

Wage and Employment Determination in
Volatile Times: Sweden 1913-1939

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Abstract

The paper studies wage and employment determination in the Swedish business sector from the mid-1910s to the late 1930s. This period includes the boom and bust cycle of the early 1920s as well as the Great Depression of the early 1930s. The events of the early 1920s are particularly intriguing, involving inflation running at an annual rate of 30 percent followed by a period of sharp deflation where nominal wages and prices fell by 30 percent and unemployment increased from 5 to 30 percent. We examine whether relatively standard wage and employment equations can account for the volatile economic development during the interwar years. By and large, the answer is a qualified yes. Industry wages were responsive to industry-specific firm performance, suggesting a significant role for “insider forces” in wage determination. Unemployment had a strong downward impact on wages. There is evidence that reductions in working time added to wage pressure; yet estimates of labor demand equations suggest that cuts in working time may have slightly increased employment as firms substituted workers for hours.

JEL-Code: J230, J310, N140, N340.

Keywords: wage determination, labor demand, interwar labor markets.

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Contents

1. Introduction
2. Labor Markets in Interwar Sweden
 - 2.1 The Macroeconomic Setting
 - 2.2 Institutions and Labor Market Policies
 - 2.3 Wages, Prices and Unemployment
3. Wage Determination
 - 3.1 Wage Bargaining
 - 3.2 Empirical Wage Equations: The Aggregate Level
 - 3.3 Empirical Wage Equations: The Sectoral Level
4. The Demand for Workers and Hours
 - 4.1 Models of Labor Demand
 - 4.2 Estimation Results
5. Concluding Remarks

References

Appendix 1. A Model of the Demand for Workers and Hours

Appendix 2. The Data

1. Introduction

The Great Depression has been the subject of an extensive research literature. Most of this literature has been concerned with the US experience and focused on the impact of aggregate demand, in particular the role of fiscal and monetary policies. A smaller literature has studied the impact of aggregate supply factors, such as the role of labor market imperfections and labor market policies. There is considerable consensus that shocks to aggregate demand were the main drivers of the slump in the 1930s, although some studies argue that supply side factors can account for a large part of the depression.¹

When studying the experiences of the Great Depression, it is worthwhile to extend the perspective to include the events of the 1920s. This is relevant for several countries, including the UK and the US, which both experienced recessions in the early 1920s. It is particularly relevant for Sweden, where the boom and bust cycle in the early 1920s brought the economy from high inflation to sharp deflation with wages and prices falling at annual rates of 30 percent. The deflation was associated with an increase in unemployment from 5 percent to 30 percent. It is notable that unemployment during the 1930s peaked at 25 percent, thus never reaching the levels experienced in the early 1920s. Compared to other countries, the Swedish depression in the early 1920s was exceptionally deep as the shocks from the international economy were reinforced by contractionary domestic policies.

The Swedish literature on the depressions of the early 1920s and the early 1930s has mainly dealt with aggregate demand issues, including the role of exchange rate policies. Studies of how the Swedish labor market fared are rare and econometric work on the two depressions in general is hard to come by.² This paper contributes to the literature on interwar labor markets by providing quantitative evidence on how wages and employment were determined in interwar Sweden. By doing so, the paper also offers perspectives on several strands of literature on wage determination and collective bargaining. This research includes numerous

¹ See e.g. Brunner (1981) and Eichengreen and Hatton (1988) for contributions to research on the Great Depression and interwar labor markets. Dimsdale et al. (1989) present a study of the interwar labor market in the UK and Hatton and Thomas (2010) offer a comparative perspective on US and UK interwar labor markets.

² Discussions and analyses of Swedish economic policies during the interwar period are contained in e.g. Bergström (1969), Jonung (1979, 1981), Lundberg (1983/1994) and Östlind (1945). Fregert (1994) includes detailed studies of wage contracts and business cycles; see also Fregert (2000) and Fregert and Jonung (2004, 2008). Jonung and Wadensjö (1978, 1979) present estimates of Phillips curves that include interwar data. Hassler et al. (1994) provide a quantitative description of stylized Swedish business cycle facts using data from the 1860s and onwards.

studies of how labor market institutions and policies shape real wage outcomes as well as research on nominal wage flexibility (or the lack thereof).

One purpose of the paper is to examine the role of insider forces in wage determination. To what extent does firms' ability to pay impact on wages? There is a presumption that higher productivity or higher output prices would translate into higher wages under decentralized wage bargaining with strong labor unions.³ Wage bargaining in interwar Sweden took place at a relatively decentralized industry level, thus suggesting that one should expect to find significant insider effects.

We also wish to shed light on how certain labor market policies affected wage outcomes. The first policy concerns working time legislation. There are numerous "modern" papers, theoretical as well as empirical, that investigate how shorter working time affects wage and employment outcomes.⁴ Sweden saw sharp reductions in the "standard" workweek during the 1910s, culminating in legislation on a 48-hour workweek (eight-hour work day) from 1920. The labor unions demanded "full compensation" for the loss in earnings and a period of widespread industrial conflicts followed. Thus, a goal of the paper is to provide estimates of how the cuts in working time affected wages and employment. More generally, we will study how firms in booms and slumps adjusted labor input along the extensive and intensive margins, i.e., workers and hours per worker. It turns out that adjustment along the intensive margin accounted for most of the variance in total hours during the interwar period.

A final purpose of the paper is to investigate whether public employment programs targeted at the unemployed caused an increase in wage pressure, thereby crowding out some "regular" employment. Such programs were introduced in Sweden on a small scale in the 1910s and reached a non-trivial scale during the early 1930s. Similar programs were also introduced in the US as part of the New Deal. The impact of such programs has been subject to debate and research, in the past as well as more recently.⁵

³ The empirical literature on these issues includes, among others, contributions from Bårdsen et al. (2010), Forslund (1994), Holmlund and Zetterberg (1991), Johansen (1996, 1999) and Nickell and Wadhvani (1990).

⁴ An example of a relatively recent theoretical paper is Marimon and Zilibotti (2000). An empirical study of recent Swedish experiences of working time reductions is contained in Nordström Skans (2004).

⁵ See Calmfors and Forslund (1991) and Forslund and Kolm (2004) for studies that use Swedish data from the post-World War II period. Darby (1976) and Kesselman and Savin (1978) discuss the New Deal experiences.

A recent paper partly related to the present study is Bårdsen et al. (2010). The authors estimate wage equations by exploiting panel data for 55 Norwegian manufacturing industries from the late 1920s to the late 1930s. Bårdsen et al. argue that their results are consistent with conventional bargaining models and with empirical results obtained in studies that make use of data from recent decades. For example, there is evidence of a long-run “wage curve” that relates real wages to labor productivity and with negative unemployment elasticity. The present study makes use of fewer industries than Bårdsen et al. but extends the data series back to the World War I period, thus including the turbulent years of the early 1920s. Our paper also differs from Bårdsen et al. by examining the impact on wages of temporary public works and cuts in working time and by studying labor demand on the extensive and intensive margins.

The next section of the paper provides a brief overview of the macroeconomic setting and describes key labor market characteristics of the interwar period, including institutions and market outcomes.⁶ Section 3 includes specification and estimation of wage equations, both at the aggregate level and the sectoral level. Section 4 deals with labor demand at the extensive and intensive margins and Section 5 concludes.

2. Labor Markets in Interwar Sweden

2.1 The Macroeconomic Setting

The Swedish interwar years featured two major slumps in economic activity. The first depression that took place in the early 1920s was deeper but shorter than the slump that occurred a decade later. Both depressions involved sharp declines in output and employment and huge increases in unemployment. GDP fell by 8 percent between 1920 and 1921 and manufacturing output fell by over 20 percent over the same period. The unemployment rate jumped from 4.5 percent in the beginning of 1920 to 30 percent in early 1922. The recovery in terms of output was remarkably quick: GDP increased by almost 10 percent between 1921 and 1922 and manufacturing output increased by over 20 percent. The labor market recovered only gradually, however; unemployment remained at two-digit levels for the rest of the decade.

⁶ With some abuse of language, we frequently refer to the period from the mid-1910s to the late 1930s as the “interwar” period.

The slump of the early 1930s was milder than in the early 1920s but lasted longer. Manufacturing output declined by some 6–7 percent for three consecutive years and unemployment increased from 9.5 to 25 percent between early 1930 and early 1933. The rebound in output kicked in during 1933 and 1934; manufacturing output increased by 10 percent in 1932–33 and by over 20 percent in 1933–34. Unemployment, however, remained at two-digit levels for most of the decade.

A striking difference between the two slumps, aside from depth and duration, concerns the evolution of nominal wages and prices. Deflation was sharp in the early 1920s with wages and producer prices falling by almost 30 percent at the trough. Deflation, by comparison, was mild in the early 1930s; wages and prices declined by at most a couple of percentage points.

Both of the slumps originated from external shocks that hit the small and open Swedish economy. A number of countries experienced more or less severe recessions in the early 1920s as well as in the early 1930s. Swedish export volumes declined by around 20 percent in 1921 as well as in 1931. The depth of the Swedish crisis in the early 1920s was arguably reinforced by domestic policies. Indeed, the Swedish crisis of the early 1920s seems to have been deeper than elsewhere. One contributing factor was the desire among most politicians (and economists as well) to pursue a monetary policy that would restore the Swedish krona to the gold parity it had before World War I.⁷ Sweden had left the gold standard in 1914 and the krona had depreciated against gold in subsequent years. A reversal of this trend required restrictive monetary policy and this was also undertaken by the Riksbank; the short-term interest rate set by the Riksbank reached 7.5 percent in the early 1920s, higher than previously experienced. The restrictive monetary policy succeeded in its goal: gold parity was restored by the end of 1922 and the gold standard was formally adopted in 1924. But the successful restoration of the gold standard had a price in terms of a deeper depression than would otherwise have been experienced.⁸

Sweden followed the UK example in September 1931 and left the gold standard. This implied a depreciation of the krona by about 30 percent. The trade-weighted nominal exchange rate

⁷ Among the economists, Knut Wicksell took the most extreme position by arguing that a return to the pre-war price level should be the goal of monetary policy. This would have required a drastic reduction in the price level considering that the consumer price had increased by 170 percent from 1914 to 1920.

⁸ See Klovland (1998) for a comparative analysis of Scandinavian monetary policies and business cycles in the 1920s and 1930s.

remained some 30 percent weaker during most of the 1930s relative to the 1920s. The nominal depreciation appears to have been associated with a real depreciation that contributed to Sweden's recovery from the depression of the early 1930s.⁹

Discretionary countercyclical fiscal policy was not on the agenda during the 1920s and the early 1930s. The goal of fiscal policy was to maintain annual budget balance, although budget deficits did appear during the two depressions as a result of falling tax revenues. The overall public sector budget deficit reached 3 percent of GDP in 1922 and 2 percent in 1932. During the course of the 1930s, the idea of pursuing countercyclical fiscal policies gradually gained ground among (younger) economists and politicians. Gunnar Myrdal and others argued that budget balance over the business cycle – rather than annual budget balance – should be the goal of fiscal policy. This idea became explicit government policy in the late 1930s.¹⁰

2.2 Institutions and Labor Market Policies

Unions and Collective Bargaining

The interwar period involved largely decentralized wage bargaining typically at the industry level. Unionization and collective bargaining were gradually gaining foothold. Unionization among (blue-collar) workers in general stood at 15 percent in 1915 and had increased to 66 percent in 1940. Union density among industrial workers increased from 41 percent to 83 percent between 1920 and 1940. The coverage rate, i.e., the fraction of workers covered by union-negotiated collective agreements, had already exceeded 50 percent in the industrial sector by the end of World War I and had reached over 80 percent by the late 1930s.¹¹ The length of new collective agreements hovered between one and two years in the 1920s and the 1930s. Most agreements could be renegotiated in a given year (Fregert, 2000).

Employer associations were created mainly as a response to the growth of labor unions. The nationwide Federation of Swedish Employers (*Svenska Arbetsgivareföreningen*, SAF) was established in 1902 and comprised various sectoral employer organizations. For example,

⁹ See Jonung (1979) for a detailed account of Swedish monetary policy in the 1930s. Bohlin (2010) includes a detailed discussion of Swedish exchange rate policies.

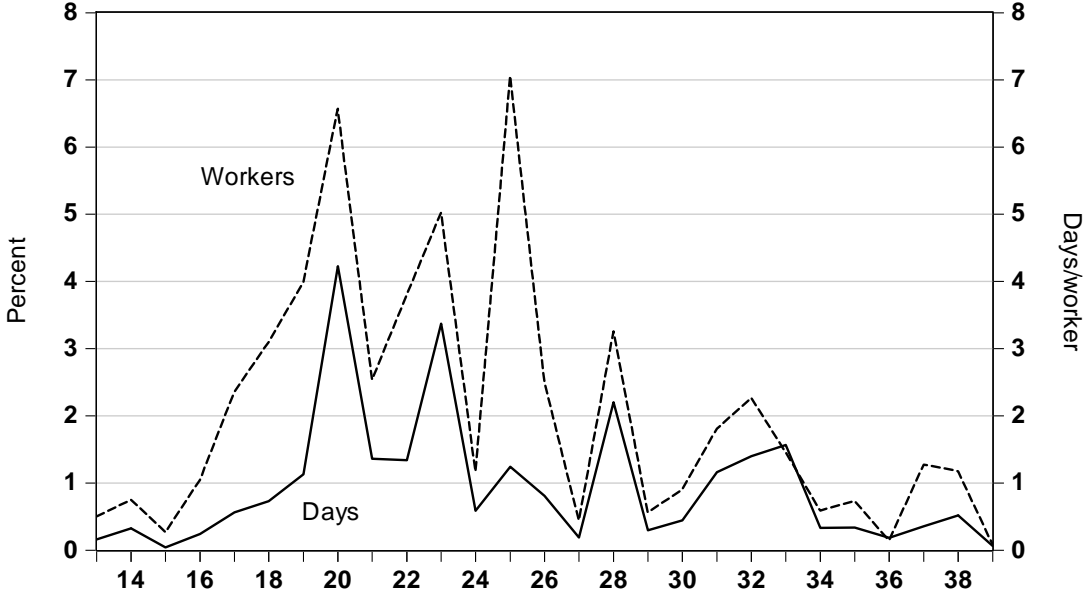
¹⁰ Bergström (1969) includes an analysis of Swedish fiscal policy in the interwar period.

¹¹ See Kjellberg (1983, pp. 269–70) for data on union density and Fregert and Jonung (2008) for data on coverage rates.

some 60–70 percent of workers in the textile industry were employed in firms that were members of SAF by the late 1930s.¹²

Labor market conflicts (strikes and lockouts) were relatively frequent in the 1920s; see Figure 1. Some 6–7 percent of employees were involved in conflicts during 1920 as well as during 1925. Conflict intensity during the 1930s was considerably lower, presumably influenced by new legislation on collective agreements in 1929. An important ingredient of this legislation was its stipulation of a “peace obligation” once a contract was agreed upon. The right to undertake industrial action, such as a strike or a lockout, was thereby restricted to periods when contracts had expired.

Figure 1. Labor market conflicts, 1913–39. Number of workers (percent) and number of workdays lost.



Sources: See Appendix 2.

*Employment Programs and Unemployment Insurance*¹³

The first central government (state) initiatives concerning labor market policies were taken in 1914 when a Government Unemployment Commission (*Statens arbetslöshetskommission*) was established. The commission’s mandate was gradually expanded to include responsibility for job creation measures (“reserve works” or “relief works”)¹⁴ as well as “passive” measures

¹² See Hansson (1942, p. 373) for data on SAF members. The number of workers in the industry was obtained from Statistics Sweden

¹³ See SOU 1936:32, Öhman (1970) or Axelsson et al. (1987) for descriptions and discussions of Swedish unemployment policies during the interwar period.

¹⁴ We will use “relief works” as a generic term for public employment programs during the interwar period.

in the form of (cash) unemployment assistance. To the extent that such measures existed before 1914, they were part of the municipalities' poverty-alleviating efforts. Unemployment assistance was typically available for members of labor unions; these benefits were financed entirely by membership fees. Public (but voluntary) unemployment insurance (UI) was introduced in 1935 and involved government subsidies to UI funds that were effectively run by the labor unions; the system has become known as the "Ghent model" after the Belgian city where it first was implemented. However, UI coverage remained low throughout the 1930s as the unions were initially hesitant to introduce UI funds.

Information about employment in relief works is available from 1922, including works provided by the state as well as the municipalities. Information is also available on state relief works from 1918. We have used information on the total number of relief works relative to state relief works to impute a series capturing the total number of relief works for the period before 1922; see Appendix 2 for details. Figure 2 shows the number of relief workers relative to the total number of employees. Participation in these programs accounted for slightly more than one percent of the number of employees in 1922 and reached two percent in 1933.

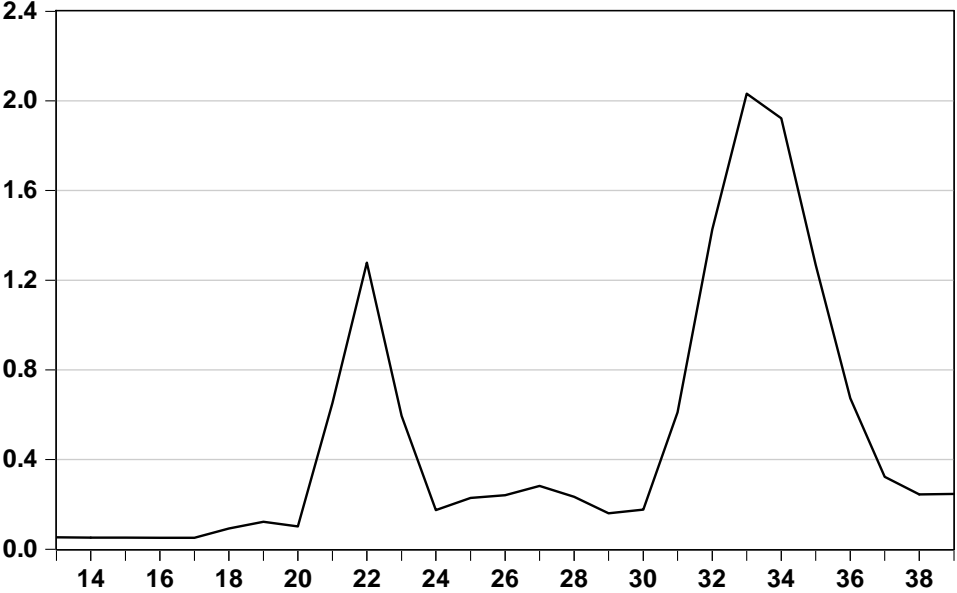
The compensation available for relief workers was, at least during the 1920s, significantly lower than wages obtained by regular employees. Such a wage differential was deemed desirable so as to provide incentives for active search for regular jobs. This view was challenged in the early 1930s when a Social Democratic government came into power and Keynesian policies were increasingly advocated. Relief works were then viewed as instruments for expansionary policies and the "wage penalty" for relief workers was eradicated.¹⁵

There is some, although limited, information on public cash unemployment assistance in the interwar period. The number of workers receiving unemployment assistance was typically lower than the number of relief workers, at least for the period 1922–32. The level of cash assistance per day amounted to roughly 50 percent of the daily remuneration to a relief worker.

¹⁵ The case for using public works in recessions was also argued by Bertil Ohlin (1934) in an important contribution to the theory of economic expansion.

Summing up, public unemployment insurance was virtually nonexistent for most of the interwar period. Cash unemployment assistance was available for workers who were members of unions that offered UI. Active measures in the form public relief works were substantially expanded in the early 1920s and, in particular, in the early 1930s.

Figure 2. Participants in relief works, percent of the total number of employees, 1913–39.



Sources: See Appendix 2.

Hours of Work

The length of the workweek was basically unregulated in the 19th century. A number of collective agreements during the 1910s brought about substantial reductions in the Swedish workweek and established a “standard” workweek. These negotiated working time reductions were followed by legislation on the 48-hour workweek (eight-hour workday) that came into force in 1920.¹⁶

The introduction of the 48-hour workweek had strong repercussions on wage bargaining and triggered major industrial conflicts. Indeed, more workdays were lost in conflicts in 1920 than in any other year during the interwar period (Figure 1). The employers and their organizations had struggled fiercely against the legislation. Their resistance to the reform was not softened when it turned out that the labor unions demanded “full compensation” for the cut in hours, i.e., wage increases so as to avoid income reductions. Failure to reach collective agreements

¹⁶ European labor unions had demanded a 48-hour workweek for decades and legislations in line with these demands were undertaken in many countries by the end of the 1910s.

on this matter initiated strikes in early 1920 in the metal industry – strikes that triggered large-scale lockouts from the employers. The agreements that were finally agreed upon seem to have delivered substantial compensation, at least for metal workers; the agreements stipulated wage increases by 8 percent for workers with time-rate pay whose workweek was reduced from 52 to 48 hours.¹⁷ Employers could also count on some gains in terms of increased flexibility and more efficient use of working time.

Figure 3 shows the evolution of the standard workweek along with average annual hours per worker in the business sector.¹⁸ The shortening of the standard workweek is associated with a marked decline in actual hours worked. There is also a strong procyclical pattern in actual hours. Annual hours declined by over 100 when the slump hit in 1920–21 and by over 200 between 1929 and 1932. Regressing actual annual hours on standard weekly hours and the unemployment rate yields a coefficient of -12 on the unemployment rate; an increase in unemployment by 10 percentage points would thus be associated with a decline in annual hours by 120 hours.¹⁹ Changes in hours per worker account for 60 percent of the variance in total hours. As is clear from Figure 4, changes in hours per worker tend to lead changes in employment.²⁰

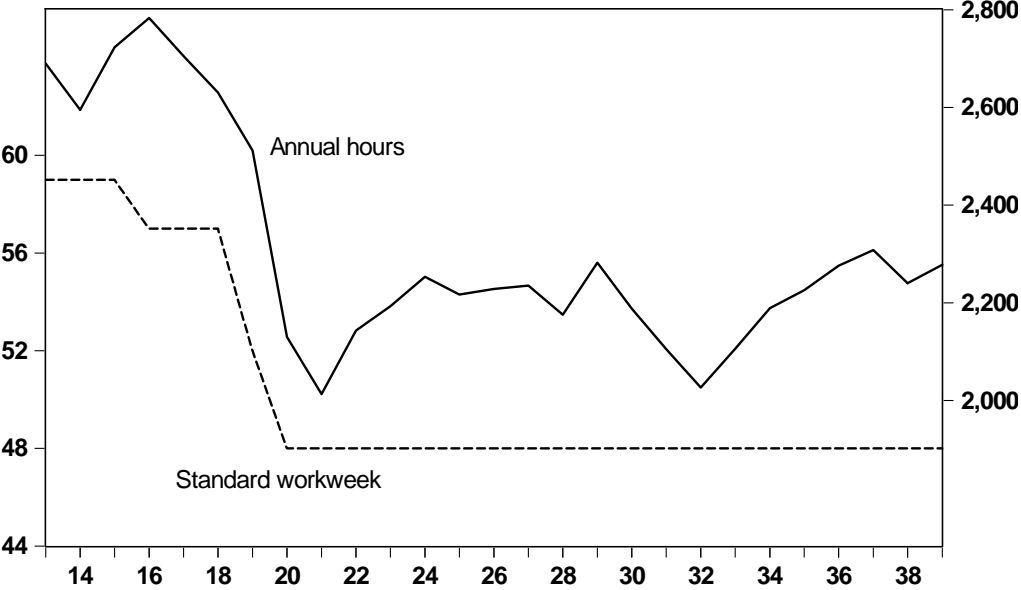
¹⁷ These events in the metal industry have been called the “great compensation conflict”; see Lindgren et al. (1948) for a detailed account of this conflict.

¹⁸ The business sector is defined as including manufacturing, building and construction, transport and communication, and private services.

¹⁹ The estimated equation for 1913–39 is: Annual hours = constant + 38.6×(standard hours) – 12.1×(unemployment, %). The (absolute) *t*-values on the two regressors are 10.5 and 4.8, respectively; adj. R-sq=0.93, DW=1.76.

²⁰ Bernanke and Powell (1986) report similar patterns for the interwar US labor market.

Figure 3. Work hours, 1913–39. Annual hours: right scale; standard workweek: left scale.



Sources: See Appendix 2.

Figure 4. Log annual changes in labor inputs along the intensive and extensive margins, 1914–39.



Sources: See Appendix 2.

2.2 Wages, Prices and Unemployment

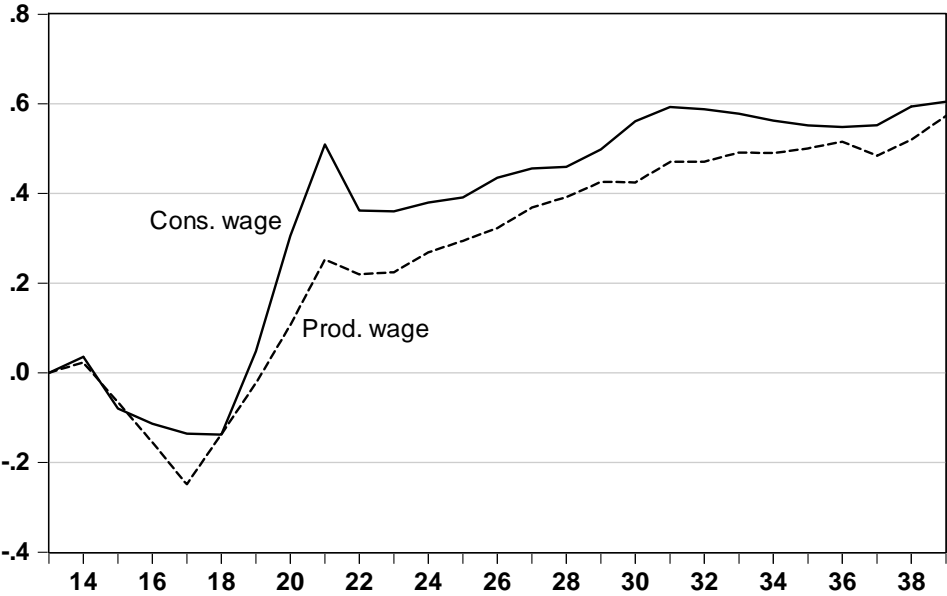
Wages and Prices

The evolution of real consumption and real product wages for the business sector are displayed in Figure 5. The former wage is defined as the hourly wage divided by the consumer price, the latter as the hourly wage divided by the value added price for the business

sector. Taxes are thus ignored, but they are unimportant for the period under study. Over the years 1913–39, the trend increase in the real consumption wage amounted to 2.9 percent per year whereas the real product wage increased at a rate of 2.8 percent.²¹

Wage and price inflation were exceptionally volatile in the aftermath of World War I (Figure 6). During the early postwar years, price and wage inflation were running at rates exceeding 30 percent. The period of high inflation was followed by a period of sharp deflation; nominal wages fell by no less than 28 percent between 1921 and 1922. The real consumption wage increased by almost 30 percent between 1919 and 1920 and declined by 14 percent between 1921 and 1922. Nominal wage changes were highly correlated across nine main industries; see Table 1.²² Wage dispersion across the industries exhibited a modest increase over the period: the (unweighted) standard deviation of log daily wages stood at 0.16 in 1913 as well as in 1923; from the late 1920s and onwards, wage dispersion hovered between 0.18 and 0.20.

Figure 5. Real consumption and real product wages (index in logs), 1913–39.



Sources: See Appendix 2.

²¹ The estimates of trend growth rates were derived from semi-logarithmic regressions where the log of the variable of interest is explained by a linear trend.

²² Wage changes in the construction industry – not included among the nine industries studied – were also highly correlated with wage changes in manufacturing, albeit slightly less so than the correlations set out in Table 1. Wages in construction declined even more than wages in manufacturing between 1921 and 1922.

Table 1. Correlation matrix: Δ log daily wage, nine industries, 1914–39.

	1	2	3	4	5	6	7	8	9
1	1.000								
2	0.960	1.000							
3	0.956	0.949	1.000						
4	0.941	0.928	0.939	1.000					
5	0.943	0.885	0.859	0.878	1.000				
6	0.944	0.896	0.943	0.951	0.893	1.000			
7	0.965	0.937	0.959	0.943	0.930	0.967	1.000		
8	0.936	0.923	0.867	0.854	0.940	0.849	0.906	1.000	
9	0.906	0.854	0.866	0.850	0.929	0.888	0.922	0.924	1.000

Notes: See Appendix 2 for sources and definitions of industries.

How could the dramatic nominal wage cuts of the early 1920s occur? The severity of the slump with sharply falling output demand was employers' overriding argument for wage cuts. The fact that consumer prices had been falling should also have weakened workers' resistance to nominal wage cuts.²³ In some cases, collective agreements had expired or had been abrogated, so that the employers could unilaterally set wages at their own discretion. This was the case in the metal industry during 1921–22. The overall coverage of collective agreements declined by some 15 percentage points between 1920 and 1922; in the metal industry, coverage fell from 70 to 12 percent. In other cases, nominal wage cuts were agreed upon through collective bargaining, sometimes after strikes and/or mediation by government-appointed arbitrators. These agreements were often preceded by vastly incompatible employer offers and union demands. An example is the textile industry where employers initially asked for 20–30 percent wage cuts in 1921, a proposal to which the union responded by demanding wage *increases* of 10–15 percent. The final agreement that was reached after strikes and lockouts was largely in line with the employers' initial requests.²⁴

²³ In a speech 1918, Knut Wicksell argued strongly against the idea that workers would be unwilling to accept wage cuts when prices were falling; cited by Lundberg (1983/1994) pp. 73–74.

²⁴ See Nerman (1939) for a detailed account of these events.

Figure 6. Wage and price inflation ($\Delta \log W$, $\Delta \log CPI$), 1914-39.



Sources: See Appendix. 2

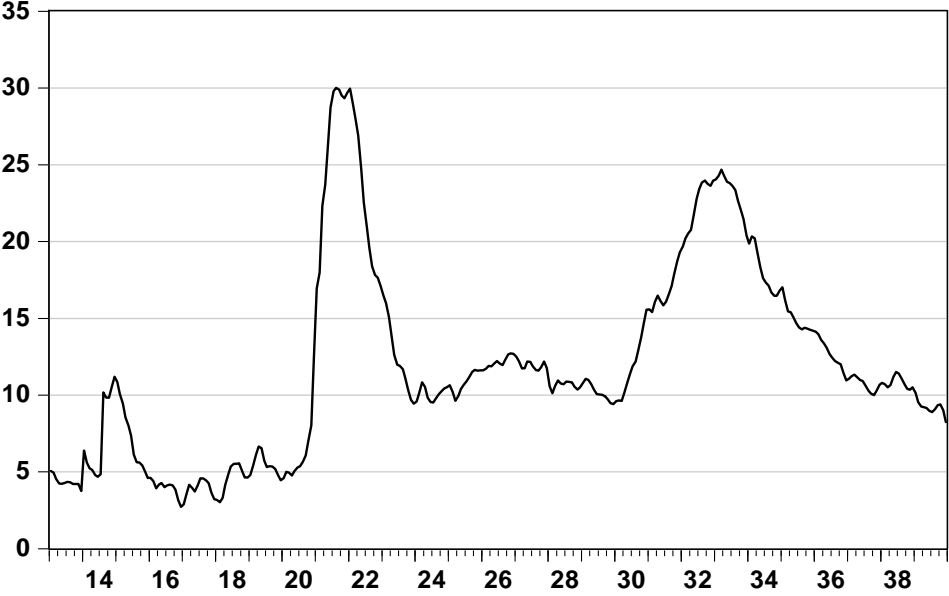
Unemployment and Matching

Available information on unemployment during the interwar period pertains to joblessness among union members. This series is displayed in Figure 7. The exceptionally sharp rise in the early 1920s stands out: unemployment stood at 5 percent in the beginning of 1920 and had increased to 30 percent by the end of 1921. By 1924, unemployment had fallen to 10 percent but did not return to the low levels prevailing during and immediately after World War I. In the early 1930s, unemployment reached 25 percent and the duration of the slump in the 1930s was much longer than the slump in the 1920s.

It is difficult to assess how well the unemployment series for union members captures the evolution of the “true” unemployment rate, measured, say, according to the methodology of modern labor force surveys. One issue concerns compositional effects as a result of growing union membership. Two remarks are in order. First, it is plausible that unemployment among union members should play a key role in collective bargaining even if it does not fully capture overall unemployment. Second, two alternative measures of labor market conditions are broadly consistent with the pattern exhibited by the unemployment rate; see Figure 8. The first measure – “employment” – is log detrended employment obtained as residuals from a regression of the log of the number of employees on a linear time trend. The second measure – “tightness” – is obtained as residuals from a regression of the ratio of the number of vacancies to the number of job applicants on a linear time trend; see Appendix 2 for details on

these data which pertain to the public employment service (PES). The alternative measures also indicate sharply falling employment in the early 1920s.²⁵

Figure 7. Unemployment among union members, 1913–39, percent. Seasonally adjusted monthly data.



Source: See Appendix 2.

Figure 8. Alternative measures of labor market conditions, 1913–39.



Notes: Employment (right scale) is the residual obtained from regressing log (number of employees) on a linear time trend. Tightness (left scale) is the residual from regressing (number of vacancies/number of job applicants) on a linear trend.

Sources: See Appendix 2.

²⁵ The correlations are as follows: employment, tightness = 0.87; unemployment, tightness = -0.80; unemployment, employment = -0.71.

Table 2. Estimated matching functions. Dependent variable: log (job placements). Estimation period: 1913–39

	(1)	(2)
log (applicants)	0.140 (6.34)	0.142 (6.40)
log (vacancies)	0.838 (16.58)	0.879 (12.38)
AR(1)		0.790 (5.70)
Adj. R-sq.	0.974	0.989
SE	0.047	0.030
DW	0.457	1.57

Notes: Absolute *t*-values in parentheses. Estimation by OLS.

Available data from the PES on the annual flows of vacancies, job applicants and job placements can be used to examine labor market matching. Table 2 displays regression results based on a simple conventional log-linear matching model where job placements are explained by the number of job applicants and the number of vacancies. Both applications and vacancies matter for job placements. Constant returns to scale are not rejected: Increases in applications and vacancies by 10 percent are associated with an increase in job placements by 10 percent. The elasticity of matching with respect to job applications is estimated at 0.14, considerably lower than the corresponding elasticity with respect to vacancies. The estimated equation is reasonably stable over the period; Chow tests do not suggest that matching frictions differ across decades. These observations suggest that to the extent there are changes in wage setting behavior over the interwar years, these should have other causes than changes in matching frictions.

3. Wage Determination

3.1 Wage Bargaining

We now turn to an empirical analysis of wage determination in interwar Sweden. The most widely used approach to studies of wage determination invokes the Nash solution, which gives the wage as the outcome of bilateral bargaining between a union and a firm. The bargained wage generally depends on factors that influence the firm's profits and union

members' welfare. The specific predictions differ across models and are sensitive to assumptions concerning, inter alia, the bargaining setup, product market conditions and the technology of firms.

In some popular models with isoelastic (Cobb-Douglas) technology, the bargained wage is obtained as a markup on unemployment benefits – or, more generally, a markup on expected outside income opportunities – with no direct role for variables influencing the firm's ability to pay, such as output prices and productivity. However, the idea that a firm's ability to pay influences bargaining outcomes has considerable intuitive appeal and is also supported by the empirical literature. A role for ability to pay can be motivated in several ways. It is, for example, straightforward to show that a departure from isoelastic (i.e., Cobb-Douglas) technology makes a difference. The bargained wage increases as a response to a higher output price if the elasticity of labor demand with respect to the wage falls when the output price increases. This outcome obtains when the elasticity of substitution between capital and labor is less than one.²⁶

A slightly more complex model is due to Nickell and Wadhvani (1990), similar in spirit to the insider-outsider models developed by Lindbeck and Snower (1990). This model maintains the assumption that technology is isoelastic, but posits that nominal wages are set under uncertainty about output prices. The profit-maximizing firm determines employment as a function of the bargained wage and the *realized* output price. The union cares about the wage, but also about the risk that a representative member will be laid off: the higher the bargained wage, the higher the layoff risk. The bargained wage pertaining to firm (or sector) i can be written as a convex combination of insider factors (the firm's ability to pay) and outsider factors; the latter include the unemployment rate capturing job chances outside the firm as

²⁶ Consider a standard model of Nash bargaining over wages where the union's power in the bargain is captured by β , $\beta \in (0,1)$. One can derive a wage-setting rule at the sectoral level (sector i) of the form

$$w_i = \left(\frac{\varepsilon - 1 + \beta}{\varepsilon - 1} \right) \bar{w}$$

where ε is the (absolute value) wage elasticity of labor demand and \bar{w} is the outside wage. The markup on the outside wage is constant if ε is constant, as under Cobb-Douglas technology and perfectly competitive output markets. In the general CES case with a fixed capital stock we have $\varepsilon = \sigma / s^k (w / p)$, where σ is the elasticity of substitution between labor and capital and s^k is the share of capital in value added. It is straightforward to verify that the nominal wage depends positively on the output price if $\sigma < 1$. A model with imperfect competition in output markets and non-constant demand elasticities can deliver similar predictions; see for example Forslund et al. (2008).

well as wages elsewhere and unemployment benefits. A log-linear version of the resulting nominal wage equation can be written as:

$$(1) \quad w_i = \alpha_0 + \lambda(q + p)_i + (1 - \lambda)\bar{w}_i + \alpha_1 u + \alpha_2 z$$

or equivalently as a real wage equation of the form:

$$(2) \quad (w - p)_i = \alpha_0 + \lambda q_i + (1 - \lambda)(\bar{w} - p)_i + \alpha_1 u + \alpha_2 z$$

where w is the nominal wage, q a measure of labor productivity, p the output price and \bar{w} the outside wage, all in logs. The log of the unemployment rate is denoted u while z represents other variables that conceivably affect wage outcomes. The “insider weight” is captured by the parameter λ , $\lambda \in (0, 1)$.

Eq. (1) is a micro wage equation that takes outside wages as given.²⁷ It readily translates into an aggregate wage equation under the assumption of a symmetric equilibrium, i.e.,

$$w_i = \bar{w} = w :$$

$$(3) \quad w = \alpha_0 / \lambda + (q + p) + (\alpha_1 / \lambda)u + (\alpha_2 / \lambda)z$$

We use eq. (1) as the basis for empirical wage equations at the industry level, whereas eq. (3) serves as the basis for aggregate wage equations. The empirical wage equations allow for dynamics that are absent from (1), (2) and (3). The precise specification of the dynamics is largely determined by the data.

3.2 Empirical Wage Equations: The Aggregate Level

A dynamic version of eq. (3) is given by eq. (4) below. The log of the consumer price is denoted pc and the log of the length of the standard workweek is denoted h^s . Subscript t denotes time and ε is a stochastic error. Richer dynamics are conceivable but do not seem to be required by the data. The specification excludes any impact of the *level* of the wedge

²⁷ In their estimations of industry wage equations on Norwegian data, Bårdsen et al. (2010) ignore the outside wage, thus effectively setting $\lambda = 1$. This is arguably a restrictive and theoretically unappealing specification at odds with other studies of industry wages.

between real product and real consumption wages but allows for short-run wedge effects by including changes in consumer prices along with changes in output prices. (Note that the level of the wedge is given as $pc-p$ in the absence of taxes.) The wedge level was not found to have any systematic impact. Lagged output price inflation was always insignificant and the lag of the dependent variable was also always insignificant.

$$(4) \quad \begin{aligned} \Delta w_t = & \beta_0 + \beta_1 \Delta p_t + \beta_2 \Delta pc_t + \beta_3 \Delta pc_{t-1} \\ & + \beta_4 u_{t-1} + \beta_5 (w-p)_{t-1} + \beta_6 q_{t-1} + \beta_7 h_t^s + \varepsilon_t \end{aligned}$$

This general specification nests several special cases. Nominal neutrality is ensured if $\beta_1 + \beta_2 + \beta_3 = 1$. The model reduces to an expectations-augmented Phillips curve if $\beta_5 = \beta_6 = 0$. A Sargan type of wage equation (Sargan, 1984) obtains if $\beta_5 < 0$ and $\beta_6 > 0$; $\beta_5 < 0$ captures “error correction”, i.e., the speed at which wage inflation declines to past real wage levels in excess of equilibrium levels. If $\beta_5 = -\beta_6$ also holds, the error correction term takes the form $(w-p-q)_{t-1}$, i.e., the lag of the log of the wage share (assuming that q is measured as average labor productivity). The higher the wage share, the faster the decline in wage inflation. The long-run “wage curve” – a relationship between the real wage level and the unemployment rate – takes a particularly simple form under the assumptions $\beta_1 = 1$, $\beta_2 = \beta_3 = 0$ and $\beta_5 = -\beta_6$. The wage share will be constant under balanced growth so that $\Delta w = \Delta p + \Delta q$ can be used to substitute out Δw from (4) and obtain a wage curve of the form

$$(5) \quad w - p - q = -\beta_0 / \beta_5 + (1 / \beta_5) \Delta q - (\beta_4 / \beta_5) u - (\beta_7 / \beta_5) h^s$$

The slope (elasticity) of the long run wage curve is thus given as $d(w-p) / du = -\beta_4 / \beta_5$.

Inclusion of the standard workweek is perhaps problematic since some of the variation in this variable is driven by collective bargaining, thus possibly endogenous. It can be argued, however, that working time decisions are predetermined relative to wages since they are taken much less frequently and therefore reflect more long-run considerations. As noted above, the labor unions explicitly demanded wage compensation in order to avoid income reductions when the 48-hour workweek was introduced through legislation. It has been a common

presumption in the literature on the interwar period that the unions attempted to achieve wage compensation for the cut in hours – and probably succeeded in doing so.

Empirical Results

Table 3 displays the regression results. The first two columns show OLS results and the remaining columns TSLS estimates with Δp_t and Δpc_t treated as endogenous; wage and price inflation in the UK are used as instruments. The output price p is the value added deflator for the business sector and the productivity variable q is average labor productivity (value added per hour in the business sector). Estimates are shown with and without imposing homogeneity in prices, i.e., $\beta_1 + \beta_2 + \beta_3 = 1$. A wage share restriction is always imposed, i.e., $\beta_5 = -\beta_6$ in terms of eq. (4); the restriction is not statistically rejected.

The sum of the coefficients on the price inflation terms are above unity, but a formal test does not reject the conventional price homogeneity hypothesis; the t -value for the restriction is 1.56 for the model in the first column. Comparisons of estimates with and without price homogeneity restrictions do not indicate that the restrictions matter much for the “other” estimates. Unemployment has a downward impact on wages; the mean of the estimates is -0.08, implying that a rise in the unemployment rate by 10 percent, e.g. from 10 to 11 percent, would reduce wage inflation the following year by almost one percentage point.

The lagged wage share consistently enters with negative coefficients that hover around -0.2. A significant role for the lagged wage share is consistent with a wage curve interpretation of the long run wage equation. The implied elasticity of the real wage with respect to unemployment, $d(w-p)/du$, hovers around $-0.08/0.2 = -0.4$. This is on the high side compared to estimates based on data for recent decades. For example, it is more than twice as large as the estimates reported by Nymoen and Rødseth (2003) using aggregate Swedish data for the period 1965–94. Bårdsen et al. (2010) report an elasticity of -0.25 for interwar Norway. Taken at face value, our estimates imply that a one percentage point increase in unemployment, evaluated at mean unemployment over the period 1913–39 (12 percent), would reduce the real wage level by around 3 percent.

Table 3. Estimated aggregate wage equations. Dependent variable: Δw_t (hourly wages). Estimation period: 1915–39.

	OLS		TSLS	
	(1)	(2)	(3)	(4)
Δp_t	0.471 (3.08)	0.442 (2.81)	0.382 (1.11)	0.585 (1.82)
Δpc_t	0.425 (2.79)	0.366 (2.39)	0.642 (1.55)	0.254 (0.72)
Δpc_{t-1}	0.269 (2.58)	0.192	0.215 (1.83)	0.161
$(w - q - p)_{t-1}$	-0.222 (2.07)	-0.203 (1.84)	-0.228 (1.99)	-0.211 (1.86)
h_t^s	-1.138 (5.82)	-1.022 (5.46)	-1.315 (4.58)	-1.010 (4.38)
u_{t-1}	-0.065 (2.32)	-0.085 (3.28)	-0.075 (1.97)	-0.077 (2.05)
Restriction on prices	No	Yes	No	Yes
Adj. R-sq.	0.946	0.942	0.907	0.939
SE	0.032	0.032	0.039	0.033
DW	1.99	1.92	1.52	1.96

Notes: Restrictions on price terms: coefficients on Δp_t , Δpc_t and Δpc_{t-1} sum to unity. Δp_t and Δpc_t are treated as endogenous when the model is estimated by TSLS; wage and price inflation in the UK are used as instruments. Absolute t -values in parentheses.

Working time (the standard workweek) enters with highly significant and negative coefficients. This confirms anecdotal evidence and common claims that the introduction of the eight-hour workday in 1920 did result in an increase in wage pressure as the labor unions attempted to prevent a decline in earnings associated with shorter working time. The magnitude of the impact seems implausibly large but it turns out that the estimated impact of the standard workweek is quite sensitive to the sample period. Table 4 shows estimates based on data for 1918–39. Note that a long-run impact of minus one, i.e., $d(w - p) / dh^s = -1$, would correspond to full worker compensation for the shorter working time since earnings would then be independent of working time. This hypothesis cannot be rejected: the t -value for the restriction $d(w - p) / dh^s = -1$ in the first column is 0.86. This restriction is imposed in the remaining columns. Note also that the estimates of the long-run elasticity of the wage with respect to unemployment hover around -0.25 and are somewhat lower than the estimates in Table 3.

The Impact of Public Works

The expansion of temporary public jobs to combat unemployment began in the 1910s and reached non-negligible magnitudes in the early 1930s (see Figure 1 above). This development is clearly partly endogenous to the evolution of overall labor market conditions but presumably also reflects some shifts of policy preferences. It is difficult, however, to think of credible instruments for relief jobs. Table 5 shows results from some OLS regressions based on aggregate data where relief jobs as a fraction of total employment, R , is included in four different ways (lagged or not lagged, logged or not logged). There is a presumption that the use of lagged variables should be less prone to simultaneity bias, but the estimates do not indicate substantial differences depending on the lag specifications.

Table 4. Estimated aggregate wage equations, Estimation period: 1918–39. Dependent variable: Δw_t (hourly wages).

	(1)	(2)	(3)
Δp_t	0.885 (5.64)	0.964 (7.63)	0.901 (12.24)
Δpc_t	0.026 (1.17)	-0.064 (0.62)	
Δpc_{t-1}	0.089	0.100	0.099
$(w - q - p)_{t-1}$	-0.220 (2.43)	-0.202 (2.31)	-0.194 (2.28)
h_t^s	-0.426 (1.56)	-0.202	-0.194
u_{t-1}	-0.056 (2.62)	-0.045 (2.66)	-0.049 (3.15)
Restriction on h^s	No	Yes	Yes
Adj. R-sq.	0.971	0.971	0.972
SE	0.024	0.023	0.023
DW	1.84	2.06	2.00

Notes: Restrictions on price terms are imposed (coefficients on Δp_t , Δpc_t and Δpc_{t-1} sum to unity).

The restriction on h^s is $d(w - p) / dh^s = -1$: the long-run elasticity of the hourly real wage with respect to the length of the standard workweek is minus one. Absolute t -values in parentheses. Estimation by OLS.

The R -variables are always associated with positive coefficients but are never statistically significant. Taken at face values, the estimates in the first two columns suggest that an increase in the fraction employed in relief works by one percentage point would be associated with a rise in wage growth by around 2 percentage points. We also note that the inclusion of relief jobs leads to relatively large increases (in absolute values) in the estimated unemployment parameters. This is not surprising considering the fact that unemployment and

relief jobs exhibit a strong positive correlation ($R=0.62$). All in all, there is a consistent pattern that suggests that relief jobs have added to wage pressure although the magnitude of this effect is difficult to establish with much confidence.

Table 5. Estimated impacts of relief jobs on wages. Estimation period: 1915–39.

	(1)	(2)	(3)	(4)
u_{t-1}	-0.096 (2.77)	-0.111 (2.40)	-0.090 (2.71)	-0.086 (1.48)
$(w - q - p)_{t-1}$	-0.206 (1.97)	-0.156 (1.32)	-0.206 (1.95)	-0.196 (1.57)
R_t	2.41 (1.44)			
R_{t-1}		2.62 (1.24)		
$\log R_t$			0.015 (1.33)	
$\log R_{t-1}$				0.008 (0.42)
Adj. R-sq.	0.949	0.947	0.948	0.943
SE	0.030	0.031	0.030	0.032
DW	2.21	1.95	2.09	1.99

Notes: Other variables are those included in Table 3. Absolute t -values in parentheses. Estimation by OLS.

Summing up, the results from the empirical analysis suggest that wage behavior in the interwar period can be accounted for by a basically standard model of wage determination. The results are consistent with the notion of a wage curve, i.e., a long-run relationship between real wages and unemployment, with sizeable unemployment elasticity. The results are consistent with nominal neutrality in the sense that real wages are independent of inflation in the long run. The shortening of the workweek appears to have triggered a substantial increase in wage pressure.

3.3 Empirical Wage Equations: The Sectoral Level

Our analysis of sectoral wage behavior makes use of data for nine industries that essentially comprise mining and manufacturing.²⁸ Eq. (2) serves as the basis for the estimations. A general specification that nests (2) as a special case is:

$$(6) \quad \begin{aligned} \Delta w_{it} = & \gamma_0 + \gamma_1 \Delta p_{it} + \gamma_2 \Delta pc_t + \gamma_3 \Delta pc_{t-1} + \gamma_4 u_{t-1} + \gamma_5 \tilde{q}_{it-1} \\ & + \gamma_6 (\bar{w} - p)_{it-1} + \gamma_7 (w - p)_{it-1} + \gamma_8 h_t^s + v_i + \eta_{it} \end{aligned}$$

where v_i is an industry-specific fixed effect and η_{it} is a stochastic error term. We expect $\gamma_5 > 0, \gamma_6 > 0$ and $\gamma_7 < 0$. The measure of labor productivity at hand is real sales per worker. In logs, $\tilde{q}_{it} = (s - p - n)_{it}$ where s is nominal sales and n the number of workers in the industry. The outside wage pertaining to industry i , i.e. \bar{w}_i , is the average wage for all industries with industry i excluded. We did not have access to industry-specific data on the standard workweek so h^s is the same variable as the variable used in the aggregate analysis. The unemployment rate is also the aggregate rate. Even with access to sector-specific data on unemployment there is a case for focusing on the aggregate rate since there is some intersectoral mobility of labor.

Two plausible restrictions are of interest. First, price homogeneity holds if $\gamma_1 + \gamma_2 + \gamma_3 = 1$. By imposing this restriction on (6) one obtains a real wage equation of the form:

$$(7) \quad \begin{aligned} \Delta(w - p)_{it} = & \gamma_0 + \gamma_2 (\Delta pc_t - \Delta p_{it}) + \gamma_3 (\Delta pc_{t-1} - \Delta p_{it}) + \gamma_4 u_{t-1} \\ & + \gamma_5 \tilde{q}_{it-1} + \gamma_6 (\bar{w} - p)_{it-1} + \gamma_7 (w - p)_{it-1} + \gamma_8 h_t^s + v_i + \eta_{it} \end{aligned}$$

Second, note that the long-run sectoral real wage level is linearly homogeneous in sectoral productivity and the outside real wage provided that the restriction $\gamma_5 + \gamma_6 + \gamma_7 = 0$ holds.

This is a theoretically sound restriction implied by a standard bargaining model. Eq. (7) then translates into:

²⁸ The industries are: Mining and Metalwork; Stone and Glass; Wood; Paper and Printing; Foodstuff; Textiles and Clothing; Leather and Rubber; Chemical Industries; Electricity and Energy.

$$(8) \quad \begin{aligned} \Delta(w-p)_{it} &= \gamma_0 + \gamma_2(\Delta pc_t - \Delta p_{it}) + \gamma_3(\Delta pc_{t-1} - \Delta p_{it}) + \gamma_4 u_{t-1} \\ &+ \gamma_5 [\tilde{q}_{it} - (w-p)_{it-1}] + \gamma_6 [(\bar{w}-p)_{it-1} - (w-p)_{it-1}] + \gamma_8 h_t^s + v_i + \eta_{it} \end{aligned}$$

The terms associated with the parameters γ_5 and γ_6 can be thought of as capturing error corrections. Wage inflation in the current period is lower, the higher the lagged real wage is relative to firms' ability to pay (productivity); it is also lower the higher the lagged wage is relative to the outside wage (assuming $\gamma_5 > 0$ and $\gamma_6 > 0$).

Assuming $\Delta p_i = \Delta pc$ and $\Delta w_i - \Delta p_i = \Delta \tilde{q}_i$, the steady-state wage curve takes the form:

$$(9) \quad (w-p)_i = \gamma_0^* + \delta \Delta \tilde{q}_i + \lambda \tilde{q}_i + (1-\lambda)(\bar{w}-p)_i + \gamma_4^* u + \gamma_8^* h^s$$

where $\gamma_0^* = \gamma_0 / (\gamma_5 + \gamma_6)$, $\delta = -1 / (\gamma_5 + \gamma_6)$, $\lambda = \gamma_5 / (\gamma_5 + \gamma_6)$, $\gamma_4^* = \gamma_4 / (\gamma_5 + \gamma_6)$ and $\gamma_8^* = \gamma_8 / (\gamma_5 + \gamma_6)$. The "insider weight" pertaining to the long-run wage curve is obtained as $\lambda = \gamma_5 / (\gamma_5 + \gamma_6)$. There is a presumption that the insider weight goes to zero in a competitive labor market but also in an economy where collective wage bargaining is completely centralized, thereby effectively eliminating bargaining power at the sectoral level.

Empirical Results

The estimation results are set out in Table 6. We focus here on daily wages since these are available for almost all interwar years on the sectoral level (see Appendix 2). The equations are estimated by seeming unrelated regression (SUR). The contemporary correlations between the errors of equations estimated by OLS are high, typically ranging from 0.5 to 0.8. With such high correlations, estimation by SUR is much more efficient than OLS if the number of time periods, T, is at least double the number of cross-section units, N (see Beck and Katz, 1995). We have T=26 and N=9 so the efficiency case for SUR is clear. The first three regressions in Table 5 correspond to eqs. (6), (7), and (8). The last column includes estimates where the aggregate variables (unemployment, the consumer price and standard hours) are replaced by time dummies.

Table 6. Estimated sectoral wage equations, daily wages. Estimation period: 1915–39.

	(1)	(2)	(3)	(4)
Dep. variable	Δw_{it}	$\Delta(w-p)_{it}$	$\Delta(w-p)_{it}$	$\Delta(w-p)_{it}$
Δp_{it}	0.102 (6.04)			0.092 (3.56)
Δpc_t	0.568 (8.57)			
Δpc_{t-1}	0.304 (4.67)			
\tilde{q}_{it-1}	0.039 (2.80)	0.038 (2.73)		
$(\bar{w}-p)_{it-1}$	0.225 (5.31)	0.223 (5.28)		
$(w-p)_{it-1}$	-0.280 (5.88)	-0.279 (5.86)		
$[\tilde{q}-(w-p)]_{it-1}$			0.042 (3.31)	0.053 (2.83)
$(\bar{w}-w)_{it-1}$			0.234 (5.59)	0.306 (6.38)
$\Delta pc_t - \Delta p_{it}$		0.630 (11.64)	0.576 (9.76)	
$\Delta pc_{t-1} - \Delta p_{it}$		0.262 (4.85)	0.331 (5.72)	
h_t^s	-0.644 (6.05)	-0.660 (6.89)	-0.618 (6.19)	
u_{t-1}	-0.060 (4.16)	-0.057 (4.66)	-0.059 (4.67)	
Time dummies	No	No	No	Yes
Restrictions	No	A	B	
Adj. R-sq.	0.777	0.935	0.936	
DW	2.19	2.19	2.20	2.25

Notes: Restrictions A: coefficients on Δp_{it} , Δpc_t and Δpc_{t-1} sum to unity. Restrictions B: A plus $\gamma_5 + \gamma_6 + \gamma_7 = 0$ (see text). Absolute t -values in parentheses. Nine industries, fixed industry effects.

Overall, the results are similar to those obtained for the aggregate business sector. The restrictions imposed in columns (2) and (3) are easily accepted; the t -values associated with

the two restrictions are 0.36 and 1.12, respectively. Column (3) of Table (6) implies a wage curve where the industry wage is a convex combination of insider and outsider forces; the insider weight is obtained as $0.042/(0.042+0.234)=0.15$. The estimate of the insider weight obtained from regressions with time dummies in column (4) is also 0.15 (obtained as $0.053/(0.053+0.306)$). Previous Swedish studies, using post-World War II data, report insider weights of lower magnitudes (Holmlund and Zetterberg, 1991; Forslund, 1994). This is as should be expected given that wage bargaining was much less centralized during the interwar years, thus giving more scope for sector-specific factors.²⁹ The slope (elasticity) of the wage curve implied by the estimates in the third column is around -0.2, holding the outside wage constant. The estimated impact of the standard workweek is again on the high side.

4. The Demand for Workers and Hours

As noted above, actual hours per worker were procyclical and accounted for more than half of the variance in total hours over the interwar period. This observation naturally leads to the conjecture that short-run fluctuations in hours per worker were largely driven by employers' decisions. We specify and estimate simple models capturing firms' demand for labor input along the extensive and intensive margins, i.e., the number of workers and hours per worker. One can think of workers and hours per worker as two interrelated labor inputs along the lines analyzed by Nadiri and Rosen (1969) and others. We treat the standard workweek as exogenous in this exercise, assuming that the standard workweek – determined by legislation and collective agreements – puts a restriction on firms' input decisions.

Appendix 1 outlines a simple model of labor demand that delivers a framework for the empirical analysis. Consider a firm that operates in a perfectly competitive product market and takes the hourly wage as given. The production function specifies output as a function of workers and hours per worker. The production function is increasing and strictly concave in each argument. Production involves three kinds of labor costs. The first type is direct labor costs; in addition, there are costs of adjusting the workforce, such as costs for hiring and training workers; finally, there are costs to the firm of deviating from standard hours. Costs associated with hours exceeding standard hours include overtime premiums but also costs of deviating from the social norm embedded in standard hours. The firm's objective is to

²⁹ Other studies of insider effects in wage determination include, among others, Nickell and Wadhvani (1990) using UK data and Johansen (1996, 1999) using Norwegian data. Nickell and Wadhvani report estimates of the insider weight around 0.1 whereas Johansen reports estimates around 0.2.

maximize the discounted flow of profits over an infinite time horizon. The firm controls the evolution of employment by its hiring decisions. The firm also determines work hours at every instant. One implication of this model is that work hours respond quickly to changes in e.g. real wage costs whereas the number of workers exhibits gradual adjustment. In fact, the short-run impact on hours is stronger than the long-run impact.

4.1 Models of Labor Demand

The estimated models are specified as follows:

$$(8) \quad n_t = \alpha_0 + \alpha_1(w-p)_{t-1} + \alpha_2 h_t^s + \alpha_3 T_t + \alpha_4 AD_t + \alpha_5 n_{t-1} + \varepsilon_t$$

$$(9) \quad h_t = \beta_0 + \beta_1(w-p)_{t-1} + \beta_2 h_t^s + \beta_3 T_t + \beta_4 AD_t + \beta_5 n_{t-1} + \beta_6 h_{t-1} + \eta_t$$

Employment (in logs, n) is explained by the real product wage (in logs, $w-p$), the standard workweek (in logs h_t^s) and a few other variables. We regard labor demand as conditional on the evolution of capital and technology. Absent data on capital stocks and technology, time trends are included (T). Lagged employment captures lagged adjustment. We also include a measure of overall business cycle conditions captured by the GDP gap of Western Europe (11 countries, Sweden excluded); this variable is obtained as the residual from a regression of log European GDP on a linear time trend. The inclusion of this “aggregate demand” variable (AD) can be rationalized in several ways. One possibility is that firms’ markups of prices on wages vary over the business cycle. Another possibility is that some firms may be sales constrained and the fraction of constrained firms is most probably higher in slumps than in booms.

The equation for hours per worker (in logs h) has an analogous structure. Lagged hours capture lagged adjustment of hours analogous to lagged adjustment of workers in eq. (8). However, it turns out empirically that $\beta_6 = 0$ cannot be rejected ($t=0.43$), so we end up with equations for workers and hours that include the same right-hand-side variables. The long-run elasticity of workers with respect to the real product wage is obtained as

$dn / d(w-p) = \alpha_1 / (1 - \alpha_5)$ and the long-run elasticity with respect to standard hours is given as $dn / dh^s = \alpha_2 / (1 - \alpha_5)$. The long-run elasticities of hours are slightly more involved since lagged employment appears in the hours equation. We thus obtain:

$$(10) \quad \frac{dh}{d(w-p)} = \beta_1 + \frac{\beta_5 \alpha_1}{1 - \alpha_5}$$

$$(11) \quad \frac{dh}{dh^s} = \beta_2 + \frac{\beta_5 \alpha_2}{1 - \alpha_5}$$

We expect $\alpha_1 < 0$, $\alpha_2 < 0$, $\alpha_5 \in (0,1)$, $\beta_1 < 0$, $\beta_2 > 0$ and $\beta_5 < 0$. The expected negative sign of β_5 reflects an idea of “dynamic substitutability”: the greater the number of workers around, the less the need to make use of hours. These hypotheses thus imply that the long-run response of hours per worker to the real product wage should be numerically *smaller* than the short-run response. Firms adjust employment gradually as a result of hiring costs and make use of variations in hours as the main adjustment channel in the short run. The long-run response of hours to standard hours should be numerically *larger* than the short-run response, since a cut in standard hours increases the demand for workers (as firms substitute workers for hours), which in turn reduces hours per worker.

4.2 Estimation Results

The estimation results are set out in Table 7. The number of workers is measured as the number of employees in the business sector. We note that the demand for hours exhibits much stronger short-run responsiveness to wages than the demand for workers does. The long-run wage elasticity, however, is numerically *smaller* for hours than for workers. The estimated long-run elasticity of hours with respect to standard hours is close to unity. An increase in standard hours has a sizeable negative impact on the demand for workers; the estimated long-run elasticity is -0.45. All else equal, an exogenous cut in working time by 10 percent would thus increase employment by 4.5 percent. Note also that lagged employment enters with highly significant and numerically sizeable magnitudes in both equations.³⁰ The positive sign for lagged employment in the equation for workers reflects lagged adjustment, whereas the negative sign in the equation for hours captures dynamic substitutability between hours and workers. The immediate impact of the business cycle indicator *AD* is larger for hours than for workers. All in all, the estimates suggest that hours exhibit stronger short-run responsiveness to demand or wage shocks than workers do. This is in line with the empirical literature on

³⁰ The Durbin-Watson statistic is inappropriate with a lagged endogenous variable as in eq. (8). However, the LM test does not reject the null of no autocorrelation in this case; prob F(2,18)=0.06.

labor demand.³¹ The estimated models perform well in dynamic (deterministic) simulations. The mean absolute prediction error is 1.6 percent for workers and 1.8 percent for hours.

Table 7. Estimated labor demand equations: workers and hours.
Estimation period: 1914–39

Dep. variable	n_t	h_t
$(w - p)_{t-1}$	-0.127 (2.19)	-0.249 (4.48)
n_{t-1}	0.434 (3.04)	-0.426 (2.73)
h_t^s	-0.256 (1.96)	0.759 (5.33)
<i>Time</i>	0.013 (3.84)	0.013 (3.64)
AD_t	0.380 (3.81)	0.535 (4.91)
<u>Long-run elasticities</u>		
$(w - p)$	-0.22	-0.15
h^s	-0.45	0.95
Adj. R-sq.	0.976	0.921
SE	0.023	0.026
DW	1.84	2.29

Notes: Absolute t -values in parentheses. Estimation by OLS.

We noted that an exogenous cut in working time would seem to increase employment, all else equal. But all is not equal, of course. In particular, there is a case for allowing for wage adjustment to cuts in hours. The long-run elasticity of employment with respect to standard hours with wage adjustment takes the form:

³¹ Hamermesh (1993) summarizes empirical studies of the demand for workers and hours as follows (p 269): “The overwhelming bulk of evidence ... suggests strongly that employers adjust their demand for hours more rapidly than their demand for workers. ... It is reasonable to assume that the cost of hiring and training new workers increases more rapidly than that of increasing the hours of current employees. When demand drops, the fear of losing trained employees raises the costs of layoffs relative to those of cutting hours.”

$$(12) \quad \frac{dn}{dh^s} = \frac{1}{1 - \alpha_5} \left(\alpha_2 + \alpha_1 \frac{\partial(w-p)}{\partial h^s} \right) \approx \frac{\alpha_2 - \alpha_1}{1 - \alpha_5}$$

where $\partial(w-p)/\partial h^s \approx -1$ is assumed, i.e. full compensation for a cut in hours. Using our estimates we get $dn/dh^s = -0.23$, still suggesting that cuts in the standard workweek would increase employment. The elasticity of workers with respect to the wage is so low that wage hikes induced by cuts in working time have modest effects on employment.

These calculations take unemployment as given – an assumption obviously unreasonable if we consider economy-wide wage and employment adjustments. A rise in employment is bound to reduce unemployment which will bring about further wage responses. Maintaining the assumption $\partial(w-p)/\partial h^s \approx -1$ in the wage equation, one can derive a modification of (12) that accounts for unemployment adjustment:

$$(13) \quad \frac{dn}{dh^s} = \frac{\alpha_2 - \alpha_1}{1 - \alpha_5 + \alpha_1 [d(w-p)/du][(1-ur)/ur]}$$

where ur is the unemployment rate, $ur \in (0,1)$, and $d(w-p)/du$ the long-run slope (elasticity) of the wage curve. The impact on employment is thus numerically smaller, the more sensitive the wage is with respect to unemployment. Assuming $d(w-p)/du = -0.3$ and evaluating at $ur=0.055$ (the unemployment rate 1919) yields $dn/dh^s = -0.11$. We can use (13) to get a rough estimate of the employment effect of introduction of the 48-hour workweek. A cut in standard hours from 52 to 48 hours per week – 8 percent – would imply an increase in employment by 0.9 percent and a decline in the unemployment rate by 0.8 percentage points.³²

5. Concluding Remarks

Our study of interwar labor markets in Sweden suggests that standard wage and employment models can do a reasonably good job of accounting for movements in real wages and

³² To obtain the impact on the unemployment rate (ur), note that the elasticity of the unemployment rate with respect to the level of employment can be written as $du/dn = -(1-ur)/ur$. Thus we have

$du/dh^s = (du/dn) \times (dn/dh^s)$ where dn/dh^s is given by (13) and $du = d \log(ur)$.

employment over this period. A robust finding is that unemployment exercised a strong downward pressure on wages. The estimates lend support to the concept of a wage curve, i.e., a relationship between unemployment and the real wage. Industry wages responded to the evolution of productivity in the industry. Reductions in working time appear to have added to wage pressure but our estimates do not suggest any adverse impact on employment since shorter working time induced firms to substitute workers for hours. Needless to say, these calculations should be treated with at least the usual caution. The elasticities that determine the impact on employment are not estimated with a degree of precision that warrants very strong conclusions.

Labor input adjustment along the intensive margin played an important role during the interwar period. In fact, fluctuations in hours per worker accounted for most of the variation in total hours. This contrasts sharply with labor input adjustment in recent decades where adjustments along the extensive margin have become much more important.³³ One interpretation of these differences between now and then is that the costs to employers of varying hours have increased relative to the costs of varying the number of workers. The plausibility of such an interpretation is open to debate, however. It is clear that labor market regulations, including in particular employment protection legislation, have raised the costs to firms of hiring and firing workers. The costs of varying hours have presumably also risen over time but the details of these changes remain to be established.

³³ Estimation of the standard deviations of Swedish annual log changes in employment and hours per worker for the period 1987–2011 yields 0.022 for employment and 0.008 for hours per worker.

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Appendix 1. A Model of the Demand for Workers and Hours

This appendix outlines a simple model of labor demand along the intensive and extensive margins. Consider a firm that operates in a perfectly competitive product market and takes the hourly wage as given. The production function is given by $Q = Q(N, h)$ where N is the number of workers and h is hours per worker. Workers are homogeneous and they all work the same number of hours. The production function is increasing and strictly concave in each argument, i.e., $Q_N > 0$, $Q_{NN} < 0$, $Q_h > 0$ and $Q_{hh} < 0$. For concreteness we also consider a Cobb-Douglas function of the form

$$(A1) \quad Q = N^\alpha h^\beta$$

with $\alpha \in (0, 1)$ and $\beta \in (0, 1)$. Production involves three kinds of labor costs. The first type is direct labor costs, WNh , where W is the hourly wage. There are also costs of adjusting the workforce, such as for hiring and training workers. The adjustment costs are captured by a strictly convex function of the form $C(H)$, where H is the number a new hires; $C'(H) > 0$ and $C''(H) > 0$.³⁴ Finally, there are costs to the firm of deviating from standard hours. For simplicity, these costs are represented by a quadratic function of the form

$$(A2) \quad C^h = \frac{b}{2}(h - h^s)^2$$

Costs associated with hours exceeding standard hours include overtime premiums and possibly also fatigue-related costs. Costs associated with hours below standard hours involve costs of deviating from the social norm embedded in standard hours. Imposing shorter hours may also trigger worker unrest as a response to the decline in earnings. Needless to say, (A2) is a strong simplification of various mechanisms but the key idea should not be particularly controversial.

It remains to specify an equation of motion that describes the evolution of the workforce. This equation takes the form

³⁴ The model can in principle also capture layoffs by interpreting layoffs as negative hirings. We will, however, focus on the recruiting firm.

$$(A3) \quad dN / dt = H - qN$$

where q is the exogenously given quit rate.

The firm's objective is to maximize the discounted flow of profits over an infinite time horizon, i.e.,

$$(A4) \quad V = \int_0^{\infty} e^{-rt} \left[Q(N, h) - WNh - C(H) - (b/2)(h - h^s)^2 \right] dt$$

where r is the discount rate. The firm controls the evolution of employment through its control over the flow of hires. The firm also sets hours of work that are not subject to adjustment costs although there are costs associated with deviation from the norm represented by standard hours. The Hamiltonian for this problem is

$$\Gamma = e^{-rt} \left[Q(N, h) - WNh - C(H) - (b/2)(h - h^s)^2 + \lambda(H - qN) \right]$$

where λ is the multiplier associated with (A3). The necessary conditions for maximum include:

$$(A5) \quad \lambda = C'(H)$$

$$(A6) \quad Q_h(N, h) = WN + b(h - h^s)$$

$$(A7) \quad \lambda(q + r) - d\lambda / dt = Q_N(N, h) - Wh$$

One issue in this context is how optimal hours relate to standard hours. This cannot be determined in general but a look at the Cobb-Douglas special case may be useful. Invoke (A1) and note that $Q_h(N, h) - WN > 0$ implies $h > h^s$. One can then derive:

$$\text{sgn}(h - h^s) = \text{sgn} \left[wH \left(\frac{\beta}{\alpha} - 1 \right) + \frac{\beta}{\alpha} cN \right]$$

A sufficient condition for $h > h^s$ is thus $\beta \geq \alpha$. The intuition is clear: the more productive hours are relative to workers, the more likely that the optimal number of hours will exceed

standard hours. Since $\beta \geq \alpha$ is a sufficient but not necessary condition, it is reasonable to regard $h > h^s$ as the most plausible prediction.

Hours are chosen optimally at each instant as given by (A6). This yields a function for hours of the form $h = h(N; W, b, h^s)$. Combining (A5) and (A7) and recognizing $h = h(N; W, b, h^s)$ yields a differential equation for hirings of the form:

$$(A8) \quad \frac{dH}{dt} = \frac{1}{C_{HH}} \left[(q+r)C_H(H) - Q_N(N, h(N)) + Wh(N) \right]$$

This equation can be illustrated as a negatively sloped line in the H, N -space for $dH/dt=0$; see Figure A1.³⁵ Equation (A3) is depicted as a positively sloped line for $dN/dt=0$. The steady state is given as the intersection of a $dH/dt=0$ line and the $dN/dt=0$ line in the upper part of Figure 1. Points A and B correspond to two different steady states associated with two different $dH/dt=0$ lines (solid and dashed, respectively). The boldfaced arrows in the upper part of the figure illustrate optimal paths toward steady state A. The lower part illustrates the hours-employment relationship, i.e., $h = h(N; W, b, h^s)$ on the assumption that $\partial h / \partial N < 0$.

Consider a steady state at point A. A positive shock to labor demand can be illustrated as an outward shift of the $dH/dt=0$ line and a new steady state at point B. Hirings increase immediately and the number of workers adjusts gradually to the new steady state (not shown in the figure). The adjustment of workhours is illustrated as boldfaced arrows in the lower part of the figure. Hours increase immediately, followed by a gradual fall as the number of workers increase.

The comparative statics properties of the model are in part sensitive to the sign of $Q_{Nh} - W$. For example, we have $\text{sgn}(dN / dh^s) = \text{sgn}(Q_{Nh} - W)$. The empirical results are consistent with $Q_{Nh} < W$. It may also be noted that the derivative of hours with respect to the level of

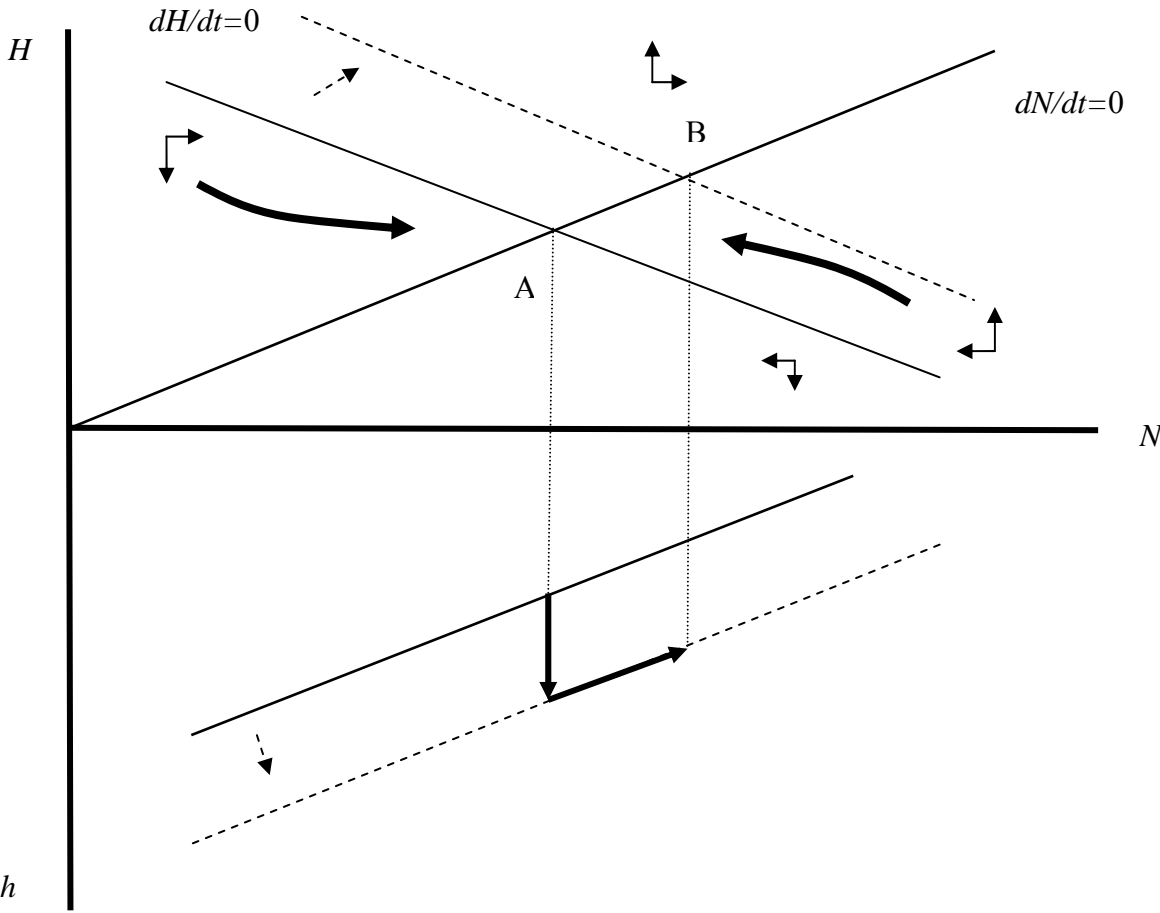
³⁵ The slope of (A8) is in general ambiguous. Implicit differentiation yields:

$$\text{sgn} \left(\frac{dH}{dN} \right)_{\dot{H}=0} = \text{sgn} \left[(Q_{Nh} - W)^2 - (Q_{NN})(Q_{hh} - b) \right]$$

which is negative if the second term in the bracket, $(Q_{NN})(Q_{hh} - b) > 0$, is large enough relative to the first term.

employment, $\partial h / \partial N$, takes the same sign as dN / dh^s . Workers and hours can be characterized as “dynamic substitutes” when these signs are negative.

Figure A1. The dynamics of workers and hours.



Appendix 2: The Data

Consumer prices: Edvinsson R and J Söderberg (2007), A consumer price index for Sweden 1290–2006. <http://www.riksbank.se/templates/Page.aspx?id=26813>

Producer prices for nine industries: Mining and Metalwork; Stone and Glass; Wood; Paper and Printing; Foodstuff; Textiles and Clothing; Leather and Rubber; Chemical Industries; Electricity and Energy. Department of Economic History, Lund University: LU-MADD (Lund University Macroeconomic and Demographic Database, <http://www.ekh.lu.se/database/lu-madd/>)

Value added price for the business sector: The series was obtained as the ratio between value added in current prices and value added in constant prices. Four sectors are aggregated: manufacturing, building and construction, transport and communication, and private services. Source: LU-MADD (see above).

Yearly wages for the business sector: Historisk statistik för Sverige – statistiska översiktstabeller (Historical Statistics for Sweden), Table 128. Refer to production workers (arbetare). Statistics Sweden, 1960.

Wage share in the business sector: (Yearly wages×employees)/value added in current prices. Employees in the business sector, see below; value added from LU-MADD, see above.

Hourly wages for the business sector: Lönenivåns förändringar för arbetare inom industri och hantverk, handel och transportväsen, allmän tjänst m m. Lönestatistisk årsbok för Sverige, various issues. Socialstyrelsen.

Daily wages for nine manufacturing industries: Data for 1923–25 were imputed by using information on the evolution of hourly wages for those years. Lönestatistisk årsbok för Sverige, various issues. Socialstyrelsen.

Hours per worker: Yearly wages divided by hourly wages; see above.

Total number of hours in the business sector: Hours per worker multiplied by the number of workers employed in the business sector (the total of employment in manufacturing, building and construction, transport and communication and private services). Employment data from LU-MADD (see above).

Standard workweek: The length of the workweek according to law and collective agreements. S Tegel (1983), Den ordinarie veckarbetstiden i Sverige 1860–1980. Meddelande 1983:86 Department of Economics, Lund University. The standard workweek is set to 48 from 1920 and onwards.

Sales per worker for nine industries: Industry sales in current prices (saluvärde i kronor) divided by the total number of workers in the industry. Industristatistik (Industrial Statistics), Statistics Sweden.

Unemployment: Unemployment among union members as a percentage of the number of members. Monthly data obtained from various issues of Sociala meddelanden published by Socialstyrelsen.

Relief jobs: Participants in public employment programs run by central or local governments (statliga reservarbeten, statskommunala reservarbeten, kommunala reservarbeten). Information on central government relief jobs is available from 1918; information involving local governments from 1922. To obtain a measure of the total number of relief workers during 1918–21, the number of central government relief workers was multiplied by two; this is based on the average ratio between total relief and central government relief works over the period 1924–28. Information on relief works prior to 1918 is not available but the magnitude is almost certainly negligible. The (partly imputed) average number of relief workers in 1918 amounted to 1800 persons and is likely to have been even lower during the previous war years. The number was set to 1000 for 1913–17. Sources: Svensk arbetslöshetspolitik åren 1914–1935 (SOU 1936:32); Statistisk årsbok 1941.

Total number of employees: Historia.se – portalen för historisk statistik (Rodney Edvinsson) (<http://www.historia.se/>).

Total number of employees in the business sector: The ratio between the number of employees in the business sector and total employment in the sector (from <http://www.historia.se/>) multiplied by total employment in the business sector according to LU-MADD.

Job placements, job vacancies, job applications: The annual flows of job placements, vacancies and job applications (number of persons applying for work) at the public employment service. Source: B Öhman (1970), *Svensk arbetsmarknadspolitik 1900–1947* (p. 187).

Wages and prices in the UK: P Scholliers and V Zamagni (1995), *Labour's Reward: Real Wages and Economic Change in 19th and 20th Century Europe* (appendix table A.24).

GDP in Western Europe: World Population, GDP and Per Capita GDP, 1-2003 AD (Angus Maddison), <http://www.historicalstatistics.org/> (11 Western European countries excluding Sweden).