relationship between output movements and movements in employment and unemployment.

An obvious indication of the relationship between output and employment changes is to look at the change to employment per unit of output or equivalently the change to output per unit of employment, i.e. to labour productivity. If employment moved one for one with output, then this derived variable would be unchanged. During normal periods in which labour saving technical progress is taking place we would expect to see output rising faster than employment, or rising perhaps even if employment is stagnant or falling. But in recessions, if there is labour hoarding, or if, as at present, employment conditions have adapted so as to maintain

employment, we would expect to see output falling more than employment, so that employment per unit of output would rise and labour productivity would fall.

## Employment and unemployment in the contraction phase of the Great Depression

The focus of attention during the Great Depression was naturally on unemployment. However, very obviously changes in unemployment can happen either because of changes in employment or because of changes in labour supply. For the purpose of understanding what was going on during the Great Depression it is important to separate out these two effects. We show in table 1 the total increase in the unemployment rate for the countries for which we have data, splitting this between the effect of the change to employment and the change to the labour supply (measured as employment plus unemployment). These are shown as percentages of the labour force at the start of the period of contraction. We also show, as a memorandum item, the increase in the unemployment rate over the period.

The correlation between the increase in unemployment and the reduction in employment, measured as a proportion of the labour force at the start of the contraction is only 0.43, demonstrating the importance

Table 1. Employment and unemployment while unemployment was rising

|           | Period in question | Increase in labour force                    | Increase in unemployment | Reduction in employment | Increase in unemployment rate |
|-----------|--------------------|---------------------------------------------|--------------------------|-------------------------|-------------------------------|
|           |                    | (% of labour force at start of contraction) |                          |                         | (% points)                    |
| UK        | 1929–32            | 4.8                                         | 9.0                      | 4.3                     | 8.3                           |
| Australia | 1926–32            | 5.2                                         | 15.5                     | 10.3                    | 13.9                          |
| Belgium   | 1928–32            | –0.8                                        | 18.9                     | 19.7                    | 19.0                          |
| Canada    | 1928–33            | 10.7                                        | 19.7                     | 9.0                     | 17.6                          |
| France    | 1929–36            | –4.9                                        | 3.4                      | 8.3                     | 3.6                           |
| Germany   | 1928–32            | –19.4                                       | 10.1                     | 29.5                    | 13.4                          |
| Neths     | 1928–36            | 9.3                                         | 11.4                     | 2.1                     | 10.3                          |
| US        | 1929–32            | 4.9                                         | 21.1                     | 16.2                    | 20.0                          |
| Norway    | 1929–31            | 2.0                                         | 4.2                      | 2.2                     | 4.0                           |
| Sweden    | 1929–33            | 4.3                                         | 5.8                      | 1.5                     | 5.4                           |

Note: The data are presented for a period of uniformly rising unemployment rates beginning in the late 1920s. France showed a very small fall in its unemployment rate in 1934 but unemployment then rose in 1935 and 1936, so we have treated the relevant period as extending to 1936. The peak–trough dates are those for unemployment and differ slightly from the comparable dates for GDP (as in the case of the US).

of, at least in any study of supply conditions, looking at the relationship between real wages and employment rather than real wages and unemployment. In particular we note that in the United Kingdom, Canada, the Netherlands and Sweden, more than half of the increase in unemployment is explained by increased labour supply rather than by reduced employment. By contrast, in France and Germany reductions in the labour force held down the increase in unemployment and in Germany the effect was extremely strong. Some authors have attempted to explain these movements in labour supply in terms of the generosity of unemployment benefits (in part because the value of benefits fixed in money terms was increased as a result of price deflation). We do not discuss that issue here but focus our attention on the relationship between employment, output and real product wages.

### A framework for exploring real wages, output and employment

We assume that output is driven by a constant elasticity of substitution production function

$$Y = (\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta)^{\frac{1}{1-\delta}}$$

where  $\gamma$  is the rate of labour-saving technical progress and  $1/(1-\delta)$  is the elasticity of substitution between labour and capital. With this production function we have the standard result that the output per unit of labour, i.e. labour productivity, depends on the wage after adjusting for trend labour-augmenting technical progress, and equating the real wage to the marginal product of labour.

$$\begin{aligned} \log\left(\frac{Y}{L}\right) &= \frac{1}{1-\delta} \log(\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta) - \frac{\log(\beta)}{1-\delta} \\ &= \frac{1}{1-\delta} \log(\alpha K^\delta) - \frac{\log(\beta) + \gamma\delta t}{1-\delta} \end{aligned} \quad (1)$$

Here it is important to note that  $w$  is the product wage and, since we are looking at the whole economy, the appropriate deflator is the GDP deflator.

There are two possible ways of looking at the relationship between employment and wages. In the first case, described by Beenstock and Warburton (1986) as the neoclassical case, we assume that output is not constrained by effective demand, so that employment responds only to the real wage.

We substitute out for  $Y$  in equation (1) to give

$$\begin{aligned} &\left(\frac{1}{\delta}\right) \log(\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta) - \log L \\ &= \frac{1}{1-\delta} \log(\alpha K^\delta) - \frac{\log(\beta) + \gamma\delta t}{1-\delta} \end{aligned} \quad (2)$$

Now, looking at small differences and equating the change in the real wage to the change in the marginal product of labour, this gives

$$\begin{aligned} \frac{\Delta w}{w} &= (\delta - 1) \left( 1 - \frac{\beta e^{\gamma\delta t} L^\delta}{\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta} \right) \frac{\Delta L}{L} \\ &\quad - \frac{(\delta - 1)(\alpha K^\delta)}{\alpha K^\delta + \beta \gamma e^{\gamma\delta t} L^\delta} \frac{\Delta K}{K} \\ &\quad + \gamma \left( \delta - \frac{(\delta - 1)(\beta L^\delta e^{\gamma\delta t})}{\alpha K^\delta + \beta \gamma e^{\gamma\delta t} L^\delta} \right) \Delta t \end{aligned} \quad (3)$$

As a check we can see that if the labour input does not change while the capital stock grows at the rate of labour-saving technical progress,  $\gamma$ , then the real wage also grows at rate  $\gamma$ .

With this general relationship there are still two possible assumptions we may wish to make, given the general absence of suitable data on capital stocks and the cost of capital. With output taken as endogenous, if we assume that the stock of capital grows at the rate  $\gamma$ , we have

$$\frac{\Delta w}{w} = (\delta - 1) \left( 1 - \frac{\beta e^{\gamma\delta t} L^\delta}{\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta} \right) \frac{\Delta L}{L} + \gamma \Delta t$$

so that

$$\frac{\Delta L}{L} = \frac{\frac{\Delta w}{w} - \gamma \Delta t}{\left( \frac{(\delta - 1)\alpha K^\delta}{\alpha K^\delta + \beta e^{\gamma\delta t} L^\delta} \right)} \quad (4)$$

Since a requirement of the production function is that  $\delta < 1$ , this shows the expected negative relationship between the growth of the real wage and the growth of labour input.

Alternatively one might assume that the capital stock is fixed rather than growing at the same rate as labour productivity. Inspection of the above equations reveals, not surprisingly, that this assumption does not affect the marginal influence of the real wage on employment; it simply delivers a different time trend. Thus with either of these assumptions we find the influence of the real

wage on employment depends on the elasticity of substitution between labour and capital,  $1/(1-\delta)$  geared up by a term which can be interpreted as the contribution of capital relative to labour in overall output.

One important point to note is that, even if the underlying production function correctly describes the determinants of output, the capital stock in all probability is neither constant over the period of interest to us, nor is it growing at a constant rate. If its growth were random and uncorrelated with employment growth, then (4) could still be estimated by OLS regression. To the extent that there is serial correlation in the growth rate of the capital stock, we will expect to find serial correlation in the residuals of a statistical relationship between employment growth and real wage growth over time for any individual country, while any correlation between growth in the capital stock and in employment will result in a biased estimate of the coefficient on wage growth.

In the second case we assume that output is demand-constrained, so that businesses take the level of demand as given and simply try to equate the marginal product of labour to the wage rate in the light of this. Beenstock and Warburton (1986) describe this as the Keynesian case.

Now the analysis is much simpler. Equation (1) is itself a statistical relationship which can be estimated, showing the real wage as a determinant of productivity. Equally the derivative of this gives, for comparison with equation (4)

$$\frac{\Delta L}{L} = \frac{\Delta Y}{Y} + \frac{1}{\delta - 1} \frac{\Delta w}{w} - \frac{\delta \gamma}{\delta - 1} \Delta t \quad (5)$$

This also shows a negative relationship between the change in the real wage and the change in employment. It is also clear that the negative impact of a change in the real wage is greater in an economy which is not demand constrained than in one which is demand constrained; in

the latter case the gearing factor,  $\frac{\alpha K^\delta + \beta \gamma e^{\gamma t} L^\delta}{\alpha K^\delta}$  is absent. Such a conclusion is hardly surprising, since in the former case output movements are endogenous while in the latter case output movements are taken as given. To the extent that we use equations (4) and (5) to explore the relationship between real wages and employment on

a cross-section basis for the period in which output contracted, the former points to estimating an equation for the change in log employment in terms of the change in the real wage and the duration of the contraction, while the latter indicates that the dependent variable should be the change in log labour productivity rather than the change in log employment. Estimation of the former equation does rely on the assumption that the

ratio  $\frac{\alpha K^\delta + \beta \gamma e^{\gamma t} L^\delta}{\alpha K^\delta}$  takes the same equilibrium value in all the countries of interest.

These observations suggest a strategy for exploring the relationship between employment, real wages and, where relevant, output. First of all we use the structure implied by the equations in differences to explore the relationship between real wages, employment and output during the period of particular interest to us, that is the period when, in each of the countries for which we have data, the unemployment rate was rising. It should be noted, of course, that this was not the same period for each country, but, because our focus is on the relationship between real wages and employment in a period of a rising unemployment rate, this is not a problem. Thus we explore this relationship using cross-section data during the period when output was falling. The second way in which we can explore the relationship between real wages, output and employment is by making use of the panel aspect of our data, albeit that they form an unbalanced panel. We explore these two different uses of our data in turn.

### Employment, real wages and output during the period of rising unemployment

We look at the cross-sectional relationship between the changes in employment, real product wages and output itself from a number of perspectives. We begin with three regression equations explaining the change in labour productivity: the Keynesian equation – the change in output, the neoclassical equation, and finally the change in employment which can also be regarded as an examination of the neoclassical idea that output and employment are jointly determined given real wages rather than output. The data we use are shown in table 2; they cover the period of rising unemployment rates.<sup>4</sup> The data show considerable heterogeneity of experience, not only in the contraction of output and the fall in employment, but also in movements of labour productivity and the product wage. It is well known that

Table 2. Output, employment and real wages during the period of rising unemployment

|                        |         | $\Delta \ln$<br>Output | $\Delta \ln$<br>Employment | $\Delta \ln Y/L$ | $\Delta \ln$<br>product<br>wage |
|------------------------|---------|------------------------|----------------------------|------------------|---------------------------------|
| UK                     | 1929–32 | -0.055                 | -0.046                     | -0.008           | -0.002                          |
| Australia              | 1926–32 | -0.250                 | -0.089                     | -0.161           | 0.061                           |
| Belgium <sup>(a)</sup> | 1929–32 | -0.124                 | -0.232                     | 0.108            | -0.072                          |
| Canada                 | 1928–33 | -0.350                 | -0.107                     | -0.243           | -0.088                          |
| France                 | 1929–36 | -0.193                 | -0.086                     | -0.107           | 0.329                           |
| Germany                | 1928–32 | -0.328                 | -0.345                     | 0.016            | 0.017                           |
| Neths                  | 1928–36 | -0.089                 | -0.072                     | -0.017           | -0.001                          |
| US                     | 1929–32 | -0.342                 | -0.135                     | -0.207           | 0.116                           |
| Norway                 | 1929–31 | -0.088                 | -0.032                     | -0.056           | 0.019                           |
| Sweden                 | 1929–33 | -0.027                 | -0.034                     | 0.008            | 0.047                           |

Note: (a) There are no real wage data for Belgium for 1928 so the change is calculated from 1929 even though 1928 is the year with the lowest unemployment rate.

Table 3. The relationship between the change in the product wage and movements in productivity, output and employment

| Dependent variable            |                | Change in log<br>product wage | Constant |
|-------------------------------|----------------|-------------------------------|----------|
| Change in log<br>productivity | Coefficient    | -0.060                        | -0.044   |
|                               | s.e.           | 0.360                         | 0.045    |
|                               | R <sup>2</sup> |                               | $\sigma$ |
|                               |                | 0.004                         | 0.116    |
| Change in log<br>output       | Coefficient    | 0.133                         | -0.170   |
|                               | s.e.           | 0.447                         | 0.055    |
|                               | R <sup>2</sup> |                               | $\sigma$ |
|                               |                | 0.011                         | 0.145    |
| Change in log<br>employment   | Coefficient    | 0.193                         | -0.126   |
|                               | s.e.           | 0.339                         | 0.042    |
|                               | R <sup>2</sup> |                               | $\sigma$ |
|                               |                | 0.039                         | 0.110    |

the contraction was at its most severe in Germany and in the United States; the movements in productivity and product wages were nevertheless very different.

The relationship between the change in product wage and the other three variables is shown in table 3. None of these equations is remotely statistically significant, suggesting that a standard production function does not offer a satisfactory explanation of the relationship between real wage movements and any of output,

Table 4. The change in employment as a function of the change in product wage and output

| Dependent variable          |                | Change in<br>log product<br>wage | Change in<br>log<br>output | Constant |
|-----------------------------|----------------|----------------------------------|----------------------------|----------|
| Change in<br>log employment | Coeff          | 0.184                            | 0.434                      | -0.046   |
|                             | s.e            | 0.262                            | 0.245                      | 0.054    |
|                             | R <sup>2</sup> |                                  | $\sigma$                   |          |
|                             |                | 0.333                            | 0.092                      |          |

employment and labour productivity movements during the period of economic contraction.

We now look in table 4 at a somewhat more flexible model related to the first (Keynesian) model. However, instead of looking at productivity movements, which effectively imposes a unit coefficient on output, we explain employment movements by means of output and real wage movements.

This equation shows a close to significant role for the change in output, but with a coefficient well below the value of one implied by the Keynesian production function model. The term in the product wage remains, however, incorrectly signed. If we suppress the term in the product wage we find that the change in log output has, not surprisingly, a statistically significant relationship with the change in log employment, again with a coefficient of well below one. However we note that a conclusion that this shows clear labour hoarding is conditional on the assumption that the output movements are exogenous. If one instead assumed that the employment movements were exogenous and estimated the reverse regression, one would then conclude that output moved less than in proportion to employment but with a coefficient which was not significantly below one.

In the first three equations we have not included any effects representing trend productivity growth. These might be expected to play a role given that the periods of rising unemployment are different for different countries. However, the inclusion of an extra variable representing the length of the interval considered has no material effect on any of the regression equations.

Secondly, one might be concerned with reference to the last regression equation that output growth is in fact endogenous, leading to biased parameter estimates. We re-estimated the equation using, as an instrument for

output growth, the country-by-country ranking of output growth and this had little overall impact on the conclusions.

To summarise, two conclusions can be drawn from this cross-section work. First of all, there is no clear evidence that movements in real wages in the different countries considered affected employment losses in any perceptible way. And secondly, there is clear general evidence of labour hoarding conditional on the assumption that output movements are exogenous. This limited the effects of the economic contraction on employment. However, as the data for individual countries show, in Belgium employment fell by much more than output and in the UK, Germany, and the Netherlands employment and output moved broadly in line, keeping productivity constant. Really sharp declines in productivity were found in Australia, Canada and the United States.

## Dynamic analysis of output, employment and real wages

### *Long-run effects from country models*

In our static cross-section analysis we were able to explore the relationship between real wages and employment making both neo-classical and Keynesian assumptions. However, an obvious extension of the analysis is to explore the idea that the production function relationship represents a long-term constraint and that short-term movements are, on the one hand a dynamic adjustment to this and, on the other hand, a process of response to shocks; as we noted earlier, this is particularly appropriate given the absence of suitable capital stock data. It would be natural to do this using all the data we have available for the interwar period rather than simply to look at the period of rising unemployment.

If we look at this longer period, the assumption that the capital stock is fixed cannot be maintained. If we assume that the capital stock grows on a trend basis, we can see that the neoclassical production function (2) provides a highly non-linear relationship between employment and the log real wage; even with capital stock data the non-linearity would still be present. By contrast the productivity equation (1) with output as exogenous gives a simple long-run relationship which can be used in a dynamic adjustment equation and it is this we use as the basis for our estimation.

Thus our main dynamic model is of the form

$$\Delta \log L_t = \alpha_1 \Delta \log Y_t - \alpha_2 \Delta \log w_t - \gamma (\log L_{t-1} - \phi_1 \log Y_{t-1} + \phi_2 \log w_{t-1} - \phi_3 t - \phi_4)$$

where we expect to be able to accept the restriction that  $\phi_1 = 1$  and also have specified the structure so that all the coefficients except possibly  $\phi_4$  are positive.

The obvious estimator to use is the Pooled Group Mean Estimator (Pesaran, Shin and Smith, 1999) which does not impose the restriction, found in more traditional panel estimators, that all the coefficients are the same for all countries. However, for the estimator to be used it is necessary to be able to estimate an individual regression for each country; while that is just possible with our data set, it is helpful to mitigate the problems arising from a small number of degrees of freedom.

We therefore impose the restrictions that  $\alpha_1 = \phi_1 = 1$  and limit ourselves to estimating the coefficients of a dynamic adjustment process for the effects of the real wage on productivity levels. We also note that to find the solution the time effect has to be outside the long-run relationship. This has the implication that, as with the other short-run effects, we are estimating the average value for the data set, but that it is not restricted to be uniform for all countries. The restricted equation is

$$\Delta \log(Y_t / L_t) = \alpha_2 \Delta \log w_t + \alpha_3 t - \gamma (\log(Y_{t-1} / L_{t-1}) + \phi_2 \log w_{t-1}) + \alpha_4$$

The Pooled Group Mean Parameter estimates are, with z-statistics shown in brackets,

$$\begin{aligned} \Delta \log(Y_t / L_t) = & 0.057 \Delta \log w_t + 0.005t - 0.58(\log(Y_{t-1} / L_{t-1}) \\ & (0.65) \quad (2.14) \quad (5.87) \\ & - 0.143 \log w_{t-1}) - 13.23 \\ & (2.22) \quad (2.20) \end{aligned}$$

The coefficients on  $\Delta \log w_t$ , on time and on the adjustment term,  $\log(Y_{t-1} / L_{t-1}) - 0.143 \log w_{t-1}$ , are the means and the constant of the sample while the coefficient on  $\log w_{t-1}$  itself is restricted to be the same for all countries. This equation suggests a correctly signed, but weak, long-term effect of product wages on productivity and thus, for any given level of output, on employment. Comparison with equation (1) shows that the time term is incorrectly signed, or at least is consistent with technical regress rather than technical progress; however it is more probable that this effect arises from a failure of movements in real wages to reflect technical progress fully during the period. The short-term relationship between productivity and real

wages is also correctly signed but it is both statistically insignificant and under half the long-term effect.

The weak nature of the long-run effect can be identified by noting that the equation implies a 7 per cent reduction in real producer wages is needed to generate a long-run increase of 1 per cent in employment. Thus a reasonable conclusion is that real wage adjustment was not a remotely plausible mechanism for offsetting the 29.5 per cent reduction in employment seen in Germany between 1928 and 1932.

We also attempted to estimate a similar equation

$$\Delta \log L_t = \alpha_2 \Delta \log w_t + \alpha_3 t - \gamma (\log L_{t-1} + \phi_2 \log w_{t-1}) + \alpha_4$$

explaining employment rather than productivity in terms of time and the real wage where we expect a positive value for  $\phi_2$ ; however the data were such that we could not find a maximum value for the likelihood function.

## Conclusions

Recently a number of authors have argued that neo-classical models, based on optimising equilibrium behaviour, but subject to distortions arising from wedges (Chari, Kehoe and McGrattan, 2007, and papers in Kehoe and Prescott, 2007) provide satisfactory explanations of the behaviour of depressed economies. Whilst our results do not rule out such conclusions, we find little general econometric evidence for the idea that movements in product wages had strong influences on employment either during the period of rising unemployment associated with the depression of the 1930s or more generally with the data which exist for the 1920s and 1930s. This finding, which is based on comparative analysis, confirms the reservations expressed by Madsen (2004) on the role of real wages in the Great Depression.

If one takes the view that wage rates are exogenous (as they would be if unemployment were a problem of sticky wages), then there is weak evidence that productivity was affected by wage movements in the way that economic theory would suggest. However, in such an analysis, movements to output are best regarded as largely exogenous and the findings are therefore consistent with the idea that demand played an important role in employment fluctuations.

The alternative view that employment is driven by factor prices and technological developments cannot be fully explored with data on the capital stock and costs of capital. However, making simplifying but necessary assumptions, we find little evidence to support this explanation. While we cannot establish statistically significant relationships between employment and product wages, we do find that, on balance, the signs of the effects tend to be incorrect.

Our analysis has also shown that the comparative approach is useful in illustrating the importance of supply-side factors in explaining some of the unemployment of the Great Depression period. Clearly, this is an important aspect of a number of the interwar national unemployment experiences that warrants further research.

## NOTES

- 1 We use the term depression to mean a period when output is depressed below its previous peak while a recession is a period of falling output.
- 2 Bernanke and Carey (1996, p.859) state: "The choice of wholesale prices index as a deflator ... is dictated by data availability".
- 3 There are data available on both wage rates and earnings. Where available, we have used movements in earnings per person as our indicators of movements in the real wage. Such data are, of course, vulnerable to inaccuracies arising from changes to the length of the working week. We have not found any evidence that this was a corrupting factor during the Great Depression – in general, the movements of rates and earnings are highly correlated.
- 4 With the exception that there was a very slight fall in the unemployment rate in France in 1934. However, unemployment continued to rise in 1935 and 1936 and we have therefore treated this as one period.

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## DATA APPENDIX: SOURCES

### I. Unemployment

#### Australia

The data used are from Keating, M. (1973), *The Australian workforce, 1910–11 to 1960–61*, Australian National University, Dept. of Economic History, Research School of Social Sciences. Similar series are reported in Vamplew, W. (ed.) (1987), *Australians: Historical Statistics*, Fairfax, Syme and Weldon Associates, Sydney, Table: LAB 86–97, column 97, p.152.

#### Belgium

Goossens, M. (1988), 'De Belgische arbeidsmarkt tijdens het Interbellum', *Tijdschrift voor Economie en Management*, Vol. 2, pp. 109–26.

#### Canada

Maddison, A. (1964), *Economic Growth in the West*, London, Allen & Unwin. The 1920–31 figures are from Urquhart, M.C. (ed.) (1965), *Historical Statistics of Canada*, Toronto, MacMillan and the 1931–8 figures are taken from the *Canadian Statistical Review*.

#### France

The unemployment data is reported in the work of Pierre Villa and can be found at the CEPII webpage <http://www.cepii.fr/francgraph/bdd/villa/mode.htm>.

#### Germany

Maddison, A. (1964), *Economic Growth in the West*, London, Allen & Unwin. The data reported in Maddison follow the same temporal movements to the data reported in Corbett, D., *Unemployment in Interwar Germany*, PhD thesis, Harvard (1991). However, Corbett reports data only for the period after 1925. For consistency we have chosen to work with Maddison's data.

#### Netherlands

Maddison, A. (1964), *Economic Growth in the West*, London, Allen & Unwin.

#### Norway

Grytten, O.H. (1995), 'The scale of Norwegian interwar unemployment in international perspective', *Scandinavian Economic History Review*, 2, pp. 226–50.

#### Sweden

Grytten, O.H. (1995), 'The scale of Norwegian interwar unemployment in international perspective', *Scandinavian Economic History Review*, 2, pp. 226–50.

#### United Kingdom

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

#### United States

The data for the 1920s is from Lebergott, S. (1964), *Manpower in Economic Growth*, New York, McGraw Hill. For the period 1929–38 we use the revisions suggested by Darby, M.R. (1976), 'Three-and-a-half million US employees have been mislaid, or an explanation of unemployment, 1934–1941', *Journal of Political Economy*, 84, 2, pp. 1–16. Similar data is reported in Carter, S.B. (2006), Table Ba470–477, 'Labor force, employment, and unemployment: 1890–

1990' in Carter, S.B., Gartner, S.S., Hainews, M.R., Olmstead, A.L., Sutch, R. and Wright, G. (eds), *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition*, New York, Cambridge University Press, 2006.

## 2. Employment

### Australia

Vamplew, W. (ed.) (1987), *Australians: Historical Statistics*, Sydney, Fairfax, Syme and Weldon Associates, Chapter 9, p.152.

### Belgium

Goossens, M. (1988), 'De Belgische arbeidsmarkt tijdens het Interbellum', *Tijdschrift voor Economie en Management*, 2, pp. 109–26.

### Canada

*Historical Statistics of Canada*: <http://www.statcan.gc.ca/pub/11-516-x/sectiond/4057750-eng.htm#2> Employment data [http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&loc=D528\\_539-eng.csv](http://www.statcan.gc.ca/cgi-bin/af-fdr.cgi?l=eng&loc=D528_539-eng.csv).

### France

The employment data is reported in the work of Pierre Villa and can be found at the CEPII webpage <http://www.cepii.fr/francgraph/bdd/villa/mode.htm>.

### Germany

Ritschl, A. (2002), *Deutschlands Krise und Konjunktur. Binnenkonjunktur, Auslandsverschuldung und Reparationsproblem zwischen Dawes-Plan und Transfersperre 1924–1934*, Berlin, Akademie-Verlag.

Data can be found at <http://personal.lse.ac.uk/ritschl/interwargermanydata.html>.

### Netherlands

Central Bureau of Statistics. Data are available at <http://www.cbs.nl/NR/rdonlyres/9E42BCD3-922D-4E4D-B957-51EE913FC450/0/BLZ187HE2009.xls> Sheet H2AE Column J.

### Norway

Grytten, O.H. (1994), *An Empirical Analysis of the Norwegian Labour market, 1918–1939*, Bergen, NHH, p. 198.

### Sweden

Edvinsson, R. (2005), *Growth, Accumulation, Crisis:*

*With New Macroeconomic Data for Sweden 1800–2000*, Doctoral dissertation, Stockholm, Almqvist & Wiksell International.

### United Kingdom

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

### United States

Carter, S.B. (2006), *Table Ba470–477*, 'Labor force, employment, and unemployment: 1890–1990' in Carter, S.B., Gartner, S.S., Hainews, M.R., Olmstead, A.L., Sutch, R. and Wright, G. (eds), *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition*, New York, Cambridge University Press, 2006.

## 3. Real earnings

All nominal wage/earnings data have been deflated by the GDP deflator of each country.

### Australia

Liesner, T. (1989), *One Hundred Years of Economic Statistics: United Kingdom, United States of America, Australia, Canada, France, Germany, Italy, Japan, Sweden*, Economist Publications, Table A.8.

The data relate to average hourly earnings in manufacturing – earnings of adult males in October of each year. For 1929–39, figures are for men in manufacturing, mining, construction, transport and agriculture. For 1920–28, the data are from Butlin, M.W. (1977), 'A preliminary annual database 1900/01 to 1973/74', Reserve Bank of Australia working paper, RDP7701.

### Belgium

International Labour Office (ILO) (1940), *Year-Book of Labour Statistics*, Geneva, Table XIII.

Series: Average wage in mines, industries and transport

### Canada

<http://www.statcan.gc.ca/pub/11-516-x/3000140-eng.htm>.

Series E41. Average annual earnings of production workers index.

### France

International Labour Office (ILO) (1940), *Year-Book of Labour Statistics*, Geneva, Table XIII.

International Labour Office (ILO) (1935–6): *Year-Book of Labour Statistics*, Geneva, Table IX.

The data relate to Hourly Industry rates (towns other than Paris) and relate mainly to skilled workers.

### Germany

Bry, G. (1960), *Wages in Germany, 1871–1945*, Princeton University Press, Table A-2 Part III.

### Netherlands

International Labour Office (ILO) (1940), *Year-Book of Labour Statistics*, Geneva, Table XIII.

International Labour Office (ILO) (1935–6): *Year-Book of Labour Statistics*, Geneva, Table IX.

Industrial hourly earnings index, mainly relating to skilled and unskilled males in mines and industries.

### Norway

Mitchell, B.R. (1992), *European Historical Statistics, 1750–1988*, Table B4, p. 184.

The wage data relate to hourly wages. However, the movements are very close to the data based on daily earnings (covering skilled and unskilled males in mining and industry) from the ILO sources:

International Labour Office (ILO) (1940), *Year-Book of Labour Statistics*, Geneva, Table XIII.

International Labour Office (ILO) (1935–6): *Year-Book of Labour Statistics*, Geneva, Table IX.

### Sweden

Liesner, T. (1989), *One Hundred Years of Economic Statistics: United Kingdom, United States of America, Australia, Canada, France, Germany, Italy, Japan, Sweden*, Economist Publications, Table S.8.

The data relate to adults only, and are derived from information in the second quarter of each year. For the period 1929–38 the data relate to males only and include mining, manufacturing, construction, commerce and transport.

### United Kingdom

Feinstein, C.H. (1972), *National Income, Expenditure and Output of the United Kingdom, 1855–1965*, Cambridge, Cambridge University Press, Table 65.

The data are average weekly wage earnings (weekly wages adjusted for the effect of changing hours). The index covers the main categories of manual workers, and is a weighted average based on wage-bills for different industries in 1924.

### United States

International Labour Office (ILO) (1940), *Year-Book of Labour Statistics*, Geneva, Table XIII

International Labour Office (ILO) (1935–6), *Year-Book of Labour Statistics*, Geneva, Table IX.

The data are average hourly earnings in Industry and were based on the National Industrial Conference Board statistics and cover males and females.

## 4. GDP

Real GDP indices are from Barro, R.J. and Ursua, J.F. (2008), 'Macroeconomic crises since 1870', *Brookings Papers on Economic Activity*.

The data set is available at:

[http://www.economics.harvard.edu/faculty/barro/data\\_sets\\_barro](http://www.economics.harvard.edu/faculty/barro/data_sets_barro).

In the case of the UK we use the balanced GDP measure from Sefton, J. and Weale, M.R. (1995), *Reconciliation of National Income and Expenditure: Balanced Estimates of National Income for the United Kingdom 1920–1990*, Cambridge, Cambridge University Press.