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# Wage Formation, Employment and Output in Barbados[1]

## INTRODUCTION

An analysis of the labour force and of the determinants of employment is central to the policymaker's understanding of the process of real output determination in any economy. In Barbados, much of the work on the labour force takes the form of one-period employment surveys. A noted example of this is the seminal work by Cumper [6]. There is a noticeable dearth of studies on what determines employment and wages in Barbados. The exception is the study by Downes and McClean [8]. However, in our opinion, their interesting and insightful theoretical discourse on the effect of the bargaining process on money wage determination still requires broader empirical support.

In the Caribbean region, as a whole, there have been interesting studies on the determinants of wages and employment. The very interesting works by Farrell [9]; St. Cyr [14] and Brown [5] merit special mention. However, apart from St. Cyr, the others discuss the issues of wages and employment in general terms. The little contribution expected of this paper is the empirical support it attempts to lend to some of the issues discussed.

The paper attempts an analysis of the labour and commodity markets in Barbados. It explores some of the main forces that seem to influence changes in wages, employment and real output in the economy in a simultaneous equation context. The organisation of the paper is as follows. First, we outline the framework of the model and then we

discuss the empirical estimates, including a review of data definitions, measurements and sources.

## A FRAMEWORK FOR THE ANALYSIS

A two-sector model is adopted for the analysis. We distinguish between traded and nontraded goods and services in the economy. The latter are basically home goods and services that do not enter into international trade. They encompass nonsugar agriculture, utilities and all services other than those arising from tourism. The tradable goods and services are traded in the international markets, but they also compete with nontradables for domestic resources in production and, to some extent, consumption.

Figure 1 illustrates the behaviour of the relative price of nontradables to tradables over the period 1958 to 1980. The diagram clearly shows a sufficiently large upward movement in the ratio over the reference period. This variability of the relative price ratio provides enough justification for the separate treatment of tradables and nontradables in the paper.

### The Wages and Employment Functions

Given the importance of trade unions in wage setting in Barbados, a wage model that takes explicit account of union power in addition to traditional variables such as expectation of future price movements, productivity and the state of the labour market would be the ideal choice. Unfortunately, we have been unable to obtain a series on trade union membership to serve as a useful proxy for union assertiveness. In addition, the alternative proxies such as the average real earnings or real wages that have been employed by such authors as Ormerod [13] and Brooks and Henry [4] are not supported by formal theoretical justification to encourage their use. Trade union influence in the determination of wages is, thus, only implicit in this paper.

We take the view that during negotiations, trade unions push to recoup losses in real wages brought about by inflationary pressures. Changes in nominal wages in the traded sector are assumed to be influenced by expected price changes and labour market conditions. The higher the unions perceive future price movements, the harder they are likely to push for higher wage demands. Firms are also encouraged to raise wages, the higher the price they expect to get for their products and the higher the level of workers' productivity. The latter is an important determinant of firms' profitability and a good indicator to workers of their contribution to the progress of the firms. However, wage demands by workers are likely to be moderated by any slackness in the labour market brought about by recessionary conditions in the economy. The unemployment rate represents labour market conditions. Therefore, we specify changes in nominal wages in the traded sector by the expression:

$$\dot{WT} = F_1((\dot{P}_{-1}^{+} + \lambda T), \bar{U}) \qquad (1)$$

where $WT$ = nominal wage index in the traded sector;

$P_{-1}$ = domestic price level lagged one period (a proxy for price expectation)

$U$ = the unemployment rate

$\lambda T$ = the trend rate of increase in labour productivity (real output per man) in the traded sector.

We anticipate strong wage impulses to pass from the traded to the nontraded sector, as the former is considered the leading sector in the wage determination process. Therefore, in addition to the above variables explaining wage movements in the nontraded sector, we include changes in the traded sector wage. Nominal wage changes in the nontraded sector is expressed functionally as:

$$\dot{WN} = F_2((\dot{P}_{-1}^{+} + \lambda N), \bar{U}, \dot{WT}^{+}) \qquad (2)$$

*Dots on top of variables represent percentage changes and the sign on the variables indicate expected direction of influence on the dependent variable.

where WN = nominal wage index in the non-traded sector, and

$\lambda N$ = the trend rate of increase in labour productivity in the nontraded sector.

Recent research into the determinants of employment in the Caribbean support the traditional orthodoxy that real output and real wages are the main determinants of employment in the region.[2] Our initial exploratory work with data in Barbados also confirmed this view (see footnote 7). However, Farrell also identifies other factors such as the extent of capital availability, production technology, organizational technology and infrastructure as some of the other crucial factors that determine employment in the Caribbean. We tend to agree with him and, so, in this study, we have, specifically, attempted to test this empirically. We believe that, in general, all the above factors may be grouped together and represented by a composite capital good. In other words, our definition of capital encompasses machinery, transport equipment, factory shells available to investors and infrastructure. Also, while capital may be both a substitute and a complement to labour in the production process, we contend that the former situation may arise only in the long term. When a factory is built, and machinery installed, the stock of capital in place becomes a complementary factor to labour services in the production process.[3]

We specify the demand for labour as dependent on the real stock of capital adjusted for capacity utilisation, the real wage and employment in the previous period. For the two sectors we have:

$$LET = F_3(\overset{+}{CP}.KT, \overset{-}{WT/PT}, \overset{+}{LET_{-1}}) \qquad (3)$$

and

$$LEN = F_4(\overset{+}{CP}.KN, \overset{-}{WN/PT}, \overset{+}{LEN_{-1}}) \qquad (4)$$

where KT,KN = the stock of capital in the traded and nontraded sectors;



PT,PN = the indexes of prices in the traded and nontraded sectors; and

CP = an index of capacity utilisation.

The lagged endogenous variables are included because firms usually make only partial adjustment in the labour force to a desired level in each period.[4]

While economic factors may be important in determining labour supply within sectors, in the aggregate, they play a secondary role to noneconomic factors. We assume that it is the demographic factors that principally determine aggregate labour supply. That variable is, therefore, considered exogenous in the model. Expression (10) establishes the equilibrium condition in the labour market. It is postulated on the implied assumption that labour demand is always satisfied.[5]

For all the commodities traded by Barbados in the international markets, the smallness of its participation means that it is a price taker in these markets. Therefore, the price received for tradable goods and services is exogenous and real output in the sector is mainly determined by supply conditions in the market. Output of tradables is expected to be sensitive to the prevailing market prices, the cost of variable factors of production, and the level of real investment in capital and intermediate goods. The latter is proxied by real imports of machinery and intermediate products. Hence, for the output of tradable goods and services, we have:

$$QT = F_5(\overset{+}{PT}, \overset{-}{r_d}, \overset{-}{ULCT}, \overset{+}{MKI/PKI}) \qquad (5)$$

where QT = real value added in the traded sector;

rd = domestic interest rate;

UCLT = the unit labour cost in the traded sector;

MKI = nominal value of imports of capital and intermediate goods; and

PKI = the import price index of capital and intermediate goods.

Nontradables, by definition, are not traded externally. Firms in the sector sell to private residents and the government in the domestic market. Excess supply or demand in this market will require price adjustments to reachieve equilibrium. Therefore, supply and demand factors determine the quantity demanded and supplied. Demand for nontradables is assumed to be dependent on real domestic expenditure, the relative price of nontradables (to tradables) and a trend variable that proxies other exogenous influences such as population changes. That is:

$$QN = F_6(\overset{+}{DE}, \overset{-}{PN/PT}, \overset{+}{T}) \qquad (6)$$

where QN = real value added in the nontradable sector;

DE = real domestic expenditures; and

T = a trend variable.

The supply price that firms in the nontraded sector expect to get for their products is a direct function of factor costs and the going price level in the traded sector, which determines what nontradable firms have to pay for imported materials. There is also a direct relationship between what firms receive for their products and what they produce. The functional relationship for the supply price of nontradables is therefore expressed as:

$$PN = F_7(\overset{+}{QN}, \overset{+}{ULCN}, \overset{+}{r_d}, \overset{+}{PT}) \qquad (7)$$

where ULCN = unit labour cost in the nontradable sector.

We complete the discussion of the commodity market with a behavioural relationship for total private domestic



expenditure. Real government expenditure is assumed exogenous. Real private domestic expenditure is determined by real disposable income, the cost of loan capital and the previous level of private expenditure, a proxy for habit persistence. Thus we have:

$$PDE = F_8(\overset{+}{YD}, \overset{-}{r_d}, \overset{+}{PDE_{-1}}) \qquad (8)$$

where PDE = Real private domestic expenditure; and

YD = real personal disposable income.

The following identities complete the model:

$$P = hPT + (1-h)PN \qquad (9)$$

$$U = (LS - LET - LEN)/LS \qquad (10)$$

$$DE = PDE + G \qquad (11)$$

and $$Q = QT + QN \qquad (12)$$

In Expressions (9) – (12),

h = the proportion of tradables in domestic price index;

G = real government expenditure;

and LS = aggregate labour supply.

The above model, consisting of eight behavioural relationships and four identities, hopefully explains conditions in the real sector of the Barbados economy. To make the presentation clearer, we summarise the model as follows:

$$\dot{WT} = F_1((\dot{P}_{-1} + \lambda T), U) \qquad (1)$$

$$\dot{WN} = F_2((\dot{P}_{-1} + \lambda_N), U, WT) \qquad (2)$$

$$LET = F_3(CP.KT, WT/PT, LET_{-1}) \qquad (3)$$

$$LEN = F_4(CP.KN, WN/PN, LEN_{-1}) \qquad (4)$$

$$QT = F_5(PT, r_d, ULCT, MKI/PKI) \qquad (5)$$

$$QN = F_6(DE, PN/PT, T) \qquad (6)$$

$$PN = F_7(QN, ULCN, r_d, PT) \qquad (7)$$

$$PDE = F_8(YD, r_d, PDE_{-1}) \quad (8)$$

$$P = hPT + (1-h)PN \quad (9)$$

$$U = (LS - LET - LEN)/LS \quad (10)$$

$$DE = PDE + G \quad (11)$$

$$Q = QT + QN \quad (12)$$

Expressions (1), (2), (3), (4) and (10) summarise conditions in the labour market while (5), (6), (7) and (12) describe conditions in the supply side in the commodity market. Equations (8) and (11) provide a link with the aggregate demand sector in the economy. The model is determinate with 12 equations explaining the 12 endogenous variables, namely: WT, WN, LET, LEN, QT, QN, PN, PDE, DE, P, U and Q.

While it is not our intention to solve the model simultaneously in this paper, a brief description of the operation of the economy should give an indication of possible policy implications of the model. Suppose there is an exogenous increase in the price of tradable goods (PT), real wage in the sector would decline and we expect the demand for labour in the traded sector to increase. Output in the traded sector should increase. An increase in PT would also tend to raise PN and hence employment and output in the nontraded sector would also increase. Meanwhile, an increase in both PT and PN should raise the domestic price level. The rising price level in association with the falling rate of unemployment in both sectors would give rise to increased wage demands. The subsequent increase in real wages would tend to moderate the demand for labour in the two sectors. Eventually, the economy may settle at higher levels of PT, WT, QT, PN, QN, WN and P.

## EMPIRICAL ESTIMATES

The model outlined is, basically, simultaneous, although some of the equations are determined independently. Each



of the eight behavioural relationships is over identified on the basis of both the order and rank conditions. The two stage least squares (2SLS) estimator was used to estimate Equations (1), (2), (6) and (7) which explicitly exhibit simultaneous equation biases. Where equations are determined independently, the OLS estimator was used; and the log-linear functional form was adopted for all but Equations (1) and (2).

The estimated model is presented in Model 1. But, before discussing the results we look at the data sources and indicate how specific variables are measured.

### Data: Definitions, Measurements and Sources

The data used were obtained from both published and unpublished sources of the Central Bank of Barbados, various issues of *Barbados Economic Report* and of the *Abstract of Statistics* of the Barbados Statistical Service; and other published sources. The wage indexes were derived from Downes [7] and *Annual Statistical Digest* (ASD) of the Central Bank of Barbados. They represent indexes of minimum wages paid mainly to manual workers in the respective sectors.

A casual examination of the wage index in the traded sector (WT) revealed cases where the index fell unrealistically sharply. These occurred in the years 1963, 1974 and 1979. A dummy variable DM which took on values of unity for these years and zero otherwise was added to the regressors as an additional variable in Equation (1). The trend growth rate of labour productivity in the respective sectors was obtained by regressing the log of average productivity on a time trend as explained for potential output below. The anti-log of the coefficient of the trend variable *minus* one yielded the trend growth rate of labour productivity ($\lambda$). For the traded sector, $\lambda T = 3.9$ per cent (1958-80) and for the non-traded sector, $\lambda_N = 2.7$ per cent.

The retail price index was used as the domestic price

level because that index appears to be more consistent than the unpublished series on GDP deflator. It was taken from the ASD and the base year changed from 1968 to 1975. The capital stock series were taken from Boamah [3, Table 1]. The shares of tradables and nontradables in overall output were used to section the total stock of capital into the traded and nontraded components.

We have defined the capacity utilisation variable as $CP = Q/Q^*$ where Q is real output and $Q^*$ the real trend or potential output. The latter was derived by estimating the relationship

$$\ln Q^* = A + b \ln T \qquad \text{(i)}$$

from which was calculated the trend growth rate ($g^*$) of real output over the period (1958-80). The potential output was then simply calculated as

$$Q^* = Ae^{g^*T} \qquad \text{(ii)}$$

By definition, the unit labour cost in a sector (ULC) may be expressed as ULC = wage bill/labour employed. There is no data on the wage bills for the two sectors for the entire reference period. The alternative of simply dividing the wage indexes by the number of people employed in the respective sectors did not yield an acceptable result. Therefore, that variable was dropped. Also, in estimating the employment functions, the retail price index was the deflator for the wage variables because that gave a better fit.

The domestic expenditure variable (DE) is defined as $DE = C + I$ where C and I represent aggregate real consumption and investment expenditures respectively. Also, the personal disposable income variable (YD) is defined as $YD = Q - TP$, where TP stands for personal direct taxes. The labour force and employment statistics were estimated and in the following paragraphs we present a detailed description of the methodology used.

**Labour Force and Employment Data**

Prior to 1975, statistics on the labour force and employment in Barbados were not collected on a continuous basis. We have had to resort to an indirect way to estimate the complete series for the two variables. To do this, we were aided by the available data from the 1965/66 *Labour Force* surveys and in the census years of 1960 and 1970.



Information on total population as at December 31 (1958-80) and adult population (aged 15-65) for 1958-69 and 1975-80 was obtained from the *Abstract of Statistics* (1969, No. 6, Barbados Statistical Service) and various issues of the *Barbados Economic Report*. The latter also provided information on the labour force and the percentage of adults in the labour force for the period 1975-80. The missing portion of the adult population (1970-74) was derived on trend. It was based on the average of the ratio of adults in total population for the five years preceding 1970 and the five years immediately after 1974.

In general, one expects the labour force to be predominantly derived from the adult population. As such, the available data on the percentage of the labour force in the adult population (participation rate) provided the base from which the labour force data were derived. The labour force participation rate shows a slight drop from about 72.5 per cent in 1960 to 68.7 per cent in 1966. Between 1966 and 1970, the ratio is fairly stable, moving from 68.7 per cent to 68.1 per cent in 1970. Given the relative stability of the participation rates between the benchmark years, one would not expect wide yearly variations in the ratios. The intervening participation rates between 1960 and 1966 were, therefore, estimated on the trend movement between the two years. The same procedure was adopted to calculate the rates between 1966 and 1970 and, thenceforth, to 1975 when regular figures became available. The labour force data were subsequently derived from a combination of the participation rates and the series on adult population.

Employment figures were also calculated from the

estimates of the proportion of adult population employed, using as benchmarks those years (1960, 1966, 1970 and 1975-80) when data were available. Information indicates that the proportion of adult population employed dropped from 66.9 per cent in 1960 to about 62.2 per cent in 1970, and subsequently to 57.6 per cent in 1980. The lowest ratio occurred in 1975 when 50.9 per cent of the adult population was employed. As was done for the labour force data, the missing employment – adult ratios within the four benchmarks were calculated on trend.

**Model 1**

**The Estimated Model**

(1*) $\dot{WT} = 12.601 + 0.507(\dot{P}_{-1} + \lambda T) - 1.1514U - 14.107DM$
(2.635) (2.114) (-2.096) (-3.393)

$R^2 = 0.587$ D-W = 2.05 S.E. = 6.14
F(3,17) = 5.69 AR(1), rho = - 0.35

(2*) $\dot{WN} = 18.940 + 0.346(\dot{P}_{-1} + \lambda N) - 1.546\,\dot{U} + 0.335WT$
(4.587) (2.449) (-4.034) (1.925)

$R^2 = 0.585$ D-W = 2.20 S.E. = 6.13
F(3, 17) = 5.64 AR(1), rho = -0.51

(3*) $\ln LET = 0.0841n\ CP.KT + 0.0881n\ (WT/P) + 0.721n\ LET_{-1}$
(2.012) (1.284) (4.347)

$R^2 = 0.644$ D-W = 2.21 S.E. = 0.07
F(3, 19) = 16.26 h = 0.935



(4*) $\ln LEN = 3.343 + 0.0821n\ CP.KN - 0.1051n\ (WN/P) + 0.1861nLEN_{-1}$
(3.635) (2.371) (-3.050) (0.894)

$R^2 = 0.892$ D-W = 1.97 S.E. = 0.04
F(3, 18) = 49.71 h = 0.303

(5*) $\ln QT = 2.733 + 0.3901nPT - 0.4881nr_d + 0.2441n\ (MKI/PKI)$
(7.027) (4.337) (- 1.887) (1.987)

$R^2 = 0.876$ D-W = 1.60 S.E. = 0.009
F(3, 17) = 28.22 AR(2), rho = 0.04

(6*) $\ln QN = 1.704 + 0.3861nDE - 0.4221nPN/PT + 0.021T$
(1.412) (2.096) (- 3.022) (2.098)

$R^2 = 0.657$ D-W = 2.01 S.E. = 0.05
F(3, 17) = 7.66 AR(1), rho = 0.71

(7*) $\ln PN = 0.4401nQN + 0.4221nr_d + 0.4641nPT$
(1.990) (2.037) (3.008)

$R^2 = 0.987$ D-W = 2.30 S.E. = 0.09
F(3, 17) = 435 AR(1), rho = 0.94

(8*) $\ln PDE = 0.598 + 0.3491nYD - 0.1761nr_d + 0.6281PDE_{-1}$
(1.504) (2.431) (-1.061) (3.913)

$R^2 = 0.932$ D-W = 1.70 S.E. = 0.06
F(3, 18) = 82.31 h = 1.075

*Note:* t-statistics are in parentheses below estimated coefficients;
rho = coefficients of auto-correlation;
S.E. = standard error of estimate.

From the estimated model, we find that changes in one period lagged prices, adjusted for productivity growth, and the unemployment rate are the main determinants of changes in nominal wages in both sectors (see (1*) and (2*)). In general, the results seem fairly robust, given that the variables are measured as percentage changes. The variables carry the expected signs and are significant at the 5 per cent level. That the coefficients of the lagged price variables are less than unity in both sectors seem to confirm general observations that expected prices are not fully reflected in money wage settlements.[6] The results also appear to lend credence to the hypothesis of a wage push arising from the traded sector. Wage settlements in the key tourism and manufacturing industries seem to have strong influence on wage settlements in the nontraded sector.

The estimates of the employment functions generally agree with *a priori* expectations ((2*) and (3*)). In both equations, the stock of capital adjusted for capacity utilisation in the respective sectors and the real wage variables explain over 64 and 89 per cent respectively in the traded and nontraded sectors. All the coefficients for the nontradable function are of the right signs and are all highly significant. The coefficient of the real wage variable for the tradable function was, however, not of the expected sign, but it is not significant. Hence, there is not enough justification either to reject or accept the original hypothesis.[7]

We realise that because of the lagged dependent variables also appearing as explanatory variables, the Durbin-Watson statistics may not strictly be appropriate. Therefore, the Durbin h-statistics[8] were also computed. In general, there appears to be no serious problem of serial correlation. The original hypothesis for tradable output appears to have been borne out by the results (see (3*)). The price of tradables seems to be a strong determinant of the output of tradables, as are the cost of loan capital and the real value of capital



and intermediate good imports. In this case, a second order correlation for auto-correlation provided the best fit. All the variables are significant at the 5 per cent level.

The results for the output of nontradables also appear to be quite robust. The relative price of nontradables carry the expected negative sign and is also significant even at the 1 per cent level. Given that the important items in nontradables such as government services and utilities tend to be price inelastic, an elasticity estimate of -0.4 which the results suggest appear to be plausible. The fit for the nontraded price formation is also acceptable, judging from the summary statistics. Over 98 per cent of the variations in the price variable are explained by the real output in the sector, the price of tradables and the cost of loan capital. All the variables carry the expected signs and are also significant at the 5 per cent level.

RELATIVE PRICE OF NON-TRADABLES
TO TRADABLES 1958-80

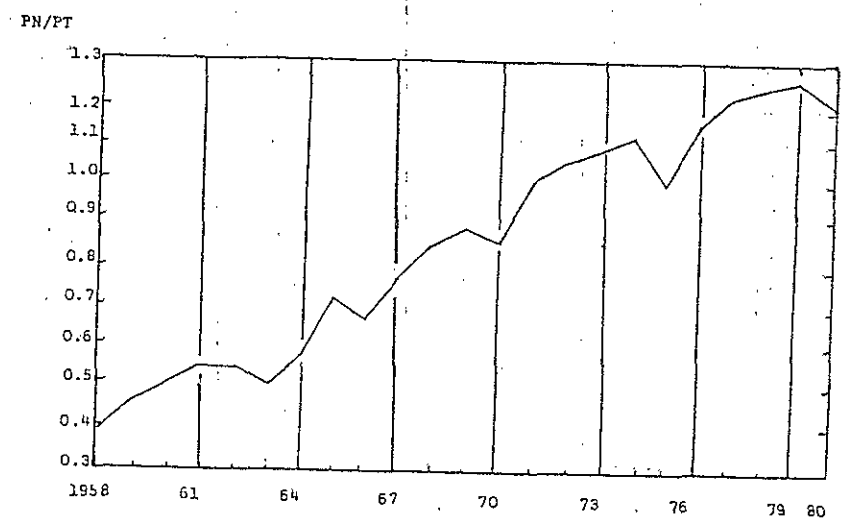


FIGURE 1

The estimates for the private domestic expenditure function also follow *a priori* expectations. Real disposable income and the lagged value of the dependent variable are highly significant. Although the interest rate variable is of the right sign, it does not seem to have much influence on real private expenditure.

## SUMMARY AND CONCLUSIONS

In this paper we have attempted to investigate, statistically, some of the factors that determine wages, employment and output in the Barbadian economy. Despite the use of a simple model, some plausible and interesting results have emerged from the analysis.

Lagged prices, adjusted for productivity growth and the unemployment rate appear to exert the main influence on wage determination in the two sectors within which the analysis has been discussed. Also, there is some evidence of wage push from the traded to nontraded sector.

Employment is principally determined by the real capital stock adjusted for capacity utilisation and, ir the case of nontradables, by the sectoral real wage. The price of tradables, the cost of loan capital and the real value of imports of capital and intermediate goods are the main determinants of tradable output. The demand for nontradables tends to be influenced mainly by real domestic expenditure, the relative price of nontradables and a trend variable. Also, the supply price of nontradables appears to be sensitive to real output of tradables, the cost of finance and the price of tradables.

While the results are interesting in themselves and also add to our understanding of the supply sector of the Barbadian economy, problems of data quality invite caution on their interpretation. They should be regarded as indicative and tentative rather than as confirmed description of the supply conditions in the economy.



## FOOTNOTES

[1]This paper has benefited substantially from suggestions and comments from DeLisle Worrell and a referee of this journal. None of them are, however, responsible for any errors and omissions which may remain.

[2]See Farrell [9], p. 97.

[3]In the short term, capital is fixed but it becomes a quasi variable factor when the stock is adjusted for capacity utilisation.

[4]In Equations (3) and (4) we have had to leave out the real output variables to avoid problems of multi-collinearity.

[5]Given the pool of unemployed labour in the system, the assumption that labour demand is always satisfied may be justified.

[6]The point is that unions do not usually get what they want.

[7]In the alternative specifications of the employment functions, the capital stock variable was replaced with real output variables. The following were the results:

$$\ln LET = \underset{(2.408)}{0.119}\ln QT + \underset{(1.429)}{0.085}\ln(WT/P) + \underset{(4.321)}{0.679}\ln LET_{-1}$$

$R^2 = 0.731$ D-W = 2.17 S.E. = 0.07

$F(3.19) = 25.88$ h = 0.594

$$\ln LEN = \underset{(3.392)}{2.951} + \underset{(2.109)}{0.094}\ln QN - \underset{(-3.027)}{0.108}\ln(WN/P) + \underset{(1.235)}{0.274}\ln LEN_{-1}$$

$R^2 = 0.887$ D-W = 2.07 S.E. = 0.04

$F(3,18) = 46.95$ h = 0.474

[8]The Durbin h-statistic is defined as:

$$h = (1 - 1/2d)\sqrt{\frac{N}{1-N\ v(b)}}$$

where d is the Durbin-Watson statistic, N is the sample size and v(b) is the estimate of the variance of the coefficient of the lagged endogenous variable. We tested the null hypothesis that the error terms are serially independent against the alternative that the null hypothesis is false. At the 95 per cent level the critical value of h is 1.645 and in both cases the computed h does not exceed the critical value. Therefore, we do not reject the null hypothesis that the error terms are serially-independent.

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