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Wages and Prices in Sweden, 1912-1921. A retrospective Test

Jonung, Lars; Wadensjö, Eskil

WAGES AND PRICES IN SWEDEN, 1912–1921

A RETROSPECTIVE TEST

Lars Jonung and Eskil Wadensjö[1]

University of Lund, Lund, Sweden

Abstract

This article examines the behavior of wages and prices in Sweden between 1912 and 1921 on the basis of a retrospective projection of a wage-price model estimated for the years 1922–1971. We investigate whether these two periods are similar with regard to their wage and price experience. Substantial differences are found between the ten years studied here and the next fifty years. The differences are explained by reference to developments related to the Swedish labor market and to Swedish monetary arrangements.

I. Introduction

This article examines the determination of annual changes in wages anp prices in Sweden during the period 1912–1921 by adopting a wage-price model estimated for 1922–1971 as the common reference for the analysis. The study thus combines econometric work with an investigation of the Swedish stabilization record during the First World War. The plan of the paper is as follows. First, the wage-price formation during 1912–1921 is compared with the behavior of wages and prices during 1922–1971 in terms of an econometric model covering the latter fifty-year period. Second, we present a number of explanations for the differences found. Third, the original econometric model is respecified and re-estimated to incorporate explicitly various developments in the labor market and in the monetary sector deemed important during the period 1912–1921. Finally, we examine the explanatory power of the respecified model.

It is common practice in econometric work to examine the explanatory power of an econometric model by including observations in the model which are not covered in the original estimation of the parameters. This is generally accomplished by examining the years following the period initially covered.

A variation of this approach is adopted in this article in that we study observations prior to the original period of estimation.[1]

II. The Determination of Wages and Prices for the Period 1912–1921 and 1922–1971

An annual model of the joint determination of wages and prices in Sweden—consisting of one wage and one price equation and estimated by the two-stage least squares technique for the period 1922–1971—is employed to compare the wage-price process during 1912–1921 with the behavior of wages and prices in the subsequent fifty years. Equations (1) and (2) constitute the model in its structural form.[2]

$$(1) \quad \dot{w} = 6.802 + 0.531\dot{p} + 0.203\dot{p}_{-1} - 0.808U$$
$$\phantom{(1) \quad \dot{w} = } (0.935) \ (0.165) \quad (0.126) \qquad (0.153)$$
$$ R^2 = 0.817 \quad DW = 1.297 \quad SE = 2.977 \quad n = 50 \ (1922\text{--}1971)$$

$$(2) \quad \dot{p} = -1.127 + 0.604\dot{w} + 0.162\dot{p}_M$$
$$\phantom{(2) \quad \dot{p} = } (0.350) \ (0.051) \quad (0.024)$$
$$ R^2 = 0.880 \quad DW = 1.734 \quad SE = 1.837 \quad n = 50 \ (1922\text{--}1971)$$

The reduced form equations of (1) and (2) are:

$$(3) \quad \dot{w} = 9.132 + 0.299\dot{p}_{-1} - 1.189U + 0.127\dot{p}_M$$

$$(4) \quad \dot{p} = 4.389 + 0.180\dot{p}_{-1} - 0.718U + 0.238\dot{p}_M.$$

Notations: $\dot{p}$ = yearly percentage change in prices (implicit gross domestic product deflator), $\dot{p}_{-1}$ = yearly percentage change in prices, lagged one year, $\dot{w}$ = yearly percentage change in nominal wages, $\dot{p}_M$ = yearly percentage change in import prices, U = rate of unemployment, in per cent.

The model demonstrates a high degree of precision for the years 1922–1971. The actual and estimated values follow each other closely. Furthermore, the developments during the first half of the 1970s are also in line with the model.[3] Now, when the actual observations for 1912–1921 are compared with those calculated from the model, will the result be the same as for the years 1922–1971 in the sense that the differences between the actual and estimated values are small?

Table 1 shows the actual and estimated values of the yearly percentage changes in wages and prices, computed from the reduced form of the model in

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[1] An example of this form of backward projection is found in Perry (1966). He applies his original equation, fitted to quarterly data for the period 1947–1960, to annual data for the years 1920–1928.
[2] The complete model and its construction is described in Jonung & Wadensjö (1978).
[3] Jonung & Wadensjö (1978).

Table 1. *Actual and estimated changes in wages and prices in Sweden, 1912–1921*

Yearly percentage changes

Year	Changes in wages			Changes in prices		
	Actual (1)	Estimated (2)	Re-estimated (3)	Actual (4)	Estimated (5)	Re-estimated (6)
1912	4.3	5.6	2.3	6.4	2.8	1.8
1913	2.7	7.6	7.5	0.0	2.9	0.6
1914	4.4	6.0	4.8	2.0	4.8	6.0
1915	4.3	6.7	7.7	14.7	5.3	9.2
1916	8.2	13.3	20.9	12.8	10.1	17.7
1917	24.5	14.1	22.9	25.8	12.4	26.1
1918	45.4	19.0	37.9	39.8	17.2	38.6
1919	33.3	18.5	38.9	15.5	11.7	14.8
1920	28.9	11.1	15.2	0.8	6.9	2.4
1921	−0.8	−14.1	−2.8	−14.4	−16.4	−13.9
Mean absolute error		9.8	5.4		6.9	2.4

Comment: Columns (2) and (5) are computed from the original wage-price model estimated for the period 1922–1971. Columns (3) and (6) are calculated from the respecified model estimated for the years 1912–1921. Wages and prices are estimated from the reduced form equations. Columns (2) and (5) are calculated from equations (3) and (4), respectively, and columns (3) and (6) from equations (9) and (8), respectively.

equations (3) and (4). The estimated and actual observations have the same sign for all years, although there are substantial differences between the observed and computed values, as seen for the mean absolute error at the bottom of the table. Judging from the size of these summary statistics, we are tempted to conclude that the applicability of the model is limited for the decade covered in Table 1, although there is a positive correlation between the actual and fitted values (computed from the reduced forms). The correlation coefficient is 0.735 for the wage equation and 0.866 for the price equation. The correlation coefficients differ significantly from zero in both cases when tested at the one per cent level. In order to describe some characteristics of the differences between the actual and estimated values for the periods 1912–1921 and 1922–1972, one of Theil's tests for inequality is applied to study the "predictive" performance of our model and a Chow test is used to search for the existence of a structural change between 1912–1921 and 1922–1971.

Theil's inequality coefficient for the wage equation (reduced form) is 0.366 and for the price equation (reduced form) 0.333, where a value of zero indicates a perfect prediction and a value of one denotes maximum inequality

between the actual and computed values.[1,2] The errors in the wage "predic-tions" may be explained in the following way: 29 % are due to bias (the predicted values are too low), 24 % to different variation (the variations of the predicted values are too low), and 46 % to different covariation (the changes in the predicted and actual values are not coordinated). The errors of the price "predictions" may be explained as follows: 24 % are due to bias, 38 % to different variation and 38 % to different covariation. Chow tests corroborate the opinion that the wage and price developments during 1912–1921 differ from those during the next fifty years; that is, the structure of the model for 1922–1971 is significantly different from the structure for 1912–1921.[3]

III. An Examination of the Residuals

In order to analyze the causes underlying the large differences between the actual and calculated values, we examine the residuals, first of the wage equation and then of the price equation.

III.1 *Wages*

A clear pattern can be seen in Table 1 with respect to the differences between actual and estimated changes in the wage level for 1912–1921. During the first five years the estimated values are consistently higher than the observed ones, whereas the opposite is true for the remaining five years. In our opinion, five developments in the labor market explain why the estimated values are higher than the actual values during the first years of the War (1914–1916):

1) The general strike in 1909 severely weakened the strength of the trade union movement, since the strike was commonly regarded as a victory for the employers' federation. Union membership dropped considerably—it took about six years for the trade unions to reach the same membership level as at the end of 1908. Thus, the strike had a dampening effect on wage demands

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[1] See Theil (1966), pp. 29–30.
[2] If we study the structural forms, i.e. each equation separately, we get the following correlation coefficients between the actual and the estimated values: 0.783 for the wage equation and 0.837 for the price equation.
  Theil's inequality coefficient for the structural form of the wage equation is 0.278 and for the price equation 0.238. The errors in the wage "predictions" may be explained as follows: 17 % by bias, 14 % by different variation and 69 % by different covariation. As for the errors in the price "predictions", 4 % are due to bias, 11 % to different variation and 88 % to different covariation.
[3] The Chow tests give the following results (the equations are estimated separately for the periods and for the whole sample):

F^* prices $(3,44) = 6.55$

critical value $F_{5\%}$ $(3,44) = 2.82$

F^* wages $(4,42) = 3.13$

critical value $F_{5\%}$ $(4,42) = 2.60$

several years after its termination.[1] This may also explain why the estimated wage changes are higher than the actual values in 1912 and 1913.

2) Shortly after the outbreak of the war, representatives from labor and management reached a *borgfred*—that is, an agreement stating that strikes and other labor disruptions should be avoided during the war.[2] Undoubtedly, the *borgfred* made labor less inclined, at least initially, to make strong demands for higher wages and resort to strikes to enforce its requests. The small number of strikes in 1915 and 1916 as compared with the large number in 1917 and 1918 should be viewed partially as the result of various attempts to establish peaceful conditions on the labor market during the war. (See Column (1) in Table 2.)

3) During the first part of the wartime business boom, the increase in the demand for Swedish products and the rise in import prices were generally expected to be temporary. These expectations suppressed wage demands, allowing for a redistribution of income from labor to capital. There is ample evidence that business profits absorbed the impact of the business upturn in advance of wages.[3]

4) The absence of price indices that could form the basis for inflationary expectations during the first years of the war had a similar effect, allowing wages to lag behind changes in prices. In the wage equation, present and past price changes exert a significant influence on wage changes. If labor neither registered nor reacted to actual price changes during 1912–1921 as rapidly as during 1922–1971—for which our original estimates are made—computed wage changes will be above the actual ones for 1912–1921. We suggest that this was the case during the early part of the war, when the public had less knowledge about actual price changes than it had later on.

5) The expanding demand for labor in industry during the wartime boom of 1915–1917 attracted a large inflow of labor from agriculture and the countryside into industries in urban areas as (1) wages were lower in agriculture than in industry and (2) emigration overseas was virtually halted during the war. This large supplement to the labor force tended to exert a downward pressure on the rise in wages.[4] The increase in the industrial labor force peaked in 1916, when the number of workers in Swedish industry expanded by about six per cent as compared with 1915.

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[1] On this point see i.a. Östlind (1945), p. 162. In several studies on wage inflation, the number of strikes is used as a proxy variable for union aggressiveness. The argument behind this choice is that a high strike frequency induces wage inflation. See e.g. Godfrey & Taylor (1973) and Taylor (1974). However, a high strike frequency may be caused by employer aggressiveness as well as by trade union militancy. The outcome of a strike is not always higher wages. The effects of strikes on the rate of wage changes are therefore ambiguous.

[2] Heckscher (1926), pp. 267–268.

[3] Östlind (1945), pp. 146–149.

[4] Östlind (1945), p. 165.

Table 2. *Some developments on the Swedish labor market, 1912–1921*

Number of strikes, column (1), number of lockouts, column (2), number of work days lost, column (3), members of trade unions in thousands, column (4), and the percentage share of union members of the total labor force, column (5)

Year	Number of strikes (1)	Number of lockouts (2)	Work days lost (3)	Members of trade unions (1 000) (4)	Union members of the total labor force, % (5)
1912	108	4	292 100	122	6
1913	118	1	303 300	136	6
1914	105	8	620 500	144	7
1915	70	7	83 300	158	7
1916	218	2	474 700	194	9
1917	458	8	1 108 800	253	11
1918	668	10	1 436 400	305	13
1919	414	10	2 295 900	367	15
1920	455	9	8 942 500	399	17
1921	302	22	2 663 300	360	15

Source: Columns 1–3: Table A in *SOS, Arbetsinställelser i Sverige år 1922*. A small number of labor market conflicts classified as neither strikes nor lockouts are included in column (3). Column 4: Edebalk (1975), p. 279. Column 5: Silenstam (1970). Census data are used for 1910 and 1920. For the remaining years, the numbers are constructed by interpolating between census data for 1910, 1920 and 1930.

In spite of these five developments, the actual and estimated changes in wages are fairly close during the first three years of the war. Between 1917 and 1921, however, actual wage changes are considerably higher than the estimated values. This pattern may be explained with reference to four factors: (1) improved knowledge of the rising level of prices. (2) an increase in labor's bargaining power, (3) political developments, and (4) a reduction in the supply of labor. These factors may be described as follows:

1) Gradually, inflationary expectations spread among the workers. It is indicative that the labor union movement organized a *dyrtidskongress* in 1916—literally, a congress dealing with high prices—where strong demands were made for higher real wages and compensation for inflationary price increases.[1]

2) A number of indicators suggest that labor's bargaining position improved considerably after 1916. First, the number of union members more than doubled between 1916 and 1920, as seen from Column (4) in Table 2. Second, unrest on the labor market increased considerably, reaching a record level by 1920, as measured in terms of the number of strikes and the number of

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[1] Heckscher (1926), p. 269.

work days lost (Table 2). We regard the labor market conflicts in these years as a sign of growing union militancy, which forced the acceptance of higher than "normal" wage increases.[1]

3) Third, and perhaps most important, political developments at this time —growing political tensions within as well as outside Sweden, the fear of revolution, and the rise to political power of parties closely associated with the labor class—made employers less inclined to resist demands for higher wages.[2]

4) The supply of labor was sharply reduced when the eight-hour workday, approved by the *Riksdag* in 1919, was introduced. Actually the workweek had been shortened before that year in anticipation of the law. It is difficult, however, to obtain a precise estimate of the effect of this reform. The workday was reduced by about 15 %, from about 56 hours to 48 hours, in 1919–1920. This implied a sharp reduction in the supply of labor and consequently an increase in the wage rate, *ceteris paribus*. It was the legislators' intention that this reform should be adopted without a decline in the total wage bill, where business would adjust through "rationalization" and other steps to improve efficiency. There is evidence that the introduction of the eight-hour day was associated with a substantial and temporary redistribution of income from capital to labor, e.g. the real annual wage per industrial worker increased by about ten per cent from 1919 to 1920, when the workweek was reduced.[3]

As Table 1 refers to changes in the hourly wage rate, it is of interest to examine annual wage trends to illustrate the effect of the shorter workweek. The annual wage rate increased by 13.2 % between 1919–1920, when the eight-hour day was introduced, while the hourly wage rate jumped by 28.9 %. Thus the difference is considerable.[4] For 1920 and 1921, the estimated hourly wage change is much closer to the actual change in the annual wage than to the actual change in the hourly wage rate.

In sum, the differences between the actual and estimated wage changes during 1912–1921 may be explained by developments related to the formation of price expectations, to changes in the bargaining position of labor and to changes in the supply of labor.

III.2. *Prices*

There is a striking pattern in the differences between the actual and estimated values of the changes in the price level—the observed price changes are larger than the estimated values between 1915 and 1919 (for 1915 to 1918, according to the reduced form). (See Columns (4) and (5) in Table 1.) We focus on changes

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[1] On this point see Östlind (1945), p. 163, and Heckscher (1926), p. 270.
[2] Östlind (1945), pp. 400–401 and 454–455.
[3] Heckscher (1926), p. 289.
[4] See *SOS, Lönestatistisk årsbok för Sverige*, 1930, p. 44. These figures refer to adult men employed in manufacturing, commerce and transport.

in monetary arrangements to account for the underestimation of actual price changes during the period 1914–1922.

At the outbreak of the war, Sweden left the gold standard which had been maintained since the first half of the 1870s. Sweden had *de facto* a paper standard with flexible exchange rates during the major part of the period 1914–1921, before it returned to fixed exchange rates in the early 1920s. The *Riksbank*, knowingly or not, allowed an extremely large monetary expansion during the years 1915–1920. During the wartime boom, the Bank discounted freely at a fairly low discount rate, extending the money stock at a very rapid rate. The money stock expanded at some of the highest rates registered in the monetary history of Sweden.[1]

The price level and the money stock increased at about the same annual percentage rates. Likewise during the depression which began after the war, the *Riksbank*, by holding a relatively high discount rate, contributed to the monetary contraction in order to hasten the return to the gold standard at prewar parity. Parity was reached in 1922, although the gold standard was not officially introduced until 1924. In other words, the monetary events during these years of flexible exchange rates gave rise to a strong covariation between money and prices.[2]

During the period 1922–1971, the monetary authorities tied the *krona* to a fixed exchange rate during most of these years. Thus, the Swedish money stock has been determined largely by changes in the demand and supply of the volume of currency that has constituted the international reserve currency. The Swedish money stock has not exhibited as sharp and strong fluctuations during periods of fixed exchange rates as during periods of flexible rates. Large fluctuations in the domestic money stock similar to those during World War I, independent of changes in the international reserve asset and in world trade, would have led to the abolishment of fixed rates.

A small and insignificant coefficient was obtained for the simultaneous change in money and prices in the original estimation of the price equation. However, this result pertains to a period of predominantly fixed exchange rates where monetary impulses were limited, as compared to the period 1914–1922 when the *Riksbank*, under a regime of flexible rates, executed first a strongly expansionary and later a highly contractionary policy. Consequently, we suggest the existence of a closer and more significant relationship between simultaneous changes in the money stock and the price level for the period 1914–1921 than for the period 1922–1971.[3]

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[1] See Jonung (1976).

[2] See Jonung (1976). See also Heckscher (1915) and Cassel (1922).

[3] The stronger co-variation between money and prices in 1912–1921, as compared with the years 1922–1972, is seen from the values of the correlation coefficients for annual percentage changes in the money stock and the price level for these two periods: 0.965 and 0.410, respectively. See also Jonung (1976). Here the money stock is defined as the sum of the volume of *Riksbank* notes and commercial bank deposits held by the public.

IV. A Reformulation and Re-estimation of the Wage and Price Equations

We now reformulate our model of prices and wages in Sweden for 1912–1921 to include the results of the examination of the residuals.

IV.1. *Wages*

There is reason to assume that the lag structure of the wage equation for 1912–1921 differs from the structure for 1922–1971 due to the lack of price indices available to the public and to the influence of political events. A re-estimation of the wage equation for 1912–1921 with two-stage least squares gives the following result:

$$(5)\quad \dot{w} = 0.544 + 0.308U + 0.454\dot{p} + 0.769\dot{p}_{-1}$$
$$\quad\quad\quad (6.884)\ (0.952)\quad (0.288)\quad (0.268)$$

$$R^2 = 0.804 \quad DW = 2.401 \quad SE = 8.738 \quad n = 10\ (1912\text{–}1921)$$

The rate of unemployment, U, has the "wrong" sign and does not differ significantly from zero at the five per cent level. One probable contributing factor is that unemployment was more unevenly distributed during 1914–1919 than later on. In the winter of 1914–1915, the rate of unemployment in seasonal industries was especially high as a result of partial mobilization. It was one hundred per cent in the tobacco industry. In 1917–1918, following the wartime boom from the spring of 1915 to the spring of 1917, the structural problem was still more pronounced. Several industries, e.g. the textile industry, suffered from shortages of raw materials. In other industries, i.e. iron and steelworks, the wartime boom continued. After November 1918, the so-called "surrogate" industry, which produced goods which Sweden had imported before the war, met with great difficulties.[1] It is well known from the discussion of the Phillips curve that it is not only the size but also the distribution of unemployment that influence the rate of wage inflation.[2] Thus the rate of unemployment is not a good indicator of the influence of the labor market on wage inflation, when the distribution of unemployment changes as much as it did during World War I. On basis of this argument, we exclude the U-variable and re-estimate equation (5) as follows:

$$(6)\quad \dot{w} = 2.370 + 0.409\dot{p} + 0.765\dot{p}_{-1}$$
$$\quad\quad\quad (3.599)\ (0.223)\quad (0.251)$$

$$R^2 = 0.800 \quad DW = 2.219 \quad SE = 8.167 \quad n = 10\ (1912\text{–}1921)$$

The above estimation supports the hypothesis that the lag structure for 1912–1921 is different from the structure for 1922–1971. Wages reacted to

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[1] See Järte (1923), Chapter 2.
[2] See e.g. Archibald (1971).

price changes more slowly but to a larger extent during 1912–1921 than later on. The residuals are smaller for the re-estimated wage equation than for the original model. (Column (3) in Table 1.) The largest residual is obtained for the year 1920. The actual value of $\dot{w}$ that year is 29 % and the estimated value is only half that amount. The introduction of the eight-hour workday is probably the main factor behind this large discrepancy.

IV.2. *Prices*

Since we have suggested that monetary development is the main explanation for the fluctuations in the price level during 1912–1921, the original price equation, equation (2), is re-estimated using two-stage least squares with the annual percentage change in the money stock ($\dot{m}$) included as an additional explanatory variable. The following result is obtained:

(7) $\dot{p} = -2.969 - 0.067\dot{w} + 0.858\dot{m} + 0.246\dot{p}_M$
$\qquad$ (2.307) (0.163) $\quad$ (0.243) $\quad$ (0.106)

$\qquad R^2 = 0.951 \quad DW = 2.686 \quad SE = 4.091 \quad n = 10$ (1912–1921)

In equation (7) the regression coefficient of the wage variable is not significantly different from zero at the five per cent level. A re-estimation of equation (7) using ordinary least squares and excluding w gives:

(8) $p = -3.127 + 0.796\dot{m} + 0.244\dot{p}_M$
$\qquad$ (2.049) (0.171) $\quad$ (0.096)

$\qquad R^2 = 0.954 \quad DW = 2.759 \quad SE = 3.686 \quad n = 10$ (1912–1921)

The new equation system in reduced form is thus:[1]

(8) $\dot{p} = -3.127 + 0.796\dot{m} + 0.244\dot{p}_M$

(9) $\dot{w} = 1.091 + 0.765\dot{p}_{-1} + 0.326\dot{m} + 0.100\dot{p}_M.$

As seen from the size of the mean absolute errors in Table 1, the residuals of the new equation system are smaller than the residuals computed from the original model, which supports the modifications of the original wage and price model.

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[1] Equation (8) is estimated by ordinary least squares. When the wage variable is eliminated from the price equation, a recursive equation system is obtained if the variance-covariance matrix of the disturbances is a diagonal matrix, where ordinary least squares is a better estimation technique than two-stage least squares. See e.g. Malinvaud (1966). We do not know, however, if this matrix is a diagonal matrix. A re-estimation of equation (6) using ordinary least squares gives equation (6a):

(6a) $\dot{w} = 2.371 + 0.409 \dot{p} + 0.766 \dot{p}_{-1}$
$\qquad$ (3.595) $\quad$ (0.216) $\quad$ (0.248)

$\qquad R^2 = 0.800 \quad DW = 2.219 \quad SE = 8.167 \quad n = 10$ (1912–1921)

which is almost identical to the result obtained using two-stage least squares.

V. Summary

It was first established that the behavior of wages and prices in Sweden between 1912 and 1921 was significantly different from that of the next fifty years in terms of a model of the determination of wages and prices estimated for 1922–1971. The values calculated retrospectively for 1912–1921 using this model were positively and significantly correlated with the actual values. However, Theil's measure of inequality and the Chow test suggested that the differences were considerable. Next, the differences between the actual and estimated values were explained by several developments: (*a*) the adjustment of wage earners to the rapid rise in prices, (*b*) the influence of political events, (*c*) changes in the degree of unionization, (*d*) changes in the supply of labor, and (*e*) the predominance of monetary impulses.

Finally, the wage-price model was reformulated and re-estimated to incorporate the conclusions of this discussion. The empirical results of the new model supported the arguments presented to account for the residuals for 1912–1921 obtained from the original model, since the reformulated model traced the actual movements of wages and prices during 1912–1921 with a higher degree of precision than the original model estimated for the period 1922–1971.

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