AN EXPECTATIONAL MODEL OF LABOUR DEMAND IN SPANISH INDUSTRY

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Abstract

The purpose of this paper is to estimate a labour demand function for the Spanish Industry in the period 1968-1982 using quaterly data. The model is cast in an imperfect competition framework where both relative factor prices and fluctuations in expected output are explaining variables of employment. Two similar approaches are used in order to estimate the model. In the first method a labour demand equation and an output equation are estimated. This method allows to separate out substitution and output effects of relative factor prices elasticities where the output effect is subsumed in the expected output equation. In the second slightly different approach those exogeneous demand variables whichs shift the firms's demand curve are directly included in the labour demand function, embodying both effects in the relative factor prices elasticities. Since both methods yield consistent estimates of these elasticities, their comparison would yield a nice test of the robustness of both specification methods.

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by

J. J. Dolado and J. L. Malo de Molina

Introduction.-

In Nickell (1984 a) a model of labour demand is presented which encompasses both purely keynesian and neoclassical ways of deriving demand for productive factors. The model is cast in an imperfect competition framework where both relative factor prices and fluctuations in expected output are explanatory variables of employment. This type of approach conforms well both to commonsense and to the data properties. On the one hand, it overcomes the standard objections to the regression of employment on output advocated by the "fix-price" approach. Since it is difficult to disentagle the demand for labour from the production function, output should be treated as endogenous when the equation is estimated for a period in which there is scarce reliable evidence about firms being constrained all the time in the goods market. On the other hand, in the neoclassical approach, aggregate demand shocks only affect employment through their impact on price forecasting errors. Given that fluctuations in output seem to be dominant factors in explaining employment fluctuations in the short run, that channel may be too limited[1].

Nickell divides the employment decision of the firm in two steps. First an expected cost minimization approach is followed, yielding a corresponding labour demand function conditional on expected output. Second, expected output is solved out, via the maximization of profits, in terms of relative output prices and aggregate demand variables, where this last set of variables serve to shift the position of the goods demand functions faced by the firms. Therefore the model consists of two equations, i.e. a labour demand equation which depends on relative factor prices and expected output and an output equation depending upon relative factor prices and aggregate demand variables. This method allows to separate out substitution and output effects of relative factor prices where the output effect is subsumed in the expected output equation.

A slightly different approach is that followed by Sachs (1983) and Symons (1981, 1984), who include in the labour demand function those exogenous demand variables which shift the firm's demand curve. So, expressed in the instrumental variables estimation language, while Nickell proceeds in the standard two step fashion, the latter authors substitute directly the potentially endogenous output by a set of instruments. Therefore by this second procedure the obtained elasticities of employment w.r.t. input prices embody both output and substitution effects. Since both methods yield consistent estimates of these elasticities, the comparison of the aggregate elasticities obtained by both procedures would yield a nice test of the robustness of both specification methods. Since Nickell cannot find relative input prices in his output equation, the quoted elasticities just represent substitution effects and the comparison cannot be made.

The purpose of this paper is to estimate a labour demand function for the Spanish Industry with quarterly data for the period 1968-1982 using both approaches in order to make the comparison. The second section of the paper presents the analytical framework that we use. The third section offers the econometric results. Conclusions are in the fourth section. Finally, there is a technical Appendix and a Data Appendix.

Section 2: A Model of Employment

Since the section relies heavily on Nickell (1984 a, b) we will just give a brief schematic representation of the model. Given that constant returns to scale (CRTS) is a convenient testable assumption in this type of models, we analyse here the determination of employment in an economy characterised by imperfect competition in the goods market and CRTS in the production side. Capital is taken as given by assuming that the investment decision is separable and previous to the employment decision[2]. Notice that by assuming that the quantity of a factor is exogenously fixed, it is possible to derive factor demand functions through the usual analysis of profit maximization under CRTS. However if one wishes to separate out substitution and income effects of relative factor prices it is convenient to start by solving out the usual cost minimization problem for the firm:

$$\min_{\underset{\sim}{x}_1} \quad \underset{\sim}{\omega}' \underset{\sim}{x}_1 \qquad \text{s.t.} \qquad Y = F(\underset{\sim}{x}_1\ x_2)$$

where $\underset{\sim}{x}_1$ represent a vector of adjustable inputs with a vector of prices $\underset{\sim}{\omega}$, x_2 is a fixed factor, Y is output in the industry and F is the production function which exhibits CRTS. The following restricted cost function is obtained:

$$C(\underset{\sim}{\omega},\ Y,\ x_2) = A(\underset{\sim}{\omega},\ Y/x_2)x_2 \tag{1}$$

where $A_i>0$, $A_{ii}<0$, $A_2>0$, $A_{22}>0$, $A_{i2}>0$ and A is homogenous of degree one in $\underset{\sim}{\omega}$. ($A_i = \partial A/\partial\ \omega_i$, $A_2 = \partial A/\partial\ Y$)

Applying Shephard's lemma to (1), one obtains a factor demand function, let's say for factor i, where output is held constant

$$x_i = C_i(\underset{\sim}{\omega},\ Y,\ x_2) = A_i(\underset{\sim}{\omega},\ Y/x_2)x_2 \tag{2}$$

Since in this function output is kept fixed by construction one can only capture substitution effects triggered by changes in factor prices. The elasticities ε_{ij} can then be obtained as follows:

$$\varepsilon_{ij} = \partial \log x_i / \partial \log w_j = A_{ij}\, x_2\, \omega_j / x_i =$$

$$= A\, A_{ij}\, \omega_j\, A_j\, x_2 / A_i\, A_j\, A x_2 = \nu_{ij}\, x_j\, \omega_j / C =$$

$$= \nu_{ij}\, s_j \qquad (3)$$

where $\nu_{ij} = A\, A_{ij} / A_i\, A_j$ is the elasticity of substitution between factors i and j (see Uzawa (1962)) and s_j is the share of factor j in total cost. Note that the sign of ε_{ij} $(i \neq j)$ cannot be determined a priori, depending on whether $\nu_{ij} \gtrless 0$, i.e. factors i and j are substitutes or complements.

Suppose now that each industry faces a demand function of the form

$$P = g(Y,D) \; ; \; g_1<0, \; g_2>0 \qquad (4)$$

where P is the output price and D is a nominal shift factor. Then if it maximises profits taking x_2 as given we obtain an output function as solution of the problem

$$\max_{Y} \{Y\, g(Y,D) - A(\underset{\sim}{\omega},\, Y/x_2)x_2\} \qquad (5)$$

$$\text{with } Y = f(\underset{\sim}{\omega},\, x_2,\, D) \qquad (6)$$

where $f_i<0$, $f_2<0$, $f_3<0$ and f is homogeneous of degree one in $(\underset{\sim}{\omega}, D)$ $(f_i = \partial f / \partial\, \omega_i,\ f_2 = \partial f / \partial x_2,\ f_3 = \partial f / \partial D)$.

By substituting (6) into (2) we obtain a new factor demand function where only relative factor prices and shift variables appear in the form:

$$\hat{x}_i = A_i(\underset{\sim}{\omega},\ f(\underset{\sim}{\omega},\ x_2,\ D)/x_2)x_2 \tag{7}$$

where x_i is a "complete" factor demand function. It is clear that the function $\hat{x}_i$ -as opposed to x_i- will have already endogeneized the response of changes in output to changes in factor prices, yielding the following price elasticities.

$$\hat{\varepsilon}_{ij} = \partial \log \hat{x}_i / \partial \log \omega_j = [A_{ij}\ x_2 + A_{i2}\ f_j]\omega_j/x_i =$$

$$= A_{ij}\ \omega_j/A_i + A_{i2}\ f_j\ \omega_j/x_i = \varepsilon_{ij} + [A_{i2}\ Y/x_i]\ [f_j\ \omega_j/Y]$$

where note that the first term in brackets is equal to the output elasticity in (2) while the second term in brackets equals factor price elasticity in (6). Therefore, the price elasticity of the complete factor demand function is equal to the price elasticity of the constant demand function plus another term (always non-positive) which represents the output effect. It is clear that

$$|\hat{\varepsilon}_{ij}| > |\varepsilon_{ij}| \quad \text{if} \quad |f_j| > 0$$

$$\hat{\varepsilon}_{ij} = \varepsilon_{ij} \quad \text{only if} \quad f_j = 0$$

According to the previous discussion Nickell proceeds to estimate (2) and (6) jointly while Symons and Sachs estimate (7) as an unrestricted reduced form. Both methods would yield consistent estimates of the complete factor's price elasticity directly as in (7) or through the addition of both output and substitution effects as in (2) and (6). Their empirical similarity would be equivalent to testing the validity of the instruments represented by lags of $\underset{\sim}{\omega}$, x_2 and D when estimating by either method.

Of course the static nature of the model is very unsatisfactory. The existence of adjustment costs, uncertainty decision lags and aggregation problems (as proved by Nickell (1984 b) may be proxied by a fairly unrestricted distributed lag specification with future output expectations in the employment equation. Therefore the dynamic correspondences of (2), (6) and (7), already translated into the usual employment function variables, may be generally expressed as follows:

$$\alpha_o(L)\ l_t = \alpha_1(L)\ (w-q)_t + \alpha_2(L^{-1})\ y^e_t + \alpha_3(L)\ k_t + \text{constant} + \text{trend} + \text{seasonals} \quad (2')$$

$$\beta_o(L)\ y_t = \beta_1(L)\ w_t + \beta_2(L)\ q_t + \beta_3(L)\ d_t + \beta_4(L)\ k_t + \text{constant} + \text{trend} + \text{seasonals} \quad (6')$$

$$\gamma_o(L)\ l_t = \gamma_1(L)\ w_t + \gamma_2(L)\ q_t + \gamma_3(L)\ d_t + \gamma_4(L)\ k_t + \text{constant} + \text{trend} + \text{seasonals} \quad (7')$$

where l is labour; w is nominal wage, q is other input prices, k_t is capital and $y^e_t = E_{t-1}\ y_t$ where L^{-1} operates as $L^{-j}\ y^e_t = E_{t-1}\ y_{t+j}$. All variables have been treated in logs. The dynamic specification has been kept rather "loose" as opposite to the temptation of imposing a very tight dynamic structure which in early attempts proved to be an inadequate way of operating.

Section 3: Estimation Results

Details of the data are given in the Appendix. Before proceeding to comment on the results a number of prior issues should be analysed. First which variables to include in d. The following choices have been made: money stock (m), nominal government expenditure (g), a world trade index (z) and lagged output (y). Second whether the wage and other inputs prices were weakly exogenous variables or not. Here we must say that in no case we could find significant effects of the contemporaneous values of these variables in any equation when they were estimated by 2SLS and Hausman tests were applied[3]. Given this fact and the homogeneity property of the equation we proceeded to express all the nominal variables in real terms. Note that unless it appeared lagged, output price would also be an endogenous variables, obtained from (4) and (5), since firms are not price takers. Third how to compute output expectations. At this stage we followed Nickell's method. This procedure consists of first treating the output equation as a single equation specifying and testing its appropiate form. Once this equation is specified, the variables which appear as regressors in the equation are also modelled in order to generate forward expectations of output. Finally we have to consider the general estimation procedure. To estimate (7') given the weakly exogenous character of the variables, OLS would yield consistent estimates. When estimating (2'), (6') and the auxiliary models of the explaining variables in the output equation, it is well known that a joint estimation of the system in this type of "quasi-rational expectations" models is fully efficient. However this involves the maximization of a likelihood which besides being highly non linear in the parameters, consumes a large number of degrees of freedom given that the exact dynamics have to be specified and hence the model has to be repeatedly estimated. Therefore, at the expense of efficiency, we adopted the usual two stage procedure advocated by Barro (1974) of computing the expectations and substitute them in the employment equation, which in turn is estimated as a single equation. Note that in this procedure, although parameter estimates are generated consistently, standard formula do not yield correct test statistics as blocks of off-diagonal elements of the system-wide information matrix are implicitly assumed to be zero (see Pagan (1984) and Hoffman et al. (1984)).

Once these considerations have been made we pass to coment on the results. In Table 1, column one the selected output equation is presented. The selection of this equation is made upon basis of goodness of fit, parameter stability and agreement of the signs with the theory. The issue of stability is particulary important since we use the whole sample to compute expectations such as y_t^e where only information up to (t-1) shoul be available. Some of the lags of the variables have been left out in order to get the most parsimonious representation without endangering the long-run properties of the model. It is should also be noted that we could not test the homogeneity property of the equation in term of d and k since d was proxied by the set of aggregate demand variables mentioned above. Since capital was rather colinear with the trend, we estimated the equation with the dependent variable transformed into a "quasi" output-capital ratio, imposing the long-run elasticity obtained in the unrestricted model.

In order to compute the expected output terms we computed autoregressive models for the real wages, real inputs prices, real money stock and world trade index. The univariate models that we used were AR(4) with seasonals and a constant, given that the series were quarterly unadjusted. Unfortunately some of the univariate processes were not stable within and outside the sample period preventing their use for expectations formation. Table 2 offers a summary of the Chow tests which show up lack of stability in certain instances. Given this defficiency, we also tried some multivariate models for these variables, but they were also unsucessful. So we decided to compute expectations of these variables using a "rolling" procedure, estimating the AR(4) models by iterative least squares (see Harvey (1981))[4]. In this fashion every time that a new observation arose the model was reestimated computing forward expectations up to two years. These expectations we subsequently plugged into the output equation in order to generate forward output expectations, this time fixing the parameter coefficients since the equation did not show signs of instability.

In Table 1, column two, the employment equation corresponding to (6') is presented. We tested whether long-run output and capital elasticities summed up to one by including an additional lag in the level of k. This hypothesis is suggested from a simple Cobb-Douglas specification in the long-run (see Appendix). We found that this t-ratio lay between .7 and 1.5 in all the stages of the specification search so that the hypothesis was not rejected. To test homogeneity of degree zero w.r.t. wages and other input prices four separate lags in w and q were added. The corresponding F test, F (8,40) = 1.42, was again non significant. When the equation was confronted with several stability tests it passed them fairly well, while in turn the tests of residuals did not show signs of misspecification. From this equation we get a long-run output elasticity of 1.5 (3.1) while the corresponding substitution elasticities w.r.t. real wages and other input prices are -.15 (2.6) and .15 (2.6) respectively. From the output equation we get output effects for both variables with respective elasticities of -.60 (3.1) and -.24 (2.1). Using expression (8) we can compute "complete" elasticities of -1.05 for real wages and -.20 for other input prices. Note that due to the two-step estimation method employed, we cannot compute standard error for these formulae.

Finally, in Table 1, column 3, we offer the selected specification of equation (7') unrestricted. After a long specification search the equation was whittled down to its present form. We used up to nine lags of each demand variable as well as the current value (except for the industry output). The most significant ones were then combined and finally only a moving average of the rate of growth of the world trade index proved to be strongly significant. It should be noticed that the level of real money balances in lagged form had a t-ratio of 1.6 although was finally discarded in order to improve other features of the model. Therefore in its present form the long run solution of the model corresponds to a "neoclassical" labour demand function where only relative factor prices matter. Note that this may be due to the irregular IV estimation method that it is used. However when considering the above comment about real money balances, the way that the aggregate demand variables appear in the equation is similar to the way they appear in the output equation. Again CRTS were tested by estimating the equation with the log of the labour-capital as dependent variable and adding one lag of the level term of the capital. The corresponding t-ratio was 1.8 that, although cautiously, does not reject the hypothesis. Comparing standard errors of the regression of both employment equations it is observable that (2') is estimated more efficiently than (7'). The "complete" real wage and other input elasticities are -.86 (2.5) and -.32 (2.4) respectively. Comparing both point estimates with those obtained through the previous method, they appear to be quite similar. Although a proper significance test is not available, this similarity some how confirms the robustness of the models[5]. Similar results are also obtained by Dolado et al (1985) using annual data for the manufacturing sector. The large value of the lagged dependent variable in both labour demand functions and the long lags in the explanatory variables imply a very slow response of employment to changes in e.g. wages and other input prices which agrees with the existence of very large lay-off and firing costs in most of the sample period (see Malo (1983)).

4. <u>Conclusions</u>

An employment model for the Spanish Industry has been estimated using quaterly data for the period 1968-82. The model considers forward output expectations besides relative factor prices among its determinants. By determining an output equation derived from profit maximization in an imperfect competition framework one can decompose total elasticities into substitution and output effects. The real wage elasticity is around -1.0 where approximately 15% of the total value corresponds to the substitution effect and the remaining 85% corresponds to the output effect. In the case of the other inputs price, the total elasticity is around -.3 but in this case the substitution effect is positive. The complete point elasticities seem to be fairly similar to those obtained through an unrestricted reduced form equation, although in this approach the aggregate demand effects are hardly captured.

Table 1

Output and Employment Equations

Dependent Variables

	y_t		Δl_t		Δl_t	
	$\frac{1}{2}(y_{t-1}+y_{t-4})$	.720 (10.0)	l_{t-1}	-.106 (3.8)	l_{t-1}	-.102 (3.7)
	$\Delta(m-p)_{t-2}$	.800 (3.2)	$(w-p)_{t-1}$	-.016 (3.2)	$\{\Delta_2(w-p)_{t-4}-\Delta_3(w-p)_{t-6}\}$	-.088 (4.4)
	$(m-p)_{t-2}$	.168 (3.8)	$\{\Delta(w-q)_{t-4}-\Delta(w-q)_{t-6}\}$	-.033} (4.0)	$(w-p)_{t-9}$	-.088 (2.6)
	$(w-p)_{t-2}$	-.168 (3.8)	$E_{t-1}\, y_t$	.160 (4.1)	$\Delta_2(q-p)_{t-2}$	-.033 (2.9)
	$\Delta_2\, z_t$	.343 (5.1)	$\{E_{t-1}\, y_{t+4} - E_{t-1}\, y_{t+5}\}$	.871 (5.0)	$(q-p)_{t-8}$	-.033 (2.7)
	$(q-p)_{t-3}$	-.067 (2.6)	$\{E_{t-1}\, y_{t+4} - E_{t-1}\, y_{t-3}\}$	.549 (5.9)	$\Delta_2\, z_t$	.049 (2.8)
	$\Delta_3(q-p)_{t-1}$	-.045 (1.9)	$\Delta E_{t-1}\, y_t$	-.250 (5.3)	$t(10^{-2})$	.281 (3.0)
	$\Delta_3(q-p)_{t-6}$	-.100 (3.4)	$\{\Delta E_{t-1}\, y_{t+3} - \Delta E_{t-1}\, y_{t+4} + \Delta E_{t-1}\, y_{t+s}\}$	.438 (6.8)	$t^2(10^{-4})$	-.221 (5.8)
	$t(10^{-2})$	.383 (2.7)	$\Delta E_{t-1}\, y_{t+6}$	-.151 (3.8)	k_t	.102 (-)
	$t^2(10^{-4})$	-.156 (.7)	$t(10^{-2})$	-.347 (3.6)		
	k_t	.800 (-)	$t^2(10^{-4})$	.182 (1.7)		
			k_t	-.054 (-)		
T	60		60		60	
R^2	.97		.79		.75	
s	.0187		.0049		.0054	
h	-		-.7		-.7	
$\chi^2_{LM}(8)$	11.7		7.2		6.6	
$\chi^2_{JB}(2)$	3.2		2.1		4.1	
$\chi^2_{ARCH}(1)$	1.2		.7		2.2	
F_{CH} 1973(IV)	1.35 (11,38)		1.15 (13,34)		2.08^* (10,40)	
F_{CH} 1977(IV)	1.25 (11,38)		.84 (13,34)		1.04 (10,40)	
F_{CH} 1979(IV)	.59 (12,36)		1.09 (12,35)		.66 (12,38)	

Note: t-ratios appear in parenthesis; $\bar{R}^2$ is the corrected coefficient of determination; s is the standard error or the regression; h is the Durbin's statistic in the presence of lagged dependent variable; $\chi^2_{LM}(.)$ is a LM test which tests for AR(8) or MA(8) in the disturbance; $\chi^2_{JB}(.)$ is the Jarque-Bera test for normality of the disturbances; $\chi^2_{ARCH}(.)$ is Engle's test for autorregresive heterocedasticit F_{CH} is Chow test for structural change in the parameters where (.,.) represent degrees of freedom of the F test; (*) non significant at 1% level of significance, all equations contain a constant term and combined seasonal dummies.

Table 2

Stability tests for the AR(4) models

Breaking Point	d.f.	Real Money Balances	Index of World Trade	Real Wages	Real other Input prices
1973(IV)	(8,44)	1.32	1.43	1.22	2.95*
1977(IV)	(8,44)	1.08	1.46	3.24*	.55
1979(IV)	(12,40)	.46	.76	1.22	2.70*

Note: (*) significant at 5% level of significance.

Appendix

Consider a Cobb-Douglas production function of the form

$$Y = e^{f(t)} L^{\alpha} M^{\beta} K^{\gamma} \; ; \; \alpha+\beta+\gamma = 1 \qquad (A.1)$$

where Y is output, L is labour, M is raw materials + energy, K is capital stock and f(t) is a time polynomial reflecting technical progress. Capital stock is taken as a fixed factor. Then the corresponding restricted cost function for a given level of output is:

$$C(W,Q,K,Y,t) = \exp\,[-f(t)/1-\gamma]\; W^{\alpha/1-\gamma}\; Q^{\beta/1-\gamma}\; K^{-\gamma/1-\gamma}\; Y^{\,1/1-\gamma} \qquad (A.2)$$

where W is wage, Q is price of raw materials + energy. The corresponding conditional labour demand function (in logs) is:

$$l = h(t) + b_1\, w + b_2\, q + b_3\, k + b_4\, y \qquad (A.3)$$

where

$$b_1<0,\; b_2>0,\; b_3<0,\; b_4>1,\quad b_1+b_2=0,\quad b_3+b_4=1,\; h(t)\alpha\text{-}f(t)$$

Suppose that the industry faces a constant elasticity demand function of the form:

$$P = Y^{-1/\varepsilon}\; D;\; \varepsilon>1 \qquad (A.4)$$

where P is output price and D is a nominal exogenous shift factor. Then by maximizing profits, we obtain the following output function (in logs)

$$y = g(t)+c_1\, w + c_2\, q + c_3\, k + c_4\, d \qquad (A.5)$$

where

$$c_1<0,\; c_2<0,\; c_3>0,\; c_4>0,\; c_1+c_2+c_3=0,\; g(t)\;\alpha f(t)$$

By substituting (A.5) in (A.3) we get a complete labour demand function (in logs)

$$l = j(t)+e_1 w+e_2 q+e_3 k+e_4 d$$

where

$$e_1<0,\ e_2<0,\ e_3>0,\ e_4>0,\quad e_1+e_2+e_4=0,\ j(t)\alpha\ f(t)$$

Data Appendix

All series are quarterly unadjusted data (in logs) for the period 1968-1982.

1. h = Total number of employers in Industry (elaborated from GTE and EPA).

2. w = Average monthly earnings per employee (ES) + Employer's mandatory contributions to Social Security (CN).

3. q = Industrial Import Price Index. It is elaborated as a weighted average of an Index of Domestic Prices of Energy and the Indexes of Unit Value of Import of Raw Materials and Semi-Elaborated Goods in Industry (BE).

4. p = Industrial Output Price Index. It is elaborated from the industrial component of the Wholesale Price Index and the Index of Industrial Prices (BE).

5. Y = Industrial GDP (BE).

6. K = Capital stock Index (BE).

7. m = M3 nominal holdings (BE).

8. z = Index of World Trade. It is defined as a Quantum Index of Exports by Industrial Countries and LD'c non oil exporting countries (IFS).

Abbreviations for Sources

BE = Boletín Estadístico. Banco de España

CN = Contabilidad Nacional

EPA = Encuesta de Presupuestos Familiares

ES = Encuesta de Salarios

GTE = Grupo de Trabajo del Ministerio de Economía

IFS = International Financial Statistics

Footnotes

1. Some more recent empirical work based upon the idea of imperfect competitive firms is contained in Layard and Nickell (1984) and Wadwhani (1985). In the first paper, the demand for labour equation is complemented by wage and price equations, in order to analyse the determination of the NAIRU. In the second paper, besides aggregates demand effects, the repercursion of inflation and multi-period uncertainty on the determination of employment is also studied.

2. Since the capital stock is taken as given, it is important to consider the effect of changes in the relative price of labour and other inputs on capital via a process of accelerated economic obsolescence. Otherwise the overstimation of the capital stock could lead to biased results. In order to tackle with this issue somehow roughly a variable depreciation rate has been used (see Dolado and Malo de Molina (1983)).

3. Note that the real raw materials+energy price is endogenous since it is computed in domestic currency and therefore embodies the exchange rate. The instrument set used contained lagged values of real wages, other inputs price, aggregate demand variables and unemployment rate and contemporaneous values of the total tax-wedge, labour force in Industry and import price relative to world manufactures prices (both in dollars).

4. Observations from 1964 to 1968 have been used to compute the initial parameter coefficients.

5. This result has to be taken cautiously since as it is well known the results in time series econometrics can vary a great deal between different specifications. Wadwhani (1985) shows evidence of the lack of robustness of the real wage elasticity when considering inflation illusion and uncertainty effects, which have not been explicitly considered in this study.

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