Relations industrielles
Industrial Relations

Labour Hoarding and the Wage Share: Test of a Hypothesis
La réserve de travail et l'évolution cyclique de la part du travail

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Volume 34, numéro 1, 1979

URI : https://id.erudit.org/iderudit/028937ar
DOI : https://doi.org/10.7202/028937ar

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Éditeur(s)

Département des relations industrielles de l'Université Laval

ISSN

0034-379X (imprimé)
1703-8138 (numérique)

Découvrir la revue

Citer cet article

Marion, G. & Spencer, B. G. (1979). Labour Hoarding and the Wage Share: Test of a Hypothesis. *Relations industrielles / Industrial Relations*, *34*(1), 70–85. https://doi.org/10.7202/028937ar

Résumé de l'article

On observe généralement que les parts distributives du revenu national varient selon la conjoncture. En particulier, la part des profits a tendance à suivre le cycle économique, alors que celle des salaires subit des changements contra-cyclique.

Soit la relation suivante :

$$\frac{W}{y} = \frac{w}{P} \cdot \frac{E}{Q}, \text{ où}$$

W, représente la masse nationale des salaires; Y, le revenu national nominal; w, le taux de rémunération, p, un indice de prix; Q, la production en volume; E, l'emploi.

Partant de la constatation que w/p est plus stable, en courte période, que E/Q, certains chercheurs ont conclu que les changements dans E/Q sont à l'origine de l'évolution contra-cyclique de la part salariale. Comme E/Q est la réciproque de la productivité, il suit que l'évolution de la part salariale doit également refléter les changements de productivité. Mais pour qu'il en soit ainsi, celle-ci devrait alors croître dans les périodes de haute conjoncture et décroître dans les phases descendantes du cycle économique. Pourtant cette conclusion ne va pas dans le sens de la théorie de la productivité marginale de la répartition.

Dans une tentative pour résoudre cette contradiction R.M. Solow suggère que l'existence d'une réserve de travail, élevée en période de baisse et faible en période de forte conjoncture, donnerait à E/Q une allure contra-cyclique et expliquerait par le fait même la tendance de la part salariale, W/Y, à baisser lors des périodes de reprise économique et à augmenter lors d'un déclin de la conjoncture.

$$E^* = A\, y^{-\frac{1}{y}}\, e^{-\frac{ot}{y}}\, Qt^{\frac{1}{y}}$$

où o- est la base des logarithes naturels, p, y, A des paramètres et r une variable de tendance; également une fonction d'ajustement de court-terme,

$$\frac{E_t}{E_{t-1}} = \left(\frac{E^*_t}{E_{t-1}}\right)^{\lambda}$$

où X est le coefficient d'ajustement de courte période

$$\text{Ln } E_t = \partial_0 + \partial_1 \text{ Ln } Qt + \partial_2 \text{ Ln } \frac{E}{t-1} + \partial_3 T$$

où ∂_0 = constance

$$\partial_1 = \frac{\lambda}{\gamma}$$

$$\partial_2 = 1 - \lambda$$

$$\partial_3 = \lambda\left(\frac{}{\gamma}\right)$$

Les résultats de notre étude sont à l'effet que la réserve de travail est un important facteur d'explication de l'évolution cyclique de la part du travail. Nous ne nous prononçons pas sur l'hypothèse que la rigidité des salaires à la baisse pourrait être une cause de changements dans la répartition des revenus, nous donnons cependant à l'emploi un rôle important dans les variations de court terme des parts distributives.

Labour Hoarding and the Wage Share
Test of a Hypothesis

Gerald Marion
and
Byron G. Spencer

The authors seek to build on the work of Ball and St. Cyr, Smith and Ireland, Solow, and others, in order to estimate the assessment of labour hoarding and test the relationship between labour hoarding and the wage share.

It is well known that the shares of capital and labour in the total product do not remain constant over the trade cycle. In particular, profits vary pro-cyclically, while the wage bill varies counter-cyclically.

Consider the following expression for the labour share: $\frac{W}{Y} = \frac{w}{p} \cdot \frac{E}{Q}$, where W is the aggregate wage bill, Y is the value of output, Q is the level of total physical output, w is the average money wage rate, p is the price level, and E is the number employed. It has been observed that w/p is more stable over the cycle than is E/Q, which leads one to focus on the latter for an explanation of the cyclical response of the wage share.[1] Moreover, since the inverse of E/Q is output per man, the cyclical variations in labour's share must be largely a reflection of short-run changes in productivity. Thus E/Q must be falling on the upswing (i.e., productivity must be rising) and rising on the downswing (i.e., productivity must be falling). While this conclusion is consistent with the

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** The study was undertaken while the authors were senior visitors to the Faculty of Economics and Politics, Cambridge University, during the academic year 1973-74. Without holding them responsible, they are grateful to their colleagues at Cambridge University, at the Université de Montréal and at the McMaster University for comments. They also with to thank Karen Scott for research assistance.

[1] Supporting evidence is provided in KUH (1960) and NIELD (1963).

facts, it does not appear to be consistent with the marginal productivity theory of distribution.[2]

Recent studies have attributed the pro-cyclical movement in product per man to the practice of labour hoarding.[3] Solow has suggested that the phenomenon of labour hoarding might be reconciled with the marginal productivity theory of distribution by taking into account the trade-off between the costs associated with hiring and firing (which would include training costs and severance pay) and the costs associated with hoarding.[4] In the same article Solow also suggested that the practice of labour hoarding would help to explain the counter-cyclical movement in the wage share in national income.

It is the purpose of this paper to build on the work of Ball and St. Cyr (1966), Smyth and Ireland (1967), Solow (1968), and others, in order to estimate the amount of labour hoarding and then test the relationship between labour hoarding and the wage share.

We start, in section 2, by deriving short-run labour requirements (or employment) functions based on alternative specifications of the aggregate production function. A measure of labour hoarding is derived, and estimates are presented. In section 3 we consider the relationship between the wage share and labour hoarding, and present some estimates. Finally, in section 4, we conclude.

DERIVATION AND TESTING OF AN AGGREGATE SHORT-RUN EMPLOYMENT FUNCTION

The common means of establishing the amount of labour required to produce a certain level of output is to assume the existence of an

[2] A word on the other component of the wage share, the real wage $\frac{w}{p}$, has its place here. In the traditional view, short-run variations of the wage share $\frac{W}{Y}$, were thought to be positively related to and explained by the cyclical variations of real wages. Indeed, according to the marginal productivity theory, as applied to cyclical variations in real wages, and expounded in the writings of MARSHALL (1920), KEYNES (1936, p. 10) and RUEFF (1951), real wages will fall when the economy is on the upswing, and rise when the economy is on a downswing. Subsequent empirical investigations have not supported Keynes' 1936 hypothesis; rather they have found that real wages tend to vary pro-cyclically, if at all. See, for example, DUNLOP (1938), TARSHIS (1938), and BODKIN (1969). It should be noted however, that Keynes later took pains to say that his position takes into account only those changes in real wages which are brought about by changes in effective demand. Changes in wages which are the result of conditions governing the wage bargain are less predictable. See Keynes (1939, p. 35).

[3] See, for example, SOLOW (1968).

[4] In a 1968 article, SOLOW refers to « the widely, if casually, discussed notion of 'labour hoarding' » [Solow (1968, p. 456)]. The concept is defined below.

aggregate production function. At any time the stock of capital and the state of technology are fixed, while their change over time is approximated by an exponential time trend. Below we consider the implied labour requirements functions under two alternative assumptions of the short-run aggregate production function. It turns out that the estimating equations are identical, though the interpretation of the results depends on the underlying production function. We then proceed to compare the amount of labour actually employed at each level of observed production with the level implied by the labour requirements function; the difference is taken as a measure of labour hoarding.

Consider first the short-run Cobb-Douglas function which may be written as

$$Q_t = Ae^{\rho t}(E_t)^{\gamma} \tag{1}$$

where Q is the level of total output, E is total employment, t is time, e is the base of natural logarithms, and A, ρ, and γ are parameters. We may solve (1) for the level of labour requirements, E_t^*, associated with the (given) current level of output.

$$E_t^* = A^{-\frac{1}{\gamma}} e^{-\frac{\rho t}{\gamma}} Q_t^{\frac{1}{\gamma}} \tag{2}$$

If, in general, the amount of labour employed does not adjust instantly to changes in the level of output, but instead follows a partial adjustment sequence from the actual to the desired level, then we may write (3), where λ is the coefficient of partial adjustment:[5]

$$\frac{E_t}{E_{t-1}} = \left(\frac{E_t^*}{E_{t-1}}\right)^{\lambda} \tag{3}$$

Substitution of (2) into (3) yields a solution for the observed employment each period as a function of current production and past employment, as well as the time trend. Expressed in log linear form, we have

$$\ln E_t = \alpha_0 + \alpha_1 \ln Q_t + \alpha_2 \ln E_{t-1} + \alpha_3 t \tag{4}$$

where α_0 = constant

$$\alpha_1 = \frac{\lambda}{\gamma}$$

$$\alpha_2 = 1 - \lambda$$

$$\alpha_3 = \frac{\lambda}{\gamma}\rho$$

[5] If one use a formal model of costs adjustment to derive equation (2), it can then be shown that equation (2) takes into account the adjustment for hours worked. See, BRECHLING, (1975), Ch. V.

Equation (4) is the usual estimating form. Ball and St. Cyr (1966) derived the same equation by starting with total hours worked in the production function (rather than numbers employed), and applying a cost-minimization procedure as well as the adjustment function (3). Based on (4), one may estimate the labour share, γ, the coefficient of adjustment, λ, and the rate of technical progress, ρ.

Alternatively, we may start with a short-run CES production function[6]

$$Q_t = \epsilon^{\rho t} A[a(E_t)^{-\omega}]^{\frac{\nu}{\omega}}$$

Again, we may solve for the desired level of employment at each level of output,

$$E_t^* = B\, e^{-\frac{\rho t}{\nu}} Q_t^{\frac{1}{\nu}} \tag{6}$$

Applying the partial adjustment equation (3), and expression it in log linear form, we obtain

$$\ln E_t = \delta_0 + \delta_1 \ln Q_t + \delta_2 \ln E_{t-1} + \delta_3 t \tag{7}$$

where δ_0 = constant

$$\delta_1 = \frac{\lambda}{\nu}$$

$$\delta_2 = (1 - \lambda)$$

$$\delta_3 = \frac{\lambda\rho}{\nu}$$

[6] The short-run specification of the CES production function is suggested in SMYTH and IRELAND (1967) on the basis outlined in the text: an alternative derivation is to start with the CES function,

$$Q_t = e^{\rho t} A_1 [a(E_t)^{-\omega} + (1-a)(Ku_t)^{-\omega}]^{-\nu/\omega}$$

and rewrite is as

$$Q^{-\frac{\omega}{\nu}} = e^{-\frac{\omega}{\nu}\rho t} A_1^{-\frac{\omega}{\nu}} a(E)^{-\omega} \left[1 - \frac{(1-a)(Ku_t)^{-\omega}}{a(E_t)^{-\omega}}\right]$$

If one assumes that the short-run ratio of utilized capital to employment, Ku/E is constant, then the function may be written as

$$Q_t = e^{\rho t} A[a(E_t)^{-\omega}]^{-\nu/\omega}$$

which is the form presented in equation (5).

Clearly equation (7) has the same form as (4), but in the case of (7) one would interpret the parameter estimates in terms of ν, the returns to scale (rather than γ, the labour share) as well as λ, the coefficient of adjustment, and ρ, the rate of technical progress. Smyth and Ireland (1967) have demonstrated that (7) also results from the application of the Ball and St. Cyr cost minimizing procedure along with the employment adjustment function (3) to a CES production function, provided that one is willing to make the assumption that "the ratio of percentage change in manhours worked to the percentage change in capital *in use* is a constant».

In Table 1, we report estimates of equation (4) or, equivalently, equation (7), based on experience in Canada, the United Kingdom, and the United States. The data are all drawn from standard sources, as indicated in the notes to Table 1. All data are quarterly and, except for the U.S. production variable, all data are seasonally unadjusted.[7] The estimated coefficients are obtained by ordinary least squares, which, in view of the simultaneity problem, will result in some bias in the coefficients.[8]

For all three countries we note that the estimated coefficients for gross product and lagged employment bear the expected sign, and that they are highly significant. We note also that the estimates are generally in line with those reported elsewhere. The overall measure of goodness of fit, $\bar{R}^2$, is very high, and there is no suggestion of problems with serial correlation, as indicated by the value of the Durbin test, m. The dummy variable entered in the case of the UK, D_{UK} is intented to capture the effect of the Selective Employment Tax.[9] It appears to perform very well. However, the estimated coefficients for the time trend raise some difficulties. It bears the right sign in the case of Britain and U.S., but is non-significant in the latter case. For Canada, it bears the wrong sign,

[7] In the case of the U.S. production, it appears that the relevant series, unadjusted for seasonality, are not available.

[8] While it would be possible to obtain 2SLS estimates for the employment function, the appropriate set of exogenous variables would differ from one country to another. Rather than attempt to define such a set of exogenous variables for each of the countries, we have limited our estimates to OLS.

[9] In the United Kingdom, the Redundancy Payment Act came into effect in December, 1965, and the National Insurance Act in October, 1966. According to GUJARATI (1972), the impact of these acts on labour market adjustments dates roughly from the fourth quarter of 1966. This view is supported by SLEEPER (1970), though for different reasons. Thus, we define the variable D_{UK} to have a value zero up to and including the third quarter of 1966, and a value one thereafter.

TABLE 1

The Employment Function

$$\ln E_t = \alpha_0 + \alpha_1 \ln Q_t + \alpha_2 \ln E_{t-1} + \alpha_3 t + \alpha_4 D_1 + \alpha_5 D_2 + \alpha_6 D_3 + \alpha_7 D_{UK}$$

	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	λ	ρ	$\nu(\gamma)$	R^2	m
Canada	2.25	.241	.607	.0002	−.014	.032	.038		.393	−.0008	1.631	.9986	−0.20
1953-71	(6.00)	(7.24)	(11.27)	(.59)	(5.01)	(8.35)	(14.98)						
United Kingdom	.269	.070	.913	−.0004	.003	.008	.006	−.007	.087	.0057	1.243	.981	−0.04
1955-71	(.88)	(2.51)	(24.2)	(2.01)	(1.49)	(5.92)	(4.50)	(3.70)					
United States	1.74	.109	.782	−.0002	−.016	.033	.024		.218	.0018	2.000	.993	0.07
1953-71	(3.45)	(3.91)	(15.2)	(.79)	(6.89)	(10.7)	(10.3)						

Definitions of Variables

Canada: E, non-agricultural employment; Q, real domestic product, less agriculture.
United Kingdom: E, civilian employment; Q, gross domestic product at 1963 prices.
United States: E, civilian employment; Q, gross national product at 1958 prices, seasonally adjusted.
D_1, D_2 and D_3; seasonal dummy variables.
D_{UK} : dummy variable assuming the value 1 from 1966-IV to 1971-IV, and 0 otherwise. Applies to UK only.
m is value of the test statistic which Durbin proposed to detect serial correlation when a lagged dependent variable is present. See Durbin (1970). The test involves regressing the calculated residual on its lagged value and the set of predetermined variables, then testing the value of the t-ratio associated with the lagged residual (here called m) against the standard normal deviate.

Data Sources

Canada: CANSIM data tape, April, 1973.
United Kingdom: *Economic Trends*, October issues, 1966-1973; *British Labour Statistics*, 1971, 1970, 1969, and *Historical Abstract*.
United States: *Survey of Current Business*, various issues to 1973.

but is non-significant. Finally, we note that the estimates of ν (or γ) exceed 1 in the case of all three countries. Such estimates are consistent with the results reported in the studies mentioned earlier; clearly they demand the short-run-returns-to-scale (ν) interpretation, inasmuch as labour's share (γ) cannot exceed 1. Recently Ireland, Briscoe, and Smyth (1973) have provided further evidence in support of the former interpretation, and have argued that short-term returns to scale of this magnitude are quite credible.

Rather than comment further on the estimates, we now proceed to use them to obtain a measure of labour hoarding, which was their intended purpose.

LABOUR HOARDING AND THE WAGE SHARE

We turn now to the relationship between labour hoarding and the wage share.

As a measure of labour hoarding, it is natural to think in terms of the difference between the observed level and the desired level of employment (as defined by equation (2) or (6)). That is, to use $(E_t - E_t^*)$. To avoid the problem of units, we work with proportions, and define the measure of labour hoarding in equation (8).

$$H_t = \left(\frac{E_t - E_t^*}{E_t}\right) \tag{8}$$

The value for the desired level of employment is obtained from the estimated relationship (4) (or, equivalently, (7)) by dividing the coefficients by λ. Specifically, the desired levels are obtained from the following equations:

Canada

$$\ln E_t^* = \frac{2.25}{.393} + \frac{.241}{.393} \ln Q_t + \frac{.0002}{.393} t - .014\, D_1 + .032\, D_2 + .038\, D_3$$

United Kingdom

$$\ln E_t^* = \frac{.269}{.087} + \frac{.070}{.087} \ln Q_t - \frac{.0004}{.087} t + .003\, D_1 + .008\, D_2 + .006\, D_3 - .007\, D_{UK}$$

United States

$$\ln E_t^* = \frac{1.74}{.218} + \frac{.109}{.218} \ln Q_t - \frac{.0002}{.218} t - .016\, D_1 + .033\, D_2 + .024\, D_3$$

In figures 1-3, we display the derived measures of H_t for Canada, the UK, and the U.S.A. In all three cases there appears to be a pronounced cyclical movement in the series, which is as we would expect.[10]

Our concern is to investigate the extent to which changes in the amount of labour hoarded may explain the counter-cyclical pattern of changes in the wage share. The approach we adopt is to assume a linear relationship of the form specified in equation (9), and to estimate it by ordinary least squares.

$$\frac{W}{Y_t} = \beta_0 + \beta_1 H_t \tag{9}$$

The hypothesis is that the greater the extent of labour hoarding, the greater the wage share. Thus, the Solow hypothesis would receive support if β_1 is significantly greater than zero.

Consider now the definition of the wage share, W/Y. On the basis of theoretical considerations, the denominator should be a measure of *net* income — that is, gross production less the amount necessary to provide for replacement of capital. One might approximate this concept with the published measure of net national income. However, for the UK, no published series net of depreciation is available, and we have instead used «total domestic income». To facilitate comparisons, we have, therefore, made two sets of estimates for both Canada and the USA, making use of the published series for (net) national income and for gross national product. For Canada, where the agricultural component of income is both quantitatively important and extremely volatile, the income figures used are net of farm income. Moreover, the estimates include a time trend and seasonal dummy variables, which have been added to equation (9). The values reported are those obtained in a second round, after adjusting for first-order autocorrelation of the residuals.

It appears that the equations have considerable explanatory power for all three countries, and for both definitions of national income. Thus,

[10] The values for H which are plotted for each of the countries are not precisely those suggested by equation (8). In order to reduce the amount of seasonal fluctuation remaining in the series, the H variable of equation (8) was regressed on a time trend and seasonal dummy variables. The values plotted in the figures and used in the subsequent estimation are «seasonally adjusted», in that they are the difference between H_t and the seasonal factor. This adjustment has no effect on the estimated coefficients of any of the variables in equation (9), below, except, of course, the coefficients of the seasonal dummy variables themselves.

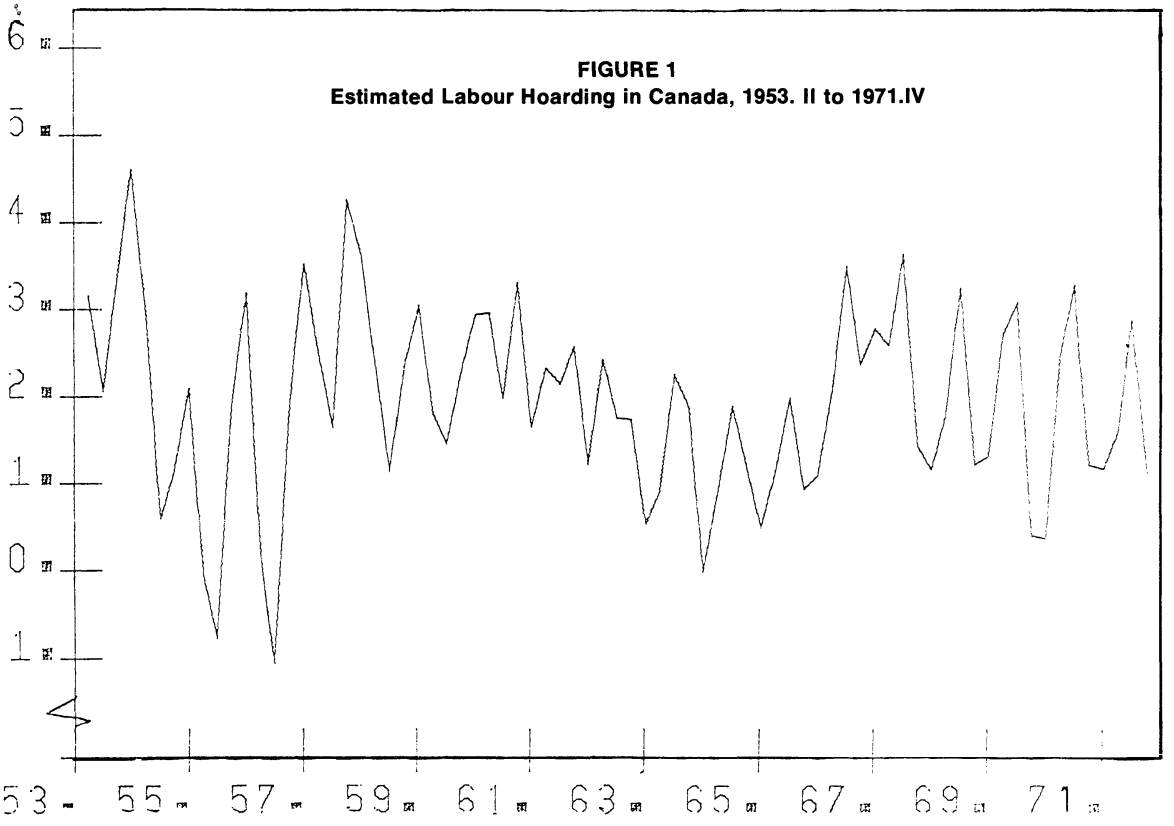

FIGURE 1
Estimated Labour Hoarding in Canada, 1953. II to 1971.IV

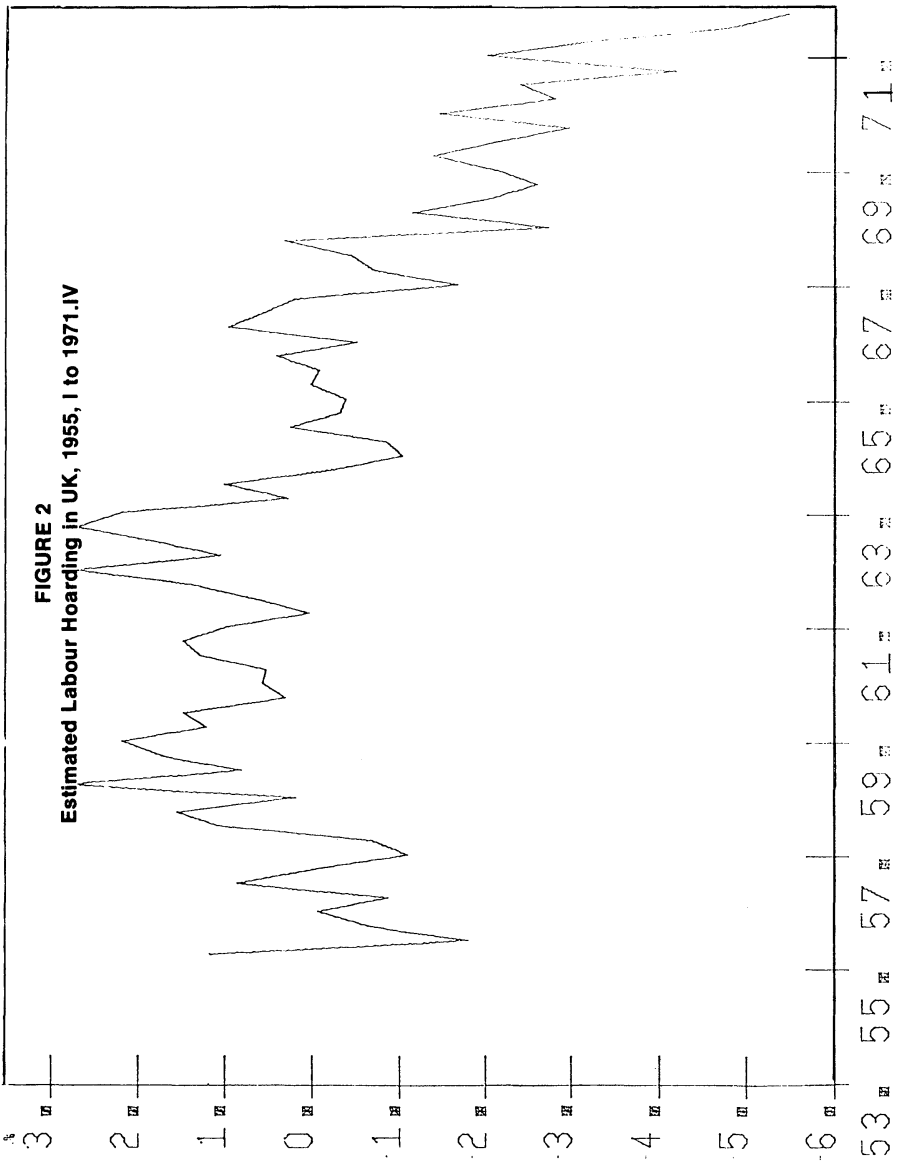

FIGURE 2
Estimated Labour Hoarding in UK, 1955, I to 1971.IV

FIGURE 3
Estimated Labour Hoarding in US, 1953.II to 1971.IV

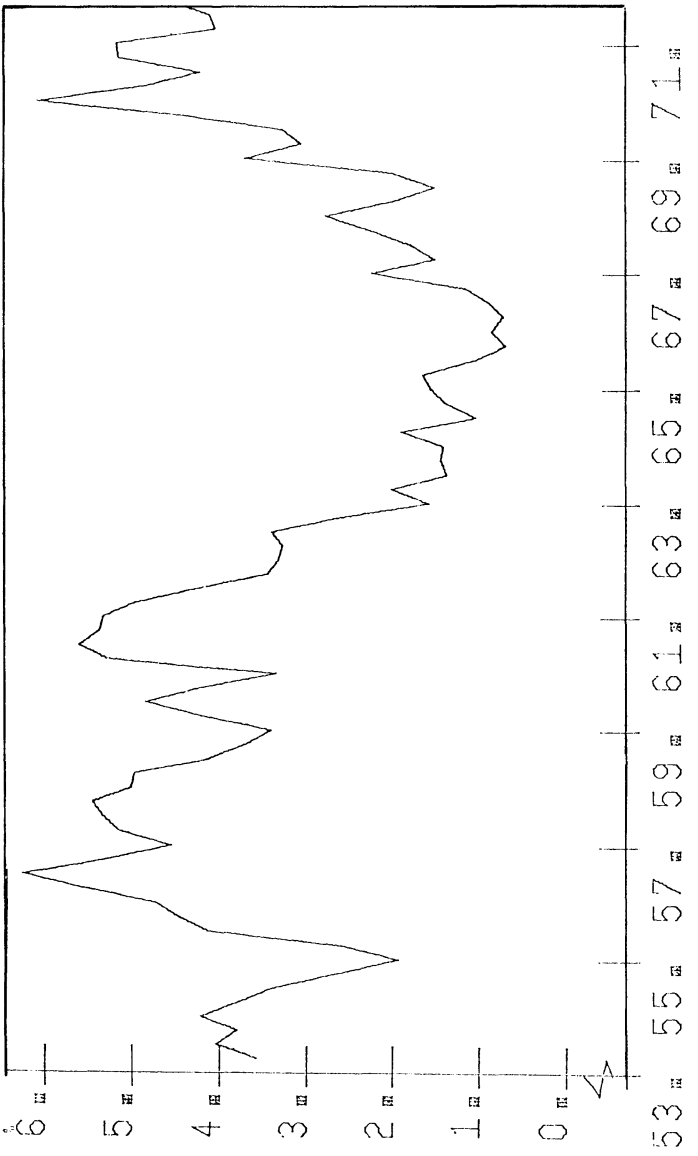

TABLE 2

Estimates of the Wage Share Equation

$$\frac{W}{Y} \beta_0 \ldots \beta_1 Ht + \beta_2 t + \beta_3 D_1 + \beta_4 D_2 + \beta_5 D_3$$

	β_0	β_1	β_2	β_3	β_4	β_5	$\bar{R}^2$	d.w.
Canada								
W/Y_1	.660	.350	.0005	.012	−.016	.000	.840	1.77
	(235.)	(5.17)	(13.4)	(5.92)	(7.89)	(0.12)		
W/Y_2	.490	.151	.0002	.024	.004	.012	.777	1.95
	(163.)	(2.88)	(6.44)	(13.6)	(2.48)	(7.19)		
United Kingdom								
W/Y	.643	.169	.0002	.010	−.000	.011	.510	1.96
	(242.)	(2.63)	(4.04)	(4.95)	(0.04)	(5.66)		
United States								
W/Y_1	.628	.488	.0006	−.003	−.003	−.002	.827	1.98
	(218.)	(7.15)	(18.5)	(1.79)	(1.64)	(1.10)		
W/Y_2	.522	.415	.0005	−.002	−.002	−.001	.828	1.97
	(236.)	(8.32)	(18.4)	(1.52)	(1.05)	(0.96)		

Definitions of Variables

Canada: W, wages, salaries and supplementary labour income, less wages and salaries in agriculture; Y_1, net national income at factor cost, less accrued net income of farm operators from farm production, less wages and salaries in agriculture; Y_2, gross national product at market prices, excluding accrued net income of farm operators.

United Kingdom: W, all income from employment, less forces' pay; Y, total domestic income.

United States: W, compensation of employees less military wages and salaries, seasonally adjusted; Y_1, national income, seasonally adjusted; Y_2, gross national product, seasonally adjusted. D_1, D_2, and D_3; seasonal dummy variables.

Data Sources

See Table 1.

the estimates support the hypothesis that the wage share is significantly and positively related to the extent of labour hoarding. For Canada and the United States, for example, the estimates imply that a 1 percent increase in labour hoarding (H) would increase the wage share (W/Y_1) by one-third and one-half percent respectively. The estimated β_1 coefficient is lower under the Y_2 than under the Y_1 income definition, as we would expect. The impact of labour hoarding on the wage share appears to be greatest in the U.S. and least in the U.K. However, differences in measurement concepts and practices mean that such statements must be made with care.[11]

CONCLUDING REMARKS

Our study supports the conclusion that the volume of labour hoarding is a significant factor in explaining cyclical movements of the wage share. While our results do not reject the hypothesis that the relative inflexibility (or « stickiness ») of money wages is a fundamental source of changes in income distribution over the cycle, they do assign to the side of employment and labour demand an important role in the short-run changes in income distribution.

[11] PEEL, BRISCOE and HOLDEN (1974) have tested a model of the wage share, using UK data, in which the wage share is a function of output per man-hour and output. Their results are generally good. For example, in the case of « all manufacturing » the R^2 value is .89; at the same time, the output-per-man-hour variable is only on the margin of being significant with a value of 1.806.

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La réserve de travail et l'évolution cyclique de la part du travail

On observe généralement que les parts distributives du revenu national varient selon la conjoncture. En particulier, la part des profits a tendance à suivre le cycle économique, alors que celle des salaires subit des changements contra-cyclique.

Soit la relation suivante:

$$\frac{W}{y} = \frac{w}{p} \cdot \frac{E}{Q}, \text{ où}$$

W, représente la masse nationale des salaires; Y, le revenu national nominal; w, le taux de rémunération, p, un indice de prix; Q, la production en volume; E, l'emploi.

Partant de la constatation que w/p est plus stable, en courte période, que E/Q, certains chercheurs ont conclu que les changements dans E/Q sont à l'origine de l'évolution contra-cyclique de la part salariale. Comme E/Q est la réciproque de la productivité, il suit que l'évolution de la part salariale doit également refléter les changements de productivité. Mais pour qu'il en soit ainsi, celle-ci devrait alors croître dans les périodes de haute conjoncture et décroître dans les phases descendantes du cycle économique. Pourtant cette conclusion ne va pas dans le sens de la théorie de la productivité marginale de la répartition.

Dans une tentative pour résoudre cette contradiction R.M. Solow suggère que l'existence d'une réserve de travail, élevée en période de baisse et faible en période de forte conjoncture, donnerait à E/Q une allure contra-cyclique et expliquerait par le fait même la tendance de la part salariale, W/Y, à baisser lors des périodes de reprise économique et à augmenter lors d'un déclin de la conjoncture.

$$E^* = A^{-\frac{1}{\gamma}} e^{-\frac{\sigma\tau}{\gamma}} Q_t^{\frac{1}{\gamma}}$$

où σ est la base des logarithes naturels, ρ, γ, A des paramètres et τ une variable de tendance; également une fonction d'ajustement de court-terme,

$$\frac{E_t}{E_{t-1}} = \left(\frac{E^*_t}{E_{t-1}}\right)^{\lambda}$$

où λ est le coefficient d'ajustement de courte période

$$\text{Ln } E_t = \partial_0 + \partial_1 \text{ Ln } Q_t + \partial_2 \text{ Ln } \frac{E}{t-1} + \partial_3 \tau$$

où $\partial_0 = \text{constance}$

$$\partial_1 = \frac{\lambda}{\gamma}$$

$$\partial_2 = 1 - \lambda$$

$$\partial_3 = \left(\frac{\lambda}{\gamma}\right)$$

Les résultats de notre étude sont à l'effet que la réserve de travail est un important facteur d'explication de l'évolution cyclique de la part du travail. Nous ne nous prononçons pas sur l'hypothèse que la rigidité des salaires à la baisse pourrait être une cause de changements dans la répartition des revenus, nous donnons cependant à l'emploi un rôle important dans les variations de court terme des parts distributives.