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PAYROLL TAXES AND WAGE INFLATION: THE SWEDISH EXPERIENCES

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1. Introduction*

Payroll taxes levied on employers have played an increasingly important role in the Swedish tax system. Those taxes - including various collective fees agreed upon in central wage negotiations - amounted to about 6 percent of the wage bill of private business in 1950 but had reached 40 percent in the late 70s. The payroll tax increases were quite dramatic during the last decade, with tax rates climbing from 14 percent to 40 percent.

The macroeconomic effects of this development have so far been basically unexplored.[1] To what extent have the tax increases been shifted back onto labor as lower wage increases? To what extent have they been shifted forward on prices? And how have the profit margins been affected? It is widely acknowledged that Sweden's unsatisfactory macroeconomic performance during the late 70s partly was linked to a severe "cost crisis". It has, however, so far been no evidence available on the extent to which the wage cost explosion is attributable to the payroll tax increases. This paper attempts to provide such information. The focus is on backward shifting on wages occuring within a time-span of one year.

Aside from the emphasis on payroll taxes, the adopted framework is fairly conventional. The specification of the wage equation is, however, somewhat different from the most widely used versions of the expectations-augmented Phillips curve. As is discussed below, there are good a priori reasons to allow both output and consumer prices to enter the wage equation. In fact, the framework implies a restriction on the payroll tax coefficient that is easily tested.

The basic message of the empirical analysis is: The payroll tax increases have produced some backward shifting on wages, but the shifting appears to be far from complete. A statutory wage cost increase by one percent is associated with an actual wage cost increase of about one half of a percent.

2. The framework

As is well known, the standard partial equilibrium analysis of tax incidence suggests that the extent of backward shifting will be determined by the supply and demand elasticities of labor. Consider the case where workers are facing a proportional tax, t, on wage income and where firms have to deliver a fraction, s, of the payroll to the government. The equilibrium wage in this labor market, w*, will be affected by tax changes according to the formulas

$$\frac{1+s}{w^*} \cdot \frac{\partial w^*}{\partial s} = \frac{\varepsilon_D}{\varepsilon_S - \varepsilon_D} \qquad (1)$$

$$\frac{1-t}{w^*} \cdot \frac{\partial w^*}{\partial t} = \frac{\varepsilon_S}{\varepsilon_S - \varepsilon_D} \qquad (2)$$

where ε_D and ε_S are demand and supply elasticities, respectively. Hence, if labor supply is completely inelastic, it holds that payroll tax increases will be fully shifted back onto labor; the RHS of (1) equals minus unity and, by implication, the total wage costs per worker will be independent of the payroll tax rate. Under "normal" assumptions of forward sloping supply curves, it is clear that increases in payroll and income tax rates imply higher labor costs:

$$\frac{1}{w^*(1+s)} \cdot \frac{\partial(w^*(1+s))}{\partial s} = \frac{\varepsilon_s}{(1+s)(\varepsilon_s-\varepsilon_D)} \quad (3)$$

$$\frac{1}{w^*(1+s)} \cdot \frac{\partial(w^*(1+s))}{\partial t} = \frac{\varepsilon_s}{(1-t)(\varepsilon_s-\varepsilon_D)} \quad (4)$$

It can be noted that expression (4) is greater than (3) for non-trivial values of the tax parameters. Hence, an increase in the income tax rate by one percentage point will induce a larger wage cost increase than a payroll tax increase by one point.[2]

The specification in this paper departures from the simple partial equilibrium framework, whose implications are outlined above. First, consider the behavior of a firm equipped with a Cobb-Douglas technology

$$Q = AN^{\alpha}e^{\lambda T} \quad (5)$$

where Q is output, N is labor and T is time, the latter capturing growth in capital and knowledge. The profit-maximizing firm will end up with a labor demand function

$$\ln N^D = \varepsilon_D \cdot \ln(w(1+s)) - \lambda\varepsilon_D T - \varepsilon_D \ln P_Q - \varepsilon_D \ln(\alpha A) \quad (6)$$

where P_Q is the output price and where $\varepsilon_D = 1/(\alpha-1)$.

Suppose, further, that labor supply is affected by the after-tax real wage $(w(1-t)/P_C)$, P_C being the price of consumption goods. Approximating by a log-linear function, we have

$$\ln N^S = \beta_0 + \beta_1 \ln(w(1-t)/P_C) + \beta_2 T \quad (7)$$

where the trend captures secular changes in omitted variables (non-labor income, for example).

Equalizing (6) and (7) and differencing yields the equilibrium money wage path as

$$\Delta \ln w^* = \frac{\lambda \varepsilon_D}{\varepsilon_D - \varepsilon_s} + \frac{\varepsilon_D}{\varepsilon_D - \varepsilon_s} \cdot \Delta \ln P_Q - \frac{\varepsilon_s}{\varepsilon_D - \varepsilon_s} \cdot \Delta \ln P_C - $$

$$- \frac{\varepsilon_D}{\varepsilon_D - \varepsilon_s} \cdot \Delta \ln(1+s) + \frac{\varepsilon_s}{\varepsilon_D - \varepsilon_s} \cdot \Delta \ln(1-t) + \frac{\beta_2}{\varepsilon_D - \varepsilon_s} \qquad (8)$$

Some implications of Eq. (8) should be noted. First, the two price coefficients sum to unity, which reflects the absence of money illusion. The case with inelastic labor supply - ignoring tax changes and trends in labor supply - implies

$$\Delta \ln w^* = \lambda + \Delta \ln P_Q \qquad (9)$$

which conforms to the basic Aukrust-EFO hypothesis about wage increases in the tradeable sector of a small open economy: Wage growth equals - in "equilibrium" or "the long run" - the sum of productivity growth and output price changes.[3] (Increases in average productivity will, of course, equal the trend factor, λ, if labor supply is fixed).

Note also that the following restrictions are implied by (8):

$$\frac{\partial(\Delta \ln w^*)}{\partial \lambda} = \frac{\partial(\Delta \ln w^*)}{\partial(\Delta \ln P_Q)} = - \frac{\partial(\Delta \ln w^*)}{\partial(\Delta \ln(1+s))} \qquad (10)$$

$$\frac{\partial(\Delta \ln w^*)}{\partial(\Delta \ln P_C)} = - \frac{\partial(\Delta \ln w^*)}{\partial(\Delta \ln(1-t))} \qquad (11)$$

An increase in the payroll tax factor, (1+s), by one percent implies the same wage reduction as an output price decrease by one percent. Analogously, an increase in the retention ratio, (1-t), by one percent is equivalent to a decrease in the price of consumption goods by one percent. Those restrictions are easily tested and can be imposed to increase efficiency.

Equation (8) depicts an equilibrium wage path, presumably at variance with actual experiences in several situations. There is, unfortunately, little concensus on how to model wage and price formation outside equilibrium. The following empirical analysis relies on a framework used by Parkin et al, (1976). The basic elements are as follows: The firms' desired demand for labor depends on the product real wage, inclusive of the employers' payroll tax. The household's desired labor supply, in turn, depends on the after-tax real wage, where the appropriate price deflator is a price index for consumption goods. And, finally, it is assumed that the agents in the labor market act as if they in each period try to eliminate a fraction of recently observed excess demand for labor. This "adjustment towards equilibrium" will be contingent upon the agents price and tax expectations as well as their perceptions about the parameters of the labor demand and labor supply functions. Each increase in money wages agreed upon will define a particular level of anticipated excess demand in the labor market.

The framework may be described by a labor demand equation (Eq.(6)), a labor supply function (Eq.(7)) and a disequilibrium reaction function

$$\Delta \ln(N^D/N^S) = -\mu \ln(N^D/N^S) + \eta \tag{12}$$

where η is a stochastic error term with zero mean and constant variance. The presence of η reflects the agents' failure to predict with certainty the demand and supply consequences of their actions.

Differentiating (6) and (7) and solving for the logarithmic wage change gives:

$$\Delta \ln w = \frac{-\mu}{\varepsilon_D - \varepsilon_S} \cdot \ln(N^D/N^S) + \Delta \ln w^* + \eta^* \tag{13}$$

where $\Delta \ln w^*$ is given by Eq.(8) and where $\eta^* = \eta/(\varepsilon_D - \varepsilon_S)$. Obviously, η^* is homoscedastic by virtue of the homoscedasticity of η and the constant elasticity forms of the demand and supply equations.

The wage equation derived is suitable for estimating the extent of tax shifting. If labor supply is completely wage inelastic, only output price changes belong to the wage equation (with a coefficient equal to one); the coefficient for the payroll tax variable should indicate complete backward shifting (it would equal minus one). Of course, one might consider other mechanisms than labor supply responses that can produce significant consumer price terms in a wage equation. For example, unions may bargain in terms of real wages even if the individual workers have inelastic labor supply schedules.

The wage equation is of course not a reduced form; there are obvious reasons to expect higher wages to feed into higher prices. Suppose, for example, that the Aukrust-EFO price formation assumptions are valid. Suppose, furthermore, that wages set in the manufacturing sector according to Eq.(13) are transmitted throughout the economy, including the non-tradeable sector. A mark-up pricing rule in the latter sector implies the following feed-back mechanism from wages to prices:

$$\Delta \ln P_C = \Phi \Delta \ln P_Q + (1-\Phi)\Delta \ln\big(w(1+s)\big) \tag{14}$$

where Φ is the relative size of the tradeable sector. The payroll tax effects on wages and consumer prices, given by the reduced form, are then:

$$\frac{\partial(\Delta \ln w)}{\partial(\Delta \ln(1+s))} = -\frac{\varepsilon_D + (1-\Phi)\varepsilon_s}{\varepsilon_D - \Phi\varepsilon_s} \tag{15}$$

$$\frac{\partial(\Delta \ln P_C)}{\partial(\Delta \ln(1+s))} = -\frac{(1-\Phi)\varepsilon_s}{\varepsilon_D - \Phi\varepsilon_s} \tag{16}$$

It is clear that the extent of backward shifting is inversely related to the share of the non-tradeable sector. Taking account of the wage-price feed-backs implies that the estimated shifting coefficient in the wage equation will overstate the degree of backward shifting, simply because the "indirect" wage increasing effects arising from higher prices are ignored.

3. The Data

The data set has been put together from a variety of sources.[4] Wage rates, first, refer to average hourly earnings for adult male (blue-collar) workers in mining and manufacturing. A new aggregate wage measure has been constructed, adjusted for interindustry employment shifts and excluding overtime premiums. This measure should closely conform to actual wage rates, since changes in industry mix and overtime are controlled for. The employment weights are those of 1971 and the aggregate were computed from wage rates at the two-digit level.

Output prices were represented by the producer price index for mining and manufacturing (PPI) and consumer prices by the consumer price index (CPI). As a proxy for labor market tightness we used (the log of) de-trended output, $\ln(Q/\hat{Q})$, where Q is the index of volume of industrial production; $\hat{Q}$ was estimated by an exponential trend. As is well known, Swedish unemployment figures have for several years been unsatisfactory indicators of the demand pressure in the labor market, the most important reason being the unemployment preventing role played by the labor market policy. Unfortunately, there is no uniform series on unfilled vacancies available from the early 50s to date.

The payroll tax rate, s, refers to blue-collar workers and applies to wages inclusive of vacation and holiday pay. The income tax rate, t, is valid for a full-time male worker in mining and manufacturing.

Table 1 sets out some basic facts about inflation and tax rates in Sweden during the investigated period, 1950-79. The average real wage increase in terms of product prices has been about 4 percent per year; in terms of consumer prices, the real wage growth has amounted to 3.5 percent. Accounting for income tax changes, we observe an increase

Table 1 Taxes and inflation. Basic data for Sweden, 1950-79.

	Mean	Min	Max	Coeff. of variation
$100 \cdot \Delta \ln w$	8.9	4.1	18.7	39.4
$100 \cdot \Delta \ln PPI$	5.0	-8.8	30.1	139.1
$100 \cdot \Delta \ln CPI$	5.4	0.66	14.7	62.6
s	0.149	0.060	0.408	73.8
$100 \cdot \Delta \ln(1+s)$	0.95	-0.66	4.7	155.1
t	0.308	0.186	0.397	20.4
$100 \cdot \Delta \ln(1-t)$	-0.83	-4.7	6.6	286.2

in the workers' after-tax real wages by about 2.7 percent per year. Analogously, by accounting for payroll tax changes, an average increase of the firms' hourly real wage costs by 4.9 percent can be noted.

Payroll tax rates have increased from 6 percent in the early 50s to 40 percent in the late 70s. The relative increase in the payroll tax factor $\Delta \ln(1+s)$ - corresponding to the statutory wage cost increases implied by the payroll tax increases - has on average been almost 1 percent and at maximum amounted to 4.7 percent.

4. The Results

The basic model, given by Eq.(8) and modified in Eq.(13), has been estimated with and without the theoretical constraints imposed. OLS-estimates are given in Table 2 and the 2SLS-results in Table 3 (with current prices instrumented).[5] Possible changes in the trend growth of labor productivity (λ) are ignored; the same holds for changes in the labor supply trend (β_2). The estimated intercept thus captures the net effect of those productivity and labor supply factors. After some experiments with current and lagged price changes, only those displayed in the tables, were retained; lagged changes of CPI had coefficients with negative signs, which hardly are reasonable. Multicollinearity is, of course, not negligible in these cases.

A glance at the tables reveals results that very much are independent of estimation method. The estimated payroll tax coefficients are in the neighborhood of -0.5, with some variations depending on the type of restrictions imposed.[6] The

Table 2. Tax changes and wage inflation in Sweden. Estimation period 1951-79. OLS, (t-ratios in parentheses).

	(1)	(2)	(3)	(4)	(5)
Constant	0.052 (8.429)	0.053 (8.653)	0.055 (10.28)	0.040 (9.811)	0.036 (9.744)
$\Delta\ln(1+s)$	-0.492 (-2.301)	-0.465 (-5.169)	-0.496 (-6.412)	-0.641 (-2.831)	-0.444 (-4.544)
$\Delta\ln(1-t)$	-0.193 (-1.483)	-0.199 (-1.641)	-0.233 (-2.131)	-0.227 (-1.586)	-0.556 (-5.701)
$\ln(Q/\hat{Q})$	0.079 (2.404)	0.078 (2.530)	0.074 (2.481)	0.093 (2.596)	0.066 (1.733)
$\Delta\ln$ PPI	0.179 (2.538)	0.181 (2.636)	0.199 (3.172)	0.098 (1.427)	0.115 (1.511)
$\Delta\ln \text{PPI}_{-1}$	0.283 (6.415)	0.284 (6.772	0.297 (7.957)	0.262 (5.487)	0.329 (7.042)
$\Delta\ln$ CPI	0.306 (1.913)	0.297 (2.074)	0.233 (2.131)	0.640 (6.885)	0.556 (5.701)
R^2	0.896	0.896	0.894	0.868	0.819
1000•MSE	0.165	0.158	0.165	0.201	0.253
DW	1.74	1.74	1.79	1.47	1.72
F (restr.)	-	0.02	0.25	6.01	5.45
F (crit., 5%)	-	4.30	3.45	4.30	3.05

Note: The restrictions imposed on the coefficients in the last four columns are as follows:

Col. (2) $\Delta\ln \text{PPI} + \Delta\ln \text{PPI}_{-1} + \Delta\ln(1+s) = 0.$

Col. (3) $\Delta\ln \text{PPI} + \Delta\ln \text{PPI}_{-1} + \Delta\ln(1+s) = 0$, $\Delta\ln \text{CPI} + \Delta\ln(1-t) = 0.$

Col. (4) $\Delta\ln \text{PPI} + \Delta\ln \text{PPI}_{-1} + \Delta\ln \text{CPI} = 1.$

Col. (5) $\Delta\ln \text{PPI} + \Delta\ln \text{PPI}_{-1} + \Delta\ln(1+s) = 0,$

$\Delta\ln \text{PPI} + \Delta\ln \text{PPI}_{-1} + \Delta\ln \text{CPI} = 1,$

$\Delta\ln \text{CPI} + \Delta\ln(1-t) = 0.$

Table 3. Tax changes and wage inflation in Sweden. Estimation period 1951-79. 2SLS, (Δ ln PPI and Δ ln CPI instrumented).

	(1)	(2)	(3)	(4)	(5)
Constant	0.056 (6.968)	0.056 (7.445)	0.057 (9.696)	0.040 (9.501)	0.036 (9.421)
$\Delta \ln(1+s)$	-0.462 (-2.118)	-0.496 (-4.635)	-0.515 (-6.171)	-0.604 (-2.633)	-0.421 (-4.111)
$\Delta \ln(1-t)$	-0.186 (-1.380)	-0.180 (-1.409)	-0.188 (-1.520)	-0.246 (-1.701)	-0.579 (-5.659)
$\ln(Q/\hat{Q})$	0.075 (2.228)	0.077 (2.494)	0.076 (2.509)	0.093 (2.597)	0.066 (1.726)
$\Delta \ln PPI$	0.204 (2.365)	0.200 (2.496)	0.212 (3.130)	0.075 (1.039)	0.098 (1.241)
$\Delta \ln PPI_{-1}$	0.299 (5.949)	0.296 (6.507)	0.303 (7.970)	0.249 (5.013)	0.323 (6.715)
$\Delta \ln CPI$	0.205 (0.920)	0.227 (1.241)	0.188 (1.520)	0.676 (6.870)	0.579 (5.659)
R^2	0.889	0.890	0.888	0.889	0.810
1000•MSE	0.168	0.160	0.156	0.168	0.253
DW	1.79	1.78	1.80	1.79	1.73
F(restr.)	-	0.03	0.06	5.32	5.37
F(crit., 5%)	-	4.30	3.45	4.30	3.05

Note: The restrictions in columns (2), (3), (4) and (5) are the same as in Table 2. It should be noted that R^2 and MSE are computed by using the actual, rather than the predicted, values of the RHS endogenous variables. This explains why (unadjusted) R^2 does not necessarily decrease when restrictions are imposed.

restriction in column (2) forces the payroll tax coefficient to equal the negative of the output price parameters. This constraint appears to be consistent with the data, as is shown in the last two rows of the tables, and its imposition produces only minor changes in the payroll tax coefficient.

The restrictions on the price coefficients, corresponding to the absence of money illusion, is not upheld by the data, as is shown by the F-test in column (4) of the tables. This restriction is associated with some change of the payroll tax coefficient (roughly from -0.5 to -0.6). When all a priori restrictions are applied the estimated payroll tax parameter is around -0.4. A null-hypothesis pertaining to the joint validity of the theoretical restrictions is, however, rejected by the standard test.

The "best" equations, in terms of lowest mean square errors (or non-rejected restrictions), are those in column (2) and column (3) of the tables. A payroll tax coefficient located near -0.5 implies that an increase of the payroll tax factor, (1+s), by one percent is associated with a decrease of the money wage rate by approximately one half of a percent. Or, put differently, a percentage point increase of the payroll tax rate results in a money wage reduction of about 0.35 percent (assuming a payroll tax rate of 0.4).[7] The implied increase in the wage cost is, in fact, also around 0.35 percent under current conditions. This is obvious from the fact that

$$\frac{\partial(\ln w(1+s))}{\partial s} = \frac{\partial(\ln w)}{\partial s} + \frac{1}{1+s} \qquad (17)$$

which equals 0.35 under the given assumptions.

The basic message from the exercises is that <u>only a fraction of postwar payroll tax increases have been directly shifted back onto labor</u> as lower wage increases. Of course, the long-run incidence may still fall on labor, even if backward shifting within the current year is far from complete. There are several conceivable mechanisms that might prevent an ongoing fall in the profit-share; suffice it here to mention induced unemployment (with its impact effect on wage growth) and devaluations (affecting profit margins through output prices).[8]

Is the estimated wage equation robust across different periods? The period after 1972, including two oil price shocks, is of special interest. A straightforward application of the Chow-test did not indicate significant structural breaks between 1951-72 and the years thereafter. The payroll tax coefficient, with restrictions corresponding to those in column (2) imposed, was estimated to -0.5 by OLS on observations up to 1972.

How much of hourly labor cost increases can be attributed to payroll tax changes? Figure 1 shows the "contribution" in terms of yearly growth rates of the wage costs.Figure 2, next, gives the contribution of payroll taxes as a fraction of total <u>predicted</u> wage cost increases (i.e., predicted by means of the wage equation). The figures show the wage cost effects of payroll tax changes during the period 1955-79 ignoring feed-backs from wages to prices. To the extent that such feed-backs are important - and they are likely to be - the "simulations" presuppose compensating policies that keep price inflation unaffected.

Figure 1 reveals the mid-70s as a period with wage cost effects of payroll tax changes around one to two percentage points. A similar peak is found in 1960, associated with the introduction of the payroll-tax financed supplementary pension scheme (ATP). The latter change accounted for about one fifth of predicted wage cost increases in 1960. (Figure 2).

Among other results given in Tables 2 and 3, it can be noted that the coefficient for the retention ratio, (1-t), is negative, as expected, although estimated with fairly large standard errors. A parameter around -0.2 implies that a decrease in the retention ratio by one percent would increase wage rates (and hourly wage costs) by one fifth of a percent. Put differently, an increase of the income tax rate by one percentage point would produce an increase in wage rates by about 0.3 percent (assuming an income tax rate of 0.36). Needless to say, the interpretations are subject to qualifications, aside from the somewhat imprecise estimates. No account is, for instance, taken of changes in the progressivity of the tax system.[9]

It is noteworthy that we cannot reject the hypothesis of equal wage effects (in absolute value) from equal relative changes in consumer prices and the retention ratio. The estimates imply, using Eqs.

Figure 1. Increases in hourly wage costs attributable to payroll tax changes, 1955-79. Percentage points.

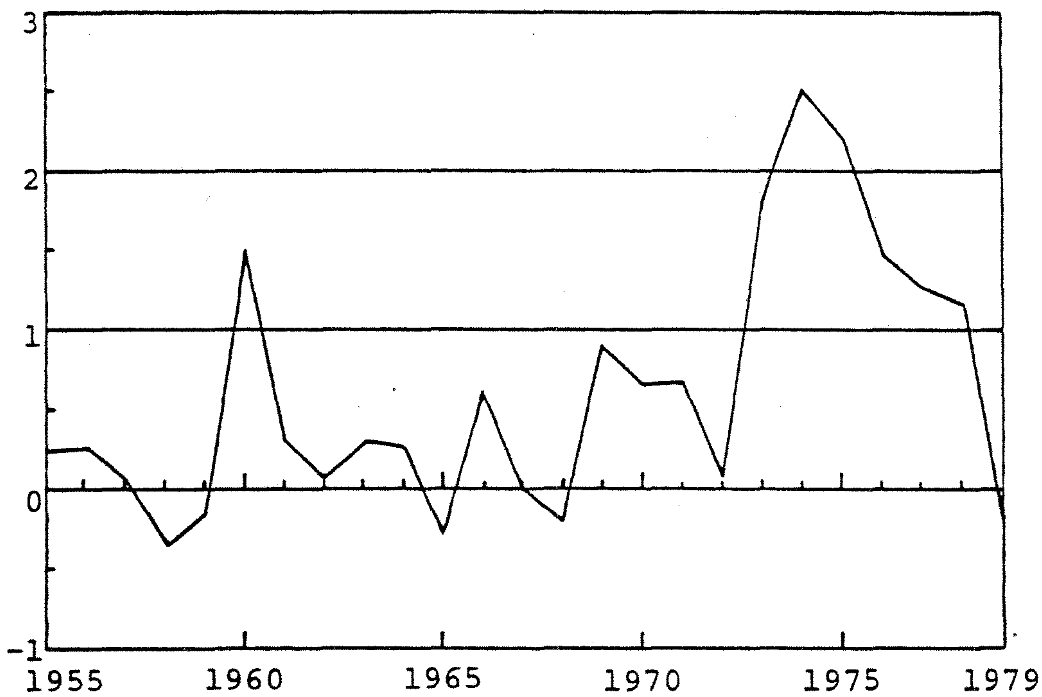
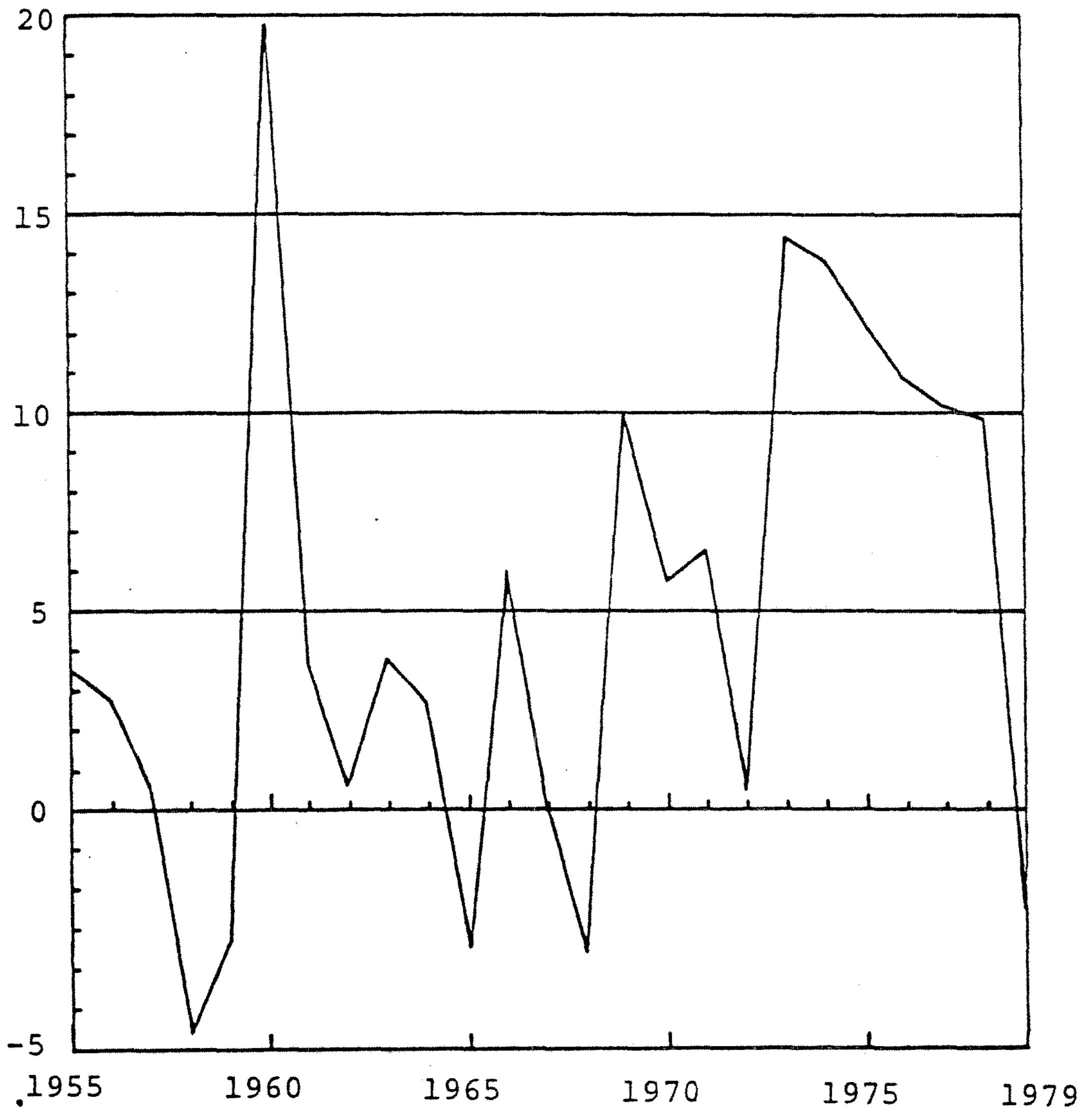


Figure 2. Fraction of predicted increases in hourly wage costs attributable to payroll tax changes, 1955-79. Percent.



Note: Predicted wage increases are from column (1) of Table 2.

(8) and (13), that $\varepsilon_D/\varepsilon_S \approx -2.5$ (given a payroll tax coefficient of -0.5 and a retention ratio coefficient around -0.2). This ratio appears to be of a reasonable magnitude; it should be of no surprise to find that the elasticity of labor demand is greater (in absolute value) than the elasticity of labor supply.

It can, finally, be observed that the output gap, $\ln Q/\hat{Q}$, generally performs well in the wage equations.[10] Taken at face values, the estimates imply that an increase in output (relative to trend) by one percent will increase wage inflation by slightly less than one tenth of a percentage point. The short-run "Phillips curve" is obviously very flat according to these estimates.

How sensitive are the basic results with respect to alternative proxies for labor market tightness? The results of some checks are given in Table 4. The variables considered are, in turn: (i) the overall rate of unemployment, RU, as well as its inverse; (ii) the unemployment rate for persons in manufacturing work, RU_m, and its inverse;[11] (iii) de-trended output with trend output determined by a quadratic trend, $\ln (Q/\hat{Q})_q$, as well as a cubic trend, $\ln (Q/\hat{Q})_c$ (estimated on data for 1948-79).

As is shown in the table, the unemployment variables have coefficients with expected signs, although the precision is far from impressive. The "best" labor market proxy (in terms of smallest MSE) is $\ln (Q/\hat{Q})_q$, i e, de-trended output where $\ln \hat{Q}$ is allowed to follow a quadratic trend. In fact, $\ln (Q/\hat{Q})_q$ outperforms also the basic linear representation of $\ln \hat{Q}$ that is used in Tables 2 and 3 above. The estimates of the payroll tax

Table 4. Alternative excess demand proxies - some tests

Excess demand proxy		$\Delta\ln(1+s)$	1000•MSE
RU	-0.010 (-1.398)	-0.315 (-1.397)	0.191
1/RU	0.040 (1.436)	-0.298 (-1.315)	0.190
RU_m	-0.005 (-1.222)	-0.320 (-1.406)	0.195
$1/RU_m$	0.033 (1.255)	-0.300 (-1.307)	0.194
$\ln(Q/\hat{Q})_q$	0.126 (2.915)	-0.508 (-2.494)	0.150
$\ln(Q/\hat{Q})_c$	0.307 (2.102)	-0.328 (-1.543)	0.173

Note: The table shows unrestricted OLS-estimates comparable to the first column of Table 2. The excess demand variables are measured as an average of values for the current and the preceeding year.

coefficients are affected by the choice of labor market proxies, but the basic conclusions remain intact: Only a fraction of post-war payroll tax increases appears to have been directly shifted back onto labor.

5. Concluding remarks

The rapid increases in Swedish payroll taxes, occuring especially during the 70s, were presumably based on the notion of backward shifting. The evidence given in this paper suggests that the payroll tax increases were partly shifted back as lower wage increases, but that this shifting was far from complete. The estimates indicate that about 50 percent of a payroll tax increase was directly shifted back within one year.

A complete macroeconomic analysis of payroll taxes should, of course, include more than just a wage equation. It seems quite clear that a profit squeeze arising from ongoing payroll tax increases will bring about various adjustment mechanisms, including policy actions. This is especially relevant in an open economy, where profitability targets mainly are exogenously determined and where the external balance sets strong limits for the development of labor costs. Labor will presumably bear the full burden of payroll tax increases in the long run, but it may take quite a while before the long run is reached.[12]

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FOOTNOTES

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1 Various efforts to estimate the relationships between payroll tax changes and wage inflation in the U.S. have appeared. See, e.g., papers by Perry (1970), Gordon (1971), Vroman (1974), Halpern and Munnel (1980), Hagens and Hambor (1979), Hamermesh (1979) and Bailey (1980).

2 For a short discussion of this asymmetry, see Holmlund (1981).

3 Empirical studies of wage formation in Sweden have usually included changes in the consumer price index (e.g., Jacobsson and Lindbeck, 1979) or the GNP-deflator (e.g. Jonung and Wadensjö, 1978) among the explanatory variables. Isachsen (1977), on the other hand, emphasizes the case for capturing changes in output prices.

4 The data are described in some detail in an Appendix.

5 The instruments -in addition to the "exogenous" variables of the wage equation - were: Changes in indirect taxes, import prices, labor productivity (net of cyclical effects, estimated by the peak-to-peak method), money supply (current and lagged M3) and, finally, changes in the consumer price index, lagged one year.

6 Experiments with lagged values of payroll tax changes were unsuccessful; all significance was placed on $\Delta\ln(1+s)$, without lags.

7 Note that

$$\frac{\partial(\Delta\ln w)}{\partial s} = \frac{\pi}{1+s}$$

where π is the estimated payroll tax parameter.

[8] Feldstein (1974) shows, by using a general equilibrium growth model, that the long-run incidence falls on labor irrespective of labor supply elasticities.

[9] A more elaborate analysis of income taxes and wage inflation is provided by Normann (forthcoming 1982).

[10] The applied output gap variable is an average of the gap for the current and the preceeding year.

[11] RU is the rate of unemployment according to the labor force surveys, chained to the unemployment rate for insured employees and the unemployment rate for union members, respectively. RU_m is given by the labor force surveys from 1963 and predicted by RU the years before; the predicting equation was obtained by regressing RU_m on RU for the period 1963-80.

[12] For some evidence on the speed of adjustment towards the long run, see Hamermesh (1980).

DATA APPENDIX

The basic data are given in Table A1 below. The variables are as follows:

w = hourly wage rate (Sw.öre) for adult male (blue-collar) workers in mining and manufacturing, adjusted for interindustry employment shifts and excluding overtime supplements. (Extra shift pay, holiday pay, lay-off pay and other wage supplements are included.) The employment weights applied refer to 1971.

Source: Official Statistics of Sweden: Wages.

PPI = producer price index for industrial products (geometric average of monthly figures). Breaks in the series are controlled for by using information from years where series overlap.

Source: Statistical Yearbook of Sweden.

CPI = consumer price index.

Source: Statistical Yearbook of Sweden.

s = payroll tax rate for adult male (blue-collar) workers in manufacturing. The tax rate was computed as follows:

1. $R_1 = \frac{\text{C-Wage}}{\text{B-Wage}}$,

where B-Wage is wages for time worked (including overtime supplements and extra shift pay) and C-Wage is B-Wage plus holiday pay, layoff pay and other wage supplements.

Source: Official Statistics of Sweden: Wages

2. $R_2 = \frac{\text{Total labor cost per hour}}{\text{B-Wage}}$,

where the numerator includes (all) wage supplements as well as payroll taxes. (Adult male workers in manufacturing).

Source: Swedish Employers' Confederation (SAF): "Wages and Total Labor Costs for Workers", various issues.

3. $s = R_2/R_1 - 1$,

which gives the payroll tax in relation to wages inclusive of all wage supplements (i.e., C-wages).

R_2 was available for 1952 and from 1957 to date. "Missing observations" in the early 50s were imputed by using information on effective payroll tax changes according to the national accounts (referring to employees in the tradeable sector, i.e., roughly mining and manufacturing). Sources in the latter case were unpublished tables from the National Central Bureau of Statistics (SCB).

t = average income tax rate (state and local) for a full-time male worker in mining and manufacturing. The series (up to 1978) were provided by Göran Normann. (The 1979 value was imputed by using the preliminary tax schedules).

Q= = index of volume of production in mining and manufacturing. (Trend output, $\hat{Q}$, was given by regressing lnQ on time for the period 1948-79.)

Source: Statistical Reports, various issues.

Table A1. Basic data

	w	PPI	CPI	s	t	Q
1949	-	55.231	100	-	-	38
1950	272	57.620	101	0.065	0.186	40
1951	328	77.863	117	0.064	0.223	43
1952	391	82.057	126	0.061	0.238	42
1953	411	75.165	128	0.062	0.213	43
1954	428	74.080	129	0.060	0.222	46
1955	461	77.797	133	0.065	0.243	49
1956	500	81.103	139	0.070	0.246	51
1957	529	82.990	145	0.071	0.252	53
1958	563	81.623	152	0.064	0.255	54
1959	587	80.629	153	0.061	0.276	58
1960	624	83.271	159	0.092	0.272	63
1961	675	85.110	163	0.098	0.281	68
1962	731	86.476	170	0.099	0.275	72
1963	784	88.171	175	0.105	0.282	76
1964	850	92.123	181	0.110	0.307	83
1965	936	95.336	190	0.103	0.327	80
1966	1016	98.541	202	0.116	0.338	93
1967	1100	99.202	211	0.116	0.354	95
1968	1173	99.856	215	0.111	0.363	100
1969	1270	103.646	221	0.130	0.378	107
1970	1411	111.210	236	0.144	0.397	114
1971	1553	113.750	254	0.158	0.356	115
1972	1724	119.201	269	0.159	0.384	118
1973	1885	133.488	287	0.199	0.375	127
1974	2106	165.176	316	0.257	0.373	133
1975	2470	177.995	347	0.310	0.367	131
1976	2784	192.858	382	0.346	0.375	130
1977	3014	209.383	426	0.378	0.361	123
1978	3284	223.718	469	0.408	0.364	121
1979	3640	247.446	502	0.402	0.360	129

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