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Inflation in Developing Countries. An Econometric Study of Chilean Inflation (Chapter III)

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INFLATION IN DEVELOPING COUNTRIES. AN ECONOMETRIC STUDY OF CHILEAN INFLATION (Chapter III)

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CHAPTER III

Industrial Prices, Industrial Wages and Inflation in Chile. A Quarterly Model.

Introduction

This chapter is divided into four sections. In the first one we study the formation of prices in the industrial sector. In the second section we study the specification of the industrial wage equation (in both these sections we use ordinary least squares as a searching procedure to select alternative specifications of the different equations of the subsystem that will be estimated using a simultaneous equation estimation procedure).[1/] In the third section we estimate the simultaneous model and in the fourth, we discuss the results and analyse their implications for stabilization policy.

The data used for the empirical estimations are presented in Appendix A.

1.- Prices in the Industrial Sector.

It is hard to specify a price equation for an economy like the chilean one in which we have had a long history of price controls. In the period considered in this study 1963 to 1968, we have had experiences of very tight price controls. The hipothesis that we want to test is that even in a framework of price controls these prices keep a stable relationship to cost

1. We made only limited use of this strategy because in the context of a simultaneous model, ordinary least square estimates are not only biased but also inconsistent.

and demand elements.

For commodities with free prices we arrive to this hipothesis from different theoretical models that we develop below. They include among others the case of a method of pricing consisting of a mark-up over average variable cost, and the case of a monopolist in the commodity market that faces a demand for his product with constant price elasticity.

For commodities under price controls this hipothesis implies that in the price negotiations between public officials and producers the objective elements are the behavior of cost elements and demand pressures. This last element through the interest of the public official in the elimination of shortages even at the cost of some price increases.

Another problem in the specification of price equation is that in an economy with price control most of the prices are adjusted in the same season, usually at the begining of the year and therefore any specification of a price equation should consider this. Fourtunatelly this is not the case in the industrial sector where the adjustment in prices is distributed along the year as is shown in the following table:

T A B L E

PRICE INCREASES IN THE INDUSTRIAL SECTOR

Year and Quarter		Rate of change with respect to the same quarter of the previous year.	Year and Quarter		Rate of change with respect to the same quarter of the previous year.
1964	1		1968	1	28,3
	2	56,2		2	29,3
	3	54,2		3	32,3
	4	50,9		4	36,8
1965	1	30,6	1969	1	34,5
	2	26,2		2	34,9
	3	26,1		3	37,1
	4	26,1		4	35,7
1966	1	34,6	1970	1	39,8
	2	28,6		2	38,8
	3	27,9		3	36,2
	4	25,8		4	34,5
1967	1	28,2			
	2	28,1			
	3	26,4			
	4	23,3			

Source: Different Issues Monthly Bulletin Central Bank of Chile.

1.1. The Model

The Industrial sector in Chile has a predominantly monopolistic structure which we would expect in any small economy as the chilean one.

In this respect the research done has arrived at conclusions such as the following ones:

Ricardo Lagos[2] in his summary of conclusions says that in 1957:

"The level of industrial concentration is rather high; the 52 largest firms of the country (they represent less than 1% of all firms) generate 38% of the value added in the industrial sector".[3]

Oscar Garretón and Jaime Cisternas[4] conclude that for 1966:

"about 17% of all enterprices control 78,2% of total assets in the corporate sector".[5]

See also footnote 8 in chapter II.

In our work we will begin assuming a pricing method that consists of a mark-up over variable cost . This mark-up will be modified by the demand conditions in the market for

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2. Lagos, Ricardo, "La Industria en Chile: Antecedentes Estructurales", Universidad de Chile, Instituto de Economía, 1966.
3. Op.cit. page 104 Author's free translation..
4. Garretón, Oscar and Cisternas, Jaime, "Algunas características del Proceso de Toma de Decisiones en la Gran Empresa: La Dinámica de Concentración", Servicio de Cooperación Técnica, Marzo, 1970.
5. Op.cit. page 8. Author's free translation.

industrial products.[6/] For commodities subject to price controls this mark-up is the results of price negotiations.

(i) Full Cost Pricing:

In this case it is assumed that

(1.1.1) $P^I(t) = (1+\mu)\left[TUC(t)\right]$

where:

$TUC(t) = ULC(t) + UIMC(t) + UDMC(t) + UCC(t)$

$ULC(t)$ = Unit Labor Cost

$UIMC(t)$ = Unit Imported Material Cost

$UDMC(t)$ = Unit Domestic Material Cost

$UCC(t)$ = Unit Capital Cost

μ = Mark-up Coefficient.

This is a behavioral equation and as such it is enterely compatible with the identity between price and average cost of production:

$$P^I(t) = ULC(t) + UIMC(t) + UDMC(t) + UCC(t) + R(t)$$

where: $R(t)$ is the residual.

What equation (1.1.1) says is that given the unit costs of that equation the residual is a consequence of the pricing method. Furthermore this equation is incompatible in general with

---

6. The most important works on the specification of a price equation from which we learned much are:
   - Eckstein and G. Fromm, "The Price Equation", American Economic Review, December 1968.
   - R.G. Lipsey and J.M. Parkin, "Income Policy: A Re-appraisal", Economica, May 1970.
   - Bodkin, R.G., The Wage, Price, Productivity Nexus, Philadelphia, 1966.

the assumption of profit maximization (however, see below).

Let us assume now that unit capital cost are a fixed proportion of total unit cost.[7/] This last assumption implies

(1.1.2) $UCC(t) = \lambda\left[ULC(t) + UIMC(t) + UDMC(t)\right]$

Substituing this last expresion in (1.1.1) we get

$$P^{I}(t) = (1+\mu)(1+\lambda)\left[ULC(t) + UIMC(t) + UDMC(t)\right]$$

If we differentiate this last expression with respect to time and then divide through by $P^{I}(t)$ we get:

$$\frac{\dot{P}^{I}(t)}{P^{I}(t)} = (1+\mu)(1+\lambda)\frac{ULC(t)}{P^{I}(t)}\frac{\dot{ULC}(t)}{ULC(t)} + (1+\mu)(1+\lambda)\frac{UIMC(t)}{P^{I}(t)}\frac{\dot{UIMC}(t)}{UIMC(t)}$$

$$+ (1+\mu)(1+\lambda)\frac{UDMC(t)}{P^{I}(t)}\frac{\dot{UDMC}(t)}{UDMC(t)}$$

Where the dots indicate time differentials:

If we assume that the shares of labor cost, domestic material cost and imported materials cost in the value of production are constant (this is equivalent to the fixed value coefficients assumed by the Cauas Model to which we referred in Chapter II) we get:

(1.1.3) $$\frac{\dot{P}^{I}(t)}{P^{I}(t)} = \alpha_1\frac{\dot{ULC}(t)}{ULC(t)} + \alpha_2\frac{\dot{UIMC}(t)}{UIMC(t)} + \alpha_3\frac{\dot{UDMC}(t)}{UDMC(t)}$$

Where: $\alpha_1 = (1+\mu)(1+\lambda)\frac{ULC(t)}{P^{I}(t)}$, $\alpha_2 = (1+\mu)1+\lambda)\frac{UIMC(t)}{P^{I}(t)}$

7. This is a sound hypothesis for the short run where most of the capital cost is a fixed cost.

and $\alpha_3 = (1+\mu)(1+\lambda) \frac{UDMC(t)}{P^I(t)}$

If this is the case, the ratio of the coefficients in (1.1.3) will have a clear interpretation in terms of relative cost.

(ii) Profit Maximization Case:

Let us consider the case of a monopolist in the commodity market who faces fixed prices in the market for factors (the results would be the same up to a constant if the producer is a monopsonist in the market for factors with constant elasticity of demand for factors). Let us assume further that the production function is a Cobb-Douglas. Then it can be shown from a fundamental theorem of duality that the price of the product is a Cobb-Douglas function of the price of inputs with the same exponents as the production function.

This means that

(1.1.4) $P^I = B\, W_1^{\alpha_1}\; W_2^{\alpha_2} \; \ldots\ldots \; W_u^{\alpha_u}$

Where:

W_j = price of input j

α_j = constant elasticity of production with respect to factor j

B = constant related to the constant of the production function and the elasticity of production.

From (1.1.4) we can get:

(1.1.5) $\frac{\dot{P}^I(t)}{P^I(t)} = \Sigma\, \alpha_i \left(\frac{\dot{W}_i(t)}{W_i(t)}\right)$

Let us now assume that we have four inputs: labor, capital, imported raw materials and domestic materials.

Therefore (1.1.5.) can be written as:

$$(1.1.6)\quad \frac{\dot{P}^I(t)}{P^I(t)} = \alpha_L \frac{\dot{W}_L(t)}{W_L(t)} + \alpha_K \frac{\dot{W}_K(t)}{W_K(t)} + \alpha_{DM} \frac{\dot{W}_{DM}(t)}{W_{DM}(t)} + \alpha_{IM} \frac{\dot{W}_{IM}(t)}{W_{IM}(t)}$$

Where:

α_L = elasticity of production with respect to labor

α_K = elasticity of production with respect to capital

α_{DM} = elasticity of production with respect to domestic materials

α_{IM} = elasticity of production with respect to imported materials

W_L = price of labor services

W_K = price of capital services

W_{DM} = price of domestic materials

W_{IM} = price of imported materials

Let us further assume that the rate of return (r) and the depreciation rate (d) on capital are constant. Then:

$$W_K = P^K(d + r)$$

Where P^K is the price of capital goods.

Then $\dfrac{\dot{W}_K(t)}{W_K(t)} = \dfrac{\dot{P}^K(t)}{P^K(t)}$. Now considering the Chilean case where most equipment is imported, and assuming that there is a constant ratio of capital stock in equipment to capital stock in plant we will further have:

$$\frac{\dot{P}^K(t)}{P^K(t)} = \frac{\dot{W}_{IM}(t)}{W_{IM}(t)}$$

We are here implicitely assuming that the price of imported equipment and imported raw materials have the same rate of change.

Replacing this last expression in (1.1.6) we get:

$$\frac{\dot{P}^I(t)}{P^I(t)} = \alpha_L \frac{\dot{W}_L(t)}{W_L(t)} + \alpha_K \frac{\dot{W}_{IM}(t)}{W_{IM}(t)} + \alpha_{DM} \frac{\dot{W}_{DM}(t)}{W_{DM}(t)} + \alpha_{IM} \frac{\dot{W}_{IM}(t)}{W_{IM}(t)}$$

Due to the fact that we are studying the industrial price equation we can further assume that the rate of change of the price of domestic imputs is the same as that of industrial prices. In this case we get:

$$(1.1.7) \quad \frac{\dot{P}^I(t)}{P^I(t)} = \beta_1 \frac{\dot{W}_L(t)}{W_L(t)} + \beta_2 \frac{\dot{W}_{IM}(t)}{W_{IM}(t)}$$

Where:

$$\beta_1 = \frac{\alpha_2}{1-\alpha_{DM}} \quad \text{and} \quad \beta_2 = \frac{\alpha_K + \alpha_{IM}}{1 - \alpha_{DM}}$$

Let us now transform equation (1.1.4) from an equation in the price of inputs to an equation in unit costs.

Using the assumption that the production function is homogeneous of first degree we have:

$$P^I = \left[\frac{W_1 V_1}{Q}\right]^{\alpha_1} \left[\frac{W_2 V_2}{Q}\right]^{\alpha_2} \cdots\cdots \left[\frac{W_m V_m}{Q}\right]^{\alpha_m}$$

Where: Q is output and

V_i is the physical amount of imput i.

From this we obtain:

$$\frac{\dot{P}^I(t)}{P^I(t)} = \Sigma \alpha_i \frac{U\dot{V}_iC(t)}{UV_iC(t)}$$

Where $UV_iC(t)$ = Unit Cost of input i in period t.

Let us again assume that we have four inputs: labor, capital, imported raw materials and domestic raw materials. Let us assume further that the rate of change in unit domestic raw material prices is the same that the rate of change in industrial prices and that the rate of change in the unit cost of capital is the same as the rate of change in unit cost of imported raw materials. This is a sound hypothesis for an economy like the chilean one in which most of the capital goods are imported and most of the changes in unit costs are due to changes in prices. In this case we get:

$$(1.1.8) \quad \frac{\dot{P}^I(t)}{P^I(t)} = \gamma_1 \frac{U\dot{L}C(t)}{ULC(t)} + \gamma_2 \frac{UI\dot{M}C(t)}{UIMC(t)}$$

Where:

$$\gamma_1 = \frac{\alpha_L}{1 - \alpha_{DM}} \qquad \gamma_2 = \frac{\alpha_{IM} + \alpha_K}{1 - \alpha_{DM}}$$

Due to the assumption of constant returns we will expect that the coefficients in (1.1.8) should add up to one.

Now we will add to the dynamic behavior of prices due to cost elements expressed in equation (1.1.8), the demand pressures in the market for industrial products.

The final expression for the price changes will be given by:

$$(1.1.9) \quad \frac{\dot{P}^I(t)}{P^I(t)} = \gamma_1 \frac{U\dot{L}C(t)}{ULC(t)} + \gamma_2 \frac{UI\dot{M}C(t)}{UIMC(t)} + f\left(\frac{D(t)-Q(t)}{Q(t)}\right) + \eta(t)$$

Where (D(t) is the demand for industrial products and

Q(t) is the production of industrial products.

Now to have an explicit price equation we need to specify the function f.

We will distinguish three cases:

Case 1.

In this case we will assume that pressures on prices comming from the commodity market are a linear function of excess demand in the commodity market.

Specifically we will assume:

$$f\left(\frac{D(t)-Q(t)}{Q(t)}\right) = h_o + h_1 \left[\frac{D(t)-Q(t)}{Q(t)}\right] = (h_o - h_1) + h_1 \frac{D(t)}{Q(t)}$$

Where h_o takes care of some upward pressures in prices even if D(t) = Q(t). This will be generated mainly through within the sector disequilibriums caused manly by changes in the composition of the industrial sector demand.

Unfortunately we do not have any direct measure of demand pressures in the market for industrial products (such as unfilled orders, inventory change, etc.). What we will do is to try to find a proxy for this excess demand.

We will specifically assume that in this non competitive system the pricing equation already discussed, assumes a target level use of capacity. If the price determined in (1.1.8) is too high there will be excess capacity and therefore prices will be marked down.

Therefore we could approximate, for a world of price makers, the demand pressures in the market by an index of capacity utilization.[8/]

8. This point is due to discussions with Professor F.M.Fisher.

Introducing this in (1.1.9) we get:

$$(1.1.10)\quad \frac{\dot{P}^I(t)}{P^I(t)} = \delta_0 + \delta_1 \frac{\dot{ULC}(t)}{ULC(t)} + \delta_2 \frac{\dot{UIMC}(t)}{UIMC(t)} + \delta_3 CU(t) + \tilde{\eta}\ (t)$$

Where $CU(t) = \frac{D(t)}{Q(t)}$ is an index of capacity utilization, used as a measure of the demand pressures in the market for industrial products.

Case 2.

In this case we will assume that the pressures coming from the demand side are some non linear function of the excess demand in the market.[9] Specifically we will assume that:

$$f(\frac{D(t)-Q(t)}{Q(t)}) = k_0 + k_1 NLCU(t)$$

Where:

$$NLCU(t) = \text{sign}\ (\frac{D(t)}{Q(t)} - M(\frac{D(t)}{Q(t)})\ ) \cdot (\frac{D(t)}{Q(t)} - M\ (\frac{D(t)}{Q(t)})\ )^2$$

And $M(\frac{D(t)}{Q(t)})$ is the sampling mean of $\frac{D(t)}{Q(t)}$

Introducing this in (1.1.9) we will get:

$$(1.1.11)\quad \frac{\dot{P}^I(t)}{P^I(t)} = \varepsilon_0 + \varepsilon_1 \frac{\dot{ULC}(t)}{ULC(t)} + \varepsilon_2 \frac{\dot{UIMC}(t)}{UIMC(t)} + \varepsilon_3\ NLCU(t) + \bar{\eta}(t)$$

To make this point clear let us consider the following example. Assume that in the first quarter of a year capacity

9. A similar treatment has been used by R.M. Solow in "Price Expectations and the behavior of the Price Level", Manchester University Press, 1969.

utilization reaches its upper limit (let us say 90%) but fiscal and monetary policy continue being expansive in the following quarters. Our equations (1.1.10) and (1.1.11) will say that the demand pressures remain the same as in the first quarter.

To take care of this shortcoming we will consider another choice for the function f.

<u>Case 3</u>:

Here we will assume that:

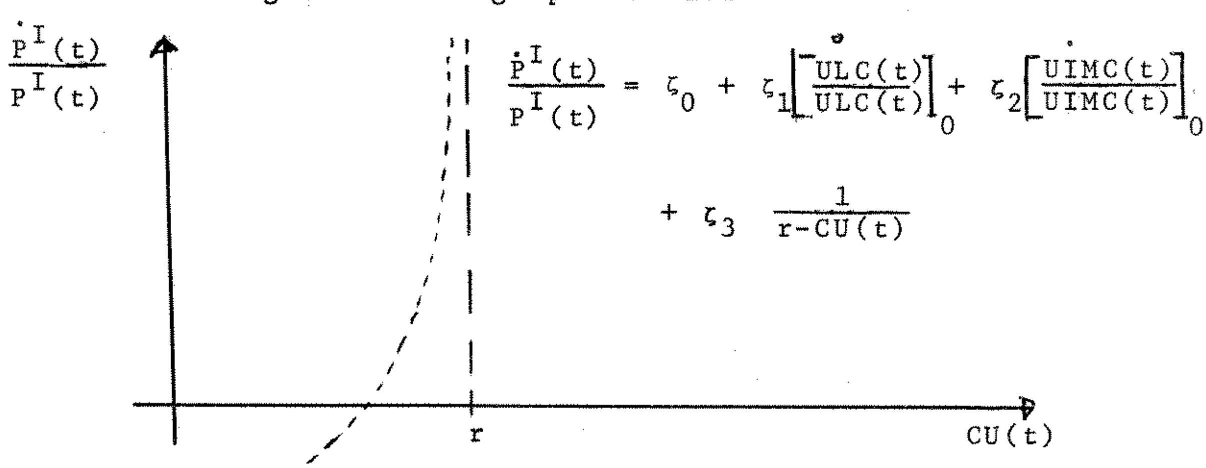
$$f\left(\frac{D(t)-Q(t)}{Q(t)}\right) = m_0 + m_1 \frac{1}{r-CU(t)} \quad \text{with } CU(t) < r.$$

Where r is the upper limit to capacity utilized in the industrial sector. In this specification when the capacity utilized approaches its ceiling r the pressures on prices become higher and higher becoming infinite in the limit.

Substituting this in (1.1.9) we will have:

$$(1.1.12) \quad \frac{\dot{P}^I(t)}{P^I(t)} = \zeta_0 + \zeta_1 \frac{\dot{ULC}(t)}{ULC(t)} + \zeta_2 \frac{\dot{UIMC}(t)}{UIMC(t)} + \zeta_3 \frac{1}{r-CU(t)} + \eta^*(t)$$

Putting this in a graph we have:



Where:

$\left[\frac{\dot{ULC}(t)}{ULC(t)}\right]_0$ and $\left[\frac{\mathring{UIMC}(t)}{UIMC(t)}\right]_0$ are some given values of both variables.

In our empirical work we could not estimate an equation like (1.1.9) because we did not have data on unit imported raw material cost. Due to this fact, we had to split the change in unit imported raw material cost into two components: change in imported raw material prices and change in imported raw material requirements per unit of production.

In this way we can rewrite (1.1.9) as:

$$(1.1.9)' \quad \frac{\dot{P}^I(t)}{P^I(t)} = \zeta_0 + \zeta_1 \frac{\dot{ULC}(t)}{ULC(t)} + \zeta_2 \frac{\mathring{P}^M(t)}{P^M(t)} + \zeta_2 \frac{\dot{UIM}(t)}{UIM(t)} + $$

$$+ \zeta_3 f\left(\frac{D(t)-Q(t)}{Q(t)}\right) + \eta(t)$$

Where UIM(t) = Unit Imported raw materials in period t

$P^M(t)$ = Price of Imports in period t.

And we proceed to estimate:

$$(1.1.9)'' \quad \frac{\dot{P}^I(t)}{P^I(t)} = \zeta_0 + \zeta_1 \frac{\dot{ULC}(t)}{ULC(t)} + \zeta_2 \frac{\mathring{P}^M(t)}{P^M(t)} + \zeta_3 f\left(\frac{D(t)-Q(t)}{Q(t)}\right) + \psi(t)$$

If model (1.1.9) is correct, when we estimate (1.1.9)" we are making a specification error which we should consider in the interpretation of the final results. It is interesting to note that if the rate of change in UIM(t) is steady, its effects will be included in the constant in (1.1.9)". Furthermore in the Leontief constant coefficient case this rate will be zero.

1.2. Definition of variables.

i) Quarterly Price Index of Industrial Commodities:

We used the manufacturing industry component of the wholesale price index with base in 1947. The dependent variable in our regressions is the overlapping four quarters annual rate of change in this index.

ii) Unit Labor Cost:

This is defined as the product of an index of wages and salaries in the industrial sector and an index of labor requirements per unit of production. The Index of wages and salaries in the Industrial sector starts only in April 1963. The Index of labor requirements per unit of production was defined as a ratio between an index of industrial employment and an index of industrial production. There are two different production indexes one computed by the National Institute of Statistic and the other by the Association of Industrial Entrepeneurs, the first one has a broader coverage. In our estimations we used both and the results were slightly better for the National Institute of Statistics Index. We report here results obtained with this last index.

In the empirical analysis that we will discuss we consider different numbers of quarters in the definition of the index of labor requirements. The rate of change of the unit labor cost is defined as the overlapping four quarters annual rate of change in the unit labor cost.

iii) Quarterly Price Index of Imported Raw Materials:

We used the imported raw materials component of the wholesale price index with base in 1947. The rate of change is defined as the overlapping four quarters rate of change of this price index.

iv) Capacity Utilization:

This is defined as the ratio between a quarterly index of industrial production and a quarterly index of maximum industrial production. This last index was built using linear interpolation from the peaks in the monthly index of industrial production. We made a correction for the level of this variable using the capacity utilization figures estimated by the Institute of Economic Research of the University of Chile, for the second half of 1961 from a survey of 42 industrial firms.

1.3. The Results:

We present in Table 1 the results of estimating the model just described.[10/] (see next page)

From this table it is clear that independently of the specification of the equation the coefficient of the rate of change in imported raw material prices is fairly steady. We also tried some distributed lags for this variable but it did not improve the results.

In the estimations we tried different distributed lags in the explanatory variables but we always got better results without them. This result can be due to the high speed of adjustment to price changes for an economy with a long history of inflation.

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10. In this section we consider only the specification corresponding to case 1 for the capacity utilization variable. This is due to the fact that most of the estimations were done before these alternative cases were thought of, and it was not thought worth while to rerun these regressions because we are mainly interested in the model in section 3 which is estimated by an estimation procedure that takes into consideration the simultaneity of the model. At that time we consider these alternative formulations.

TABLE 1*

# of the equation	Constant	Rate[a/] of change unit labor cost (2)	Rate of change unit labor cost (4)	Rate of change unit labor cost (6)	Capacity[b/] utilization (4)	Rate of change imported raw material prices	R^2 [c/]	D.W.[d/]
1.1	-2.586	.430			3.344	.362	.882	1.38
	(-4.513)[c/]	(4.775)			(4.463)	(6.184)		
1.2	-2.643		.508		3.369	.390	.917	1.81
	(-5.612)		(6.224)		(5.471)	(7.807)		
1.3	-2.817			.596	3.531	.447	.933	2.04
	(-6.806)			(7.166)	(6.519)	(9.389)		

# of the equation	Constant	Rate of change unit labor cost (8)	Rate of change unit labor cost (12)	Capacity utilization (4)	Rate of change imported raw material prices	R^2	D.W.
1.4	-3.115	.574		3.927	.434	.923	1.72
	(-7.210)	(6.556)		(7.003)	(8.623)		
1.5	-3.237		.644	4.058	.420	.897	1.30
	(-6.497)		(5.298)	(6.269)	(7.243)		

* The sample size for all these regressions was 19.

a/ The number in parenthesis indicates the numbers of quarters used in the definition of the Index of unit labor requirements.

b/ The number in parenthesis indicates the number of quarters utilized in the definition of the variable.

c/ The numbers in parenthesis are the t-statistics of the respective coefficients.

d/ R^2 is the Coefficient of Multiple Determination
D.W. is the Durbin and Watson Statistic.

In terms of t-statistics and R^2, the equations (1.4), (1.3) and (1.2) are the best, in the same order.

For most of these cases the sum of the coefficients for the unit labor cost and the imported raw materials variables is not significantly different from one as we expected a priori.

It is important to note that due to the simultaneity of the model,the coefficients and the associated "t" statistics do not have much value if we do not study the specific bias introduced in the estimation of the coefficients and in their standard errores. This same argument applies to the Durbin-Watson statistic which is now only a descriptive statistic.

In the estimation of the equations of table 1, we implicitly introduced the assumption that the coefficient of the rate of change in wages and the coefficient of the rate of change in unit labor requierements were the same. Now we want to split the unit labor cost into its two components and use regression to estimate their impact on the price variable.

In Table 2, we present the same equations, the only difference being taht the unit labor cost has been split into the rate of change in the index of wages and salaries and into the rate of change in unit labor requirements. (See Table 2 into in next page).

As we see from this table, the rate of change of unit labor requirements has a very poor showing. In some cases it has the wrong sign and it never has a t statistic over 1.753 for all periods considered. Here there is almost no difference between (2.1), (2.2), (2.3), (2.4) and (2.5).

What puzzles us is the poor showing of the labor requirements variable. An explanation of this can be the fact that the dominant element in unit labor cost is the rate of change in industrial wages, which is around 30% for most of the

Table 2. 1/

# of the equation	Constant	Rate of Change wages & salaries	Rate of change unit labor requir. (2)	Rate of change unit labor requir. (4)	Rate of change unit labor requir. (6)	Capacity utilization (4)	Rate of change prices of imported raw material	$\bar{R}^2$	D.W.
2.1	-2.427	.651	.020			3.035	.394	.889	1.47
	(-4.648)	(5.480)	(.079)			(4.364)	(7.136)		
2.2	-2.458	.648		-.145		3.077	.391	.891	1.40
	(-4.726)	(5.881)		(-.206)		(4.475)	(7.354)		
2.3	-2.355	.666			.573	2.931	.403	.895	1.66
	(-4.646)	(6.061)			(.836)	(4.357)	(7.614)		

# of the equation	Constant	Rate of change wages & salaries	Rate of change unit labor requir. (8)	Rate of change unit labor requir. (12)	Capacity utilization (4)	Rate of change prices of imported raw material	$\bar{R}^2$	D.W.
2.4	-2.445	.664	1.068		3.039	.420	.896	1.75
	(-4.920)	(6.087)	(.871)		(4.627)	(6.990)		
2.5	-2.594	.673		1.552	3.227	.416	.895	1.50
	(-4.787)			(.756)	(4.596)	(6.913)		
2.6	-2.436	.6[illegible]7			3.048	.393	.897	1.45
	(-4.944)	(5.077)			(4.678)	(7.704)		

1/ See notes at the end of Table 1.-

period; and therefore this is the variable that is used as a proxy for labor cost in pricing policy.

In light of this last comment, we left out the rate of change of unit labor requirements[11/] and got the results that appear in equation (2.6).

We see that in terms of t-statistics and $\bar{R}^2$, equation (2.6) is slightly better that the other equations from table 2. Furthermore the sum of the coefficients of the price variables is close to one. This is what we should expect in accordance with the discussion at the beginning of this section.

This means that the data do not disprove the hypothesis that the wage variable is the main element considered as a proxy for unit labor cost in the pricing mechanism.

In the last section of this chapter, we will test for non linearities in this price equation in the context of a simultaneous model.

It is important to note that if we use equation (2.6) to predict changes in industrial prices this does not include the feed-backs that are possible. The most obvious one is from industrial prices to cost of living and from there to industrial wages. We will study this in more detail after studying wages in the industrial sector, in the next section.

11. This equation corresponds also to the equation (1.1.3) considered at the beginning of this chapter.

2.- Wages in the Industrial Sector.

For the last twenty years in Chile we have had periodicals laws of wage increases. The main objective of these laws have been to "protect" wage earners against the loss in real income produced by inflation.[12/] These laws are dictated for the public sector and include some rules for the private sector. These rules have been in the form of minimum wage increases or general recommendation for wage increases. The importance of this legislation for our work is that it can include non market elements in the behavior of wages in the Industrial sector.

The other important point is timing. Wage laws are usually enacted for a calendar year. If in the industrial sector the increase in wages is concentrated in the first quarter of the year there is no point in building a quarterly model. Fourtunatelly this is not the case for the industrial sector. The different firms have wage negotiation all year long as can be seem in the next table:

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12. J. Ramos in "Política de Remuneraciones en Inflaciones Persistentes" Instituto de Economía y Planificación. Universidad de Chile, 1970, shows that the behavior of real wages has not been too much related with the wage legislation.

WAGES IN THE INDUSTRIAL SECTOR

Wages and Salaries index.

Quarter	(average 1965 = 100,0)
1963.2	46,1
1963.3	46,6
1963.4	52,3
1964.1	60,1
1964.2	68,5
1964.3	73,2
1964.4	76,3
1965.1	81,1
1965.2	98,3
1965.3	108,2
1965.4	112,4
1966.1	123,3
1966.2	141,3
1966.3	148,7
1966.4	156,7
1967.1	170,4
1967.2	181,2
1967.3	194,4
1967.4	207,4
1968.1	222,2
1968.2	238,6
1968.3	249,0
1968.4	272,7

Source: Different issues Monthly Bulletin Central Bank.

2.1. The Model

Again, given the structure of labor organizations in Chile, we will expect some mix of competitive and non competitive market behavior in the determination of industrial wages.

On the competitive side we will assume that:

$$(2.1.1) \quad \frac{\dot{w}(t)}{w(t)} = \beta_1 + \beta_2\left(\frac{d(t)-s(t)}{s(t)}\right) + \frac{\dot{CL}(t)}{CL(t)} + \theta(t)$$

Where:

$\frac{\dot{w}(t)}{w(t)}$ = Rate of change in the nominal wage rate.

$d(t)$ = Quantity demanded of labor.

$s(t)$ = Quantity supplied of labor (labor force).

$\frac{\dot{CL}(t)}{CL(t)}$ = Rate of change in the cost of living.

$\theta(t)$ = Random error

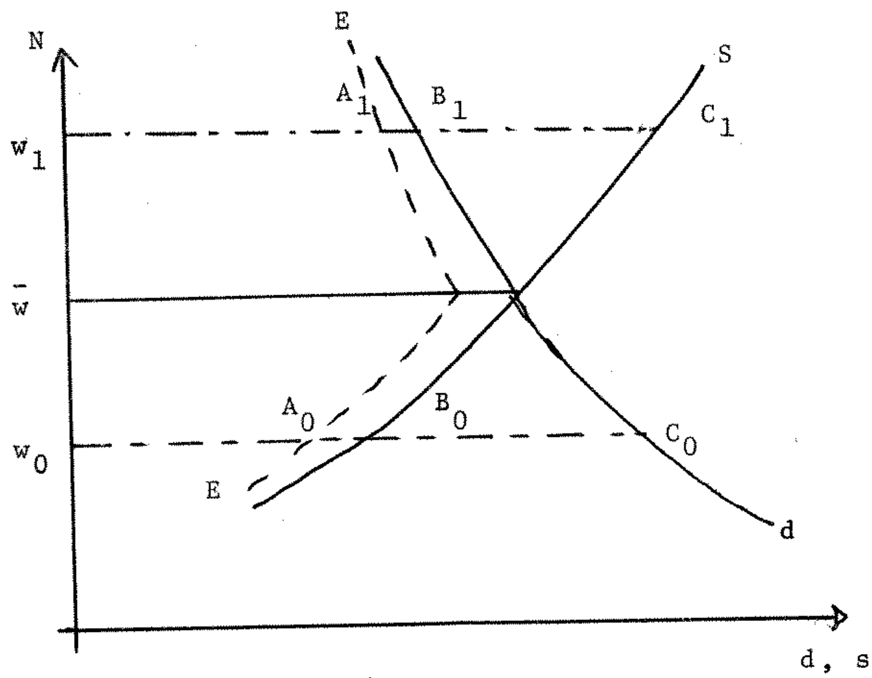
If we add to this the pressures on wages due to non competitive elements in the organization of the labor market, we will have:

$$(2.1.2) \quad \frac{\dot{w}(t)}{w(t)} = \beta_1 + \beta_2\left(\frac{d(t)-s(t)}{s(t)}\right) + \beta_3 \frac{\dot{CL}(t)}{CL(t)} + \omega(t)$$

The amount by which β_3 differs from one is an indicator of non competitive elements in the labor market.

Given the fact that we do not have observations for d(t), we have to introduce some transformations to (2.1.2) before proceeding to estimate it.

Let us describe the labor market in the following graph[13]:



Where:

s = Supply of labor.

d = Demand for labor

EE = Employment

The distance between s and EE for $w \leq \bar{w}$, and between d and EE for $w \geq \bar{w}$, is a measure of frictional unemployment. This frictional unemployment is due mainly to lack of information for suppliers and demanders.

For a wage rate w_0 below the equilibrium rate $\bar{w}$, we will have:

---

13. After the first draft of this paper was written, a paper by Bent Hansen where he presents a similar theoreticla analysis came to our attention. Hansen B. "Excess Demand, Unemployment, Vacancies, and Wages". Quarterly Journal of Economics. Vol. LXXXIV N°1, Feb. 1970.

B_0C_0 = Excess demand for labor.

A_0C_0 = Unfilled vacancies.

A_0B_0 = Measured unemployment.

For a wage rate w_1, above the equilibrium rate $\bar{w}$ we will have:

B_1C_1 = Excess demand for labor (negative)

A_1B_1 = Unfilled vacancies

A_1C_1 = Measured unemployment

From our characterization of the labor market, it is clear that for conditions where $w < \bar{w}$, measured unemployment is a very bad proxy for excess demand in the labor market. For $w > \bar{w}$, the higher is w the better is unemployment as a proxy for excess demand (negative in this case).

In general we will have:

(2.1.3) $d - s = V - U$

Where:

V = Total unfilled vacancies.

U = Total unemployment.

It is easy to see that $V = d - E$ and $U = s - E$, where E = Total employment. Therefore, equilibrium in the labor market ($d = s$) implies that the number of people looking for jobs (U) be equal to the number of unfilled vacancies (V).

The problem is that we do not have observations on V; therefore we need to relate it to some variable for which we have observations. We will study three different cases.

Case 1:

In this case we are interested in estimating the relation for points where $w \geq \bar{w}$. This is the case in which unemployment is due mainly to the inflexibility of wages. Here we can approximate the excess demand in the labor market by the level of unemployment.

Specifically we will have:

$d(t) - s(t) = -U(t)$, and introducing this in (2.1.2) we get:

$$(2.1.4) \qquad \frac{\dot{w}(t)}{w(t)} = \beta_1 - \beta_2 \frac{U(t)}{s(t)} + \beta_3 \frac{\dot{CL}(t)}{CL(t)} + \tilde{\omega}(t)$$

Case 2:

Here we will consider the simple Phillips curve kind of argument approximating $\frac{d(t) - s(t)}{s(t)}$ by $a + \frac{b}{U(t)/s(t)}$ introducing this in (2.1.2) we get:

$$(2.1.5) \qquad \frac{\dot{w}(t)}{w(t)} = \gamma_1 + \gamma_2 \frac{1}{U(t)/s(t)} + \gamma_3 \frac{\dot{CL}(t)}{CL(t)} + \chi(t)$$

Case 3:

The last case that we will study corresponds to a steady-state solution which is derived from the basic Lipsey Model.[14/]

Following Lipsey, for a given wage rate, we will assume a steady-state in which the number of people leaving jobs is equal to the number of unemployed that find jobs.

We need to introduce some additional terms: let us define;

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14. Lipsey, Richard G. "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957: A Further Analysis". Economica, Vol XXVII, Feb. 1960.

R = Number of employed that leave employment per unit of time.
F = Number of unemployed finding jobs per unit of time.

We will assume that:[15/]

$R = f_1(E,V)$ and $F = f_2(U,V)$

In the steady-state R = F implying that $f_1(E,V)=f_2(U,V)$. We can solve this for $V = g(E,U)$ and introduce this in (2.1.3) to get a relation among observed variables.

In this case we assume that f_1 and f_2 are linear in their arguments and are homogeneous.

Therefore,

$R(t) = a_1E(t) + a_2V(t)$

$F(t) = b_1U(t) + b_2V(t)$

In the steady state:

$$V(t) = \frac{b_1}{a_2 - b_2} U(t) - \frac{a_1}{a_2 - b_2} E(t)$$

Introducing this in (2.1.2), we get:

$$\frac{\dot{w}(t)}{w(t)} = \delta_1 \frac{E(t)}{s(t)} + \delta_2 \frac{U(t)}{s(t)} + \delta_3 \frac{\dot{CL}(t)}{CL(t)} + \mu(t) \qquad (2.1.6)$$

Here we excluded the constant since otherwise we would have had perfect collinearity among the regressors.

Before presenting the estimation of these three different equations, we will define the variables used in the regressions.

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15. It is important to note that Lipsey assumes that R is not a function of V. We do not know what his reason was for including it in F and excluding it in R. If in his specification of the functions f_1 and f_2 we introduce V in both, then V will cancel and he will not be able to get V out of this steady-state solution.

2.2. Definition of the variables

$\frac{\dot{w}(t)}{w(t)} = \frac{w(t)-w(t-4)}{w(t-4)} =$ Overlapping four quarters annual rate of change in the Index of wages and salaries in the industrial sector.

$\frac{U(t)}{s(t)} =$ Last four quarters weighted average rate of unemployment in the industrial sector. Where the weights are the employment levels.

$\frac{\dot{CL}(t)}{CL(t)} =$ Overlapping four quarters annual rate of change in the Index of retail prices.

$\frac{E(t)}{s(t)} =$ Last four quarters weighted average rate of employment in the industrial sector.

2.3. The Results

Here we will present the estimates that were obtained using ordinary least squares for the equations just presented. These results are shown in Table 3 on next page.

Table 3.

# of the equation	Constant	Unemployment rate	Reciprocal of unemployment rate	Employment rate	$\frac{\dot{CL}(t)}{CL(t)}$	$\frac{\dot{CL}(t-1)}{CL(t-1)}$	R^2	D.W.
3.1	.888	-9.556					.247	.59
	(4.253)	(-2.359)						
3.2	.853	-12.885			.718		.795	2.11
	(7.651)	(-5.762)			(6.544)			
3.3	.796	-11.327				.612	.760	1.89
	(6.555)	(-4.765)				(5.847)		
3.4	-.073		.024				.240	.56
	(-.382)		(2.314)					
3.5	-.463		.033		.731		.804	2.17
	(-3.812)		(5.941)		(6.780)			
3.6	-.368		.029			.627	.774	1.94
	(-2.955)		(5.016)			(6.153)		
3.7	-	-8.674		.881			.248	.59
		(-2.256)		(4.253)				
3.8	-	-12.032		.853	.718		.801	2.11
		(-5.651)		(7.651)	(6.544)			

In examining these results, we see that (3.7) and (3.8) are very similar to the equations (3.1) and (3.2) with the constants of the latter pair playing the role of the Employment rate terms of the former. It is easy to see this from the fact that the employment/unemployment ratio is very close to one. Having observed this, we discard (3.7) and (3.8).

Another important point to mention is that the coefficients of change in the cost of living are very stable in equations (3.2), (3.3), (3.5) and (3.6). Related to this it is worth noticing that the unemployment rate or its reciprocal explain no more than 25% of the variance of the rate of change in wages and that the introduction of rate of change in the cost of living improves the results quite substantially. In this respect the results agree with those of Lipsey for England. It is important to note that when we tried a distributed lag in cost of living we did not improve our results. This can be due, again to the fact that for an economy with a long history of high inflation rate people become very sensitive to price changes.

Finally we can see from the table that there is little difference between equations (3.1)-(3.3) and (3.4)-(3.6).

To study the interaction between the price and wage equation in the determination of the cost of living, we go to the following section where we present a simultaneous model.

3. Industrial Prices, Industrial Wages and Cost of Living.

In this section we will consider, in the contex of a simultaneous model, the equations that we studied in the first two sections. We will discuss the problems arising from the indiscriminate use of two stage least squares in the estimation of this type of subsystem and later, we will estimate it using instrumental variables.

3.1. The Price Subsystem.

Let us consider first the following simultaneous sub-model:

$$(3.1.1)\quad \frac{\dot{w}^I(t)}{w^I(t)} = a_1 + a_2 \frac{1}{U(t)/s(t)} + a_3 \frac{\dot{CL}(t)}{CL(t)} + \varepsilon^{w^I}(t)$$

$$(3.1.2)\quad \frac{\dot{P}^I(t)}{P^I(t)} = b_1 + b_2 \frac{\dot{w}^I(t)}{w^I(t)} + b_3\, CU(t) + b_4 \frac{\dot{P}^m(t)}{P^m(t)} + \varepsilon^{P^I}(t)$$

$$(3.1.3)\quad \frac{\dot{P}(t)}{P(t)} = c_1 \frac{\dot{P}^f(t)}{P^f(t)} + c_2 \frac{\dot{P}^I(t)}{P^I(t)} + c_3 \frac{\dot{P}^m(t)}{P^m(t)} + \varepsilon^P(t)$$

$$(3.1.4)\quad \frac{\dot{CL}(t)}{CL(t)} = d_1 + d_2 \frac{\dot{P}(t)}{P(t)} + d_3 \frac{\dot{P}(t-1)}{P(t-1)} + d_4 \frac{\dot{P}(t-2)}{P(t-2)} + d_5 \frac{\dot{P}(t-3)}{P(t-3)}$$

Where the variables are:

$\frac{\dot{P}(t)}{P(t)}$ = Four quarters annual rate of change of wholesale prices.

$\frac{\dot{P}^I(t)}{P^I(t)}$ = Four quarters annual rate of change of industrial prices.

$CU(t)$ = Four quarters weighted average of capacity utilization.

$\frac{\dot{P}^m(t)}{P^m(t)}$ = Four quarters annual rate of change of imported raw material prices.

$\frac{\dot{P}^f(t)}{P^f(t)}$ = Four quarters annual rate of change of farm prices.

$\frac{\dot{w}^I(t)}{w^I(t)}$ = Four quarters annual rate of change of Industrial wages.

The derivation of equation (3.1.1) and (3.1.2) was already discussed. What we will do now is study equations (3.1.3) and (3.14).

Although the wholesale price index is a linear combination of its different components with fixed weights, what equation (3.1.3) assumes is that its rate of growth can be approximated by a linear combination of three of its components.[16]

In other words we know that:

$$P(t) = \alpha_f P^f(t) + \alpha_I P^I(t) + \alpha_m P^m(t) + \alpha_o P^o(t)$$

Where $P^o(t)$ is a weighted average of the other prices of the index (see footnote 16).

Then:

$$\frac{\dot{P}(t)}{P(t)} = \frac{\alpha_f P^f(t)}{P(t)} \cdot \frac{\dot{P}^f(t)}{P^f(t)} + \frac{\alpha_I P^I(t)}{P(t)} \cdot \frac{\dot{P}^I(t)}{P^I(t)} + \frac{\alpha_m P^m(t)}{P(t)} \cdot \frac{\dot{P}^m(t)}{P^m(t)} + \frac{\alpha_o P^o(t)}{P(t)} \cdot \frac{\dot{P}^o(t)}{P^o(t)}$$

We are assuming that there is not too much change in relative prices and that therefore we can write:

$$\frac{\dot{P}(t)}{P(t)} = c_1 \frac{\dot{P}^f(t)}{P^f(t)} + c_2 \frac{\dot{P}^I(t)}{P^I(t)} + c_3 \frac{\dot{P}^m(t)}{P^m(t)}$$

We will expect that these weights will add up to one when we estimate this equation.

---

16. We are leaving out the Price of other imports and the Price of mining products but we assume that these minor components, that have a 10% weight in the index, will not bias the estimation too much.

Equation (3.1.4) es included to close the model and it implies that there is some kind of mark-up from wholesale prices to retail prices. If the constant mark up is proportional to the wholesale price then we will expect to get $\Sigma\ d_i = 1$. Furthermore in our equation (3.1.4) we are leaving out services, therefore the constant will take care of part of this effect (the part correlated with $\dot{P}(t)/P(t)$ will be in d_2).

In the specification of equation (3.1.4) we assume that the rate of change in the cost of living (retail prices), is a distributed lag of the rate of change in wholesale prices. The rate of change of wholesale prices here is as an element of cost in retail prices. We should also add to this equation labor cost, but unfortunatelly there is no quarterly data for wages in the retail sector.

To estimate a model like this using two-stage least squares, as G. Perry[17/] did in his book, is equivalent to assume that in each equation, excluding the four left hand variables, the others are truly exogenous in the sense of being uncorrelated in the probability limit with the disturbances of that equation. This will not be true if any of these endogenous variables has some feed back on the unemployment rate or capacity utilization variables as surely will be the case. Therefore it is a mistake to assume that CU(t) and U(t)/s(t) are truly exogenous variables and to use them as instruments in the two-stages least squares estimation procedure. In the estimation procedure that we will use, we will assume that there are other equations from a larger system that describe the behavior of CU(t) and U(t)/s(t), and we will use other exogenous variables as instruments in the estimation of this subsystem. Among them will be the rate of change of the nominal supply of money.

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17. Perry, George L. "Unemployment, Money Wage Rates, and Inflation". The M.I.T. Press, Cambridge, U.S.A. 1966.

3.2. The Results

We will start presenting the results of the estimation of equation (3.1.3). We do this because the estimated equation will be the same for the different price sybsystems that we will present. This is so because this is not a structural equation and therefore we estimated it using ordinary least squares.

When we estimated it we got:

$$(3.1.3.\text{olsq}) \quad \frac{\dot{P}(t)}{P(t)} = \underset{(8.774)}{.408} \frac{\dot{P}^I(t)}{P^I(t)} + \underset{(8.856)}{.340} \frac{\dot{P}^f(t)}{P^f(t)} + \underset{(14.987)}{.240} \frac{\dot{P}^m(t)}{P^m(t)}$$

T = 24.[18]

The sum of the coefficients is .99, therefore for a σ per cent rate of growth in industrial prices, agricultural prices and imported raw materials, the wholesale price index increases by a rate of $.99\sigma$. This is pretty close of the coefficient of one that we expected a priori.

Now we will estimate the other equations of the price subsystem using instrumental variables. In this subsystem the price of farm products can be considered exogenous because most of the farm products (including wheat and all kind of meat) have government fixed prices. The price of imported raw materials can be considered exogenous because its price in the foreign exchange unit is determined by conditions outside the

18. Number of observations.

Chilean economy, the price of foreign exchange is determined by the Central Bank authority, and the tariff structure is policy determined.

On the other hand, if the Central Bank is fixing the price of foreign exchange in accordance with the movement in some of the prices in our system, as has been the policy since 1965 this can affect the exogenous character of price of imported raw materials, when we analyzed this hypothesis we did not find a high correlation between imported materials prices and cost of living for the period under study. We will expect some correlation anyway from the reduced form of our model.

In the complete system to which (3.1.1), (3.1.2),(3.1.3) and (3.1.4) belong, there will be a money sector and in that money sector there will be a variable called the nominal supply of money.

We can take its rate of change as an instrument to be used in the subsystem in which we are interested. We are not saying that the money supply will not affect prices. The money supply will in general affect prices in a quarterly model in two ways: first, through the real liquid wealth affecting the level of consumption; second, through the rate of interest affecting consumption and investment.

In our model, these two effects will reinforce each other and will affect industrial prices via the capacity utilization and the unemployment variables. What we are saying is only that the money supply in itself does not depend on other endogenous variables of our larger system to which (3.1.1), (3.1.2), (3.1.3) and (3.1.4) belong.[19]

19. In general the money supply is an endogenous variable in the sense that it depends on the behavior of financial intermediaries (through their choice of the level of free reserves) and of the public (through their choice of the currency demand deposit ratio). For a first approximation we can take this last ratio as constant and for a economy with a long history of inflation take free reserves to be near zero. Therefore we can take the money supply as exogenous. For an alternative formulation see Chapter IV and V.

The results that we got for our whole submodel using instrumental variables were the following:

$$(3.1.1.i.v) \quad \frac{\dot{w}^I(t)}{w^I(t)} = \underset{(-3.762)}{-.523} + \underset{(5.698)}{.037} \frac{1}{U(t)/s(t)} + \underset{(6.234)}{.704} \frac{\dot{CL}(t)}{CL(t)}$$

Instruments:

$$\frac{\dot{M}(t-1)}{M(t-1)}, \frac{\dot{M}(t-2)}{M(t-2)}, \frac{\dot{P}^m(t)}{P^m(t)}, \frac{\dot{P}^m(t-1)}{P^m(t-1)}, \frac{\dot{P}^f(t)}{P^f(t)}, C.$$

$T = 19 \qquad DW = 2.17$

Where: $\frac{\dot{M}(t)}{M(t)}$ is the overlapping four quarters annual rate of growth in the nominal money supply and C is a constant.

The significant constant term and its negative value in this equation is expected a priori because of the form of the relation between excess demand and unemployment rate already discussed. Furthermore for an unemployment rate equal to 5.55 (average for the period 1960-1968) the unemployment effect is .67. Therefore equation (3.1.1.i.v) is transformed into $\frac{\dot{w}^I(t)}{w^I(t)} = .15 + .704 \frac{\dot{CL}(t)}{CL(t)}$, this results makes sense.

$$(3.1.2.i.v) \quad \frac{\dot{P}^I(t)}{P^I(t)} = \underset{(-1.331)}{-.077} + \underset{(5.520)}{.738} \frac{\dot{w}^I(t)}{w^I(t)} + \underset{(4.276)}{.016} NLCU(t-1)$$

$$+ \underset{(7.603)}{.407} \frac{\dot{P}^m(t)}{P^m(t)}$$

Instruments:

$$\frac{\dot{P}^m(t)}{P^m(t)}, \quad \frac{\dot{P}^m(t-1)}{P^m(t-1)}, \quad \frac{\dot{P}^f(t)}{P^f(t)}, \quad \frac{\dot{M}(t-1)}{M(t-1)}, \quad \frac{\dot{M}(t-2)}{M(t-2)}, \quad \frac{\dot{NM}(t-1)}{NM(t-1)}, \quad C.$$

$T = 19$ $\qquad$ $DW = 1.60$

Where the new variable introduced is:

$\frac{\dot{NM}(t)}{NM(t)}$ = square of the deviation from the mean of $\frac{\dot{M}(t)}{M(t)}$ keeping the sign of the original deviation.

When we consider the alternative specification for the non linearity in this equation we get:

$$(3.1.2.i.v)' \quad \frac{\dot{P}^I(t)}{P^I(t)} = \underset{(-3.656)}{-.166} + \underset{(5.484)}{.688} \frac{\dot{w}^I(t)}{w^I(t)} + \underset{(4.909)}{.0050} \frac{1}{.84-CU(t-1)} + \underset{(8.387)}{.406} \frac{\dot{P}^m(t)}{P^m(t)}$$

Instruments:

$$\frac{\dot{P}^m(t)}{P^m(t)}, \quad \frac{\dot{P}^m(t-1)}{P^m(t-1)}, \quad \frac{\dot{P}^f(t)}{P^f(t)}, \quad \frac{\dot{M}(t-1)}{M(t-1)}, \quad \frac{\dot{M}(t-2)}{M(t-2)}, \quad \frac{NM(t-1)}{NM(t-1)}, \quad C.$$

$T = 19$ $\qquad$ $DW = 1.68$

The significant constant term and its high absolute value in this equation is expected a priori because for CU(t) close its average value (around .80) we will expect no demand pressures in prices. In fact, for CU(t) equal to average capacity utilization rate we get:

$$-.166 + .005 \frac{1}{(.84 - .80)} = -.041$$

Therefore for a situation without cost changes

$\frac{\dot{w}^I(t)}{w^I(t)} = \frac{\dot{P}^m(t)}{P^m(t)} = 0$, and without demand pressures CU(t-1)= .80,

we get from this equation what we expected a priori: $\frac{\dot{P}^I(t)}{P^I(t)} = 0$

For capacity at its average value we should expect that for an equal rate of change of wages and raw material prices, industrial price should increase at the same rate. Therefore we should test whether the sum of the coefficients of the wage variable and the imported price variable is equal to one. The covariance of these two coefficients is .02214. When we ran the test we accepted the null hypothesis that the coefficients add up to one.

Considering these empirical results along with the theoretical discussion in section 1, we will use specification (3.1.2.i.v)' for the industrial price equation in what follows.

For the cost of living equation we assumed that the weights of the distributed lag of wholesale prices follow a second degree polynomial.

Furthermore we assumed a priori that in the explanation of cost of living we should have the rate of change in the wholesale index with a maximum lag of three periods. When we estimated this equation using R.Hall's program[20/], we got:

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20. Hall R.E. "Polynomial Distributed Lags", Working Paper N°7, Department of Economics, Massachusetts Institute of Technology July 28, 1967.

$$(3.1.4.i.v.)\quad \frac{\dot{CL}(t)}{CL(t)} = \underset{(2.553)}{.0391} + \underset{(4.411)}{.3461}\frac{\dot{P}(t)}{P(t)} + \underset{(17.251)}{.2416}\frac{\dot{P}(t-1)}{P(t-1)} +$$

$$+ \underset{(4.437)}{.1491}\frac{\dot{P}(t-2)}{P(t-2)} + \underset{(2.007)}{.0685}\frac{\dot{P}(t-3)}{P(t-3)}$$

Instruments:

$$\frac{\dot{M}(t-1)}{M(t-1)},\ \frac{\dot{M}(t-2)}{M(t-2)},\ \frac{\dot{P}^m(t)}{P^m(t)},\ \frac{\dot{P}^m(t-1)}{P^m(t-1)},\ \frac{\dot{P}^f(t)}{P^f(t)},\ C.$$

$$T = 21 \qquad \text{Mean lag} = \underset{(4.273)}{.926}$$

Equation (3.1.4) says taht for a γ per cent steady rate of growth in wholesale prices, retail prices increase only at a rate of $.805\,\gamma + .039$. This result can be due to the fact that we are leaving out wages in the service sector which may be growing at a higher rate than wholesale prices.

As we saw in the first chapter, a basic element in any formulation of the structural model of inflation is the downward inflexibility of industrial prices.

To test for this inflexibility we estimated equation (3.1.2.i.v) for the periods in which the capacity utilization index was lower than in the previous quarter.

The results were:

$$(3.1.2.i.v)''\quad \frac{\dot{P}^I(t)}{P^I(t)} = \underset{(-3.475)}{-.162} + \underset{(5.711)}{.684}\frac{\dot{w}^I(t)}{w^I(t)} +$$

$$+ \underset{(4.829)}{.0048}\frac{1}{.84-CU(t-1)} + \underset{(7.788)}{.407}\frac{\dot{P}^m(t)}{P^m(t)}$$

Instruments:

$$\frac{\dot{P}^m(t)}{P^m(t)}, \frac{\dot{P}^m(t-1)}{P^m(t-1)}, \frac{\dot{P}^f(t)}{P^f(t)}, \frac{\dot{M}(t-1)}{M(t-1)}, \frac{\dot{M}(t-2)}{M(t-2)}, \frac{\dot{NM}(t-1)}{NM(t-1)}, C.$$

T = 13 DW = 2.80

We could not estimate an equation like (3.1.2.i.v)" for the rest of the sampling period because we did not have enough degrees of freedom to run the first stage of the instrumental variables procedure. Considering this, we ran a Chow test for the case of negative degrees of freedom to study if there were differences between equation (3.1.2.i.v)" and the one for the rest of the period. The computed F was such that we accepted the null hypothesis of no difference for the complete vector of regression coefficients in both periods.[21]

Making the same kind of test for the coefficient of the non linear capacity variable alone, we accepted the null hypothesis again.

If industrial prices were inflexible downward we should have gotten a smaller coefficient for the non linear capacity variable in the priod of slackness in the market for industrial products (when the capacity utilization index was lower than in the previous quarter).

To see this let us consider equation (3.1.2) for the alternative definition of the capacity utilization variable.

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21. For a description of chow tests see Fisher F.M.: "Test of Equality Between Sets of Coefficients in Two Linear Regressions: An Expository Note". Econometrica, March 1970. The limitations of this tests are that we do not know their small sample properties.

From here we get:

$$\frac{\partial \frac{\dot{P}(t)}{P(t)}}{\partial CU(t-1)} = \frac{b_3}{.84-CU(t-1)^2}$$

Therefore we will expect that for the period of demand slackness b_3 would be smaller than for the rest of the period. The hipothesis of equality was the one accepted when we ran the test.

4.- Analysis of the Results

Some features of these results are important to note:

1) We got better results (with the exception of the demand element in the price equation and the cost of living equation), when we used unlagged right hand variables in the original model. This makes a lot of sense for an economy that has had inflation for the last one hundred years. Even more important is the fact that this inflation has been more or less steady in the last half of the sampling period (around 30% four quarter annual rate of change in the cost of living index).
2) The coefficient of the cost of living variable in the wage equation, contrary to what we should have expected from an economy with a long history of inflation, is only a little higher than the one that other people have gotten for econom ies with mild inflation. This supports the Harberger contention that: "My belief that wages should probably be readjusted more often than once a year rather than less often is regarded as heretical by some. But, in point of fact, real

wages have historically tended to fall in periods of growing inflation, forcing workers to bear a disproportionate share of the burden".[22/]

3) The rate of change in the prices of imported raw materials is an important factor in the explanation of the rate of change of industrial prices. For a one percent increase in the rate of growth of prices of imported raw materials, the direct effect is a .41% increase in the rate of growth of industrial prices. This in turn will affect the rate of change of the cost of living through equations (3.1.3 olsq) and (3.1.4). This result is in agreement with the structuralist theory of inflation regarding the propagation of inflation, through increases in the price of imported raw materials.[23/]

4) The coefficient of the non linear response to demand pressures in the industrial sector (measured by $\frac{1}{.84-CU(t-1)}$, is significantly different from zero.[24/] Therefore there is support to the hypothesis that prices are demand and cost determined.

5) There is no evidence of downward inflexibility of the rate of change in industrial prices. Therefore there is no empirical evidence for the main foundation of the structuralist model of inflation. To reach a final conclusion on this point we need more empirical evidence.

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22. Harberger Arnold C. "Economic Policy Problems in Latin America: A Review". Journal of Political Economy. Volume 78, # 4. This result is also obtained in Ramos J.

23. For a summary of the structuralist and monetarist theory of inflation, see Chapter I.

24. This using the asymptotic standard errors of the coefficients.

6) The coefficient of the excess demand variable in the wage equation is higher than the coefficients obtained for more competitive economies. This implies that the trade off between unemployment and inflation is less favorable for an economy like the Chilean one than for those economies. This supports the structuralist thesis of slow adjustments of the economic structure.

Now let us study the following system of equations:

$$\frac{\dot{w}^I(t)}{w^I(t)} = a_1 + a_2 \frac{1}{U(t)/s(t)} + a_3 \frac{\dot{CL}(t)}{CL(t)}$$

(4.1) $$\frac{\dot{P}^I(t)}{P^I(t)} = b_1 + b_2 \frac{\dot{w}^I(t)}{w^I(t)} + b_3 \frac{1}{.84-CU(t-1)} + b_4 \frac{\dot{P}^m(t)}{P^m(t)}$$

$$\frac{\dot{P}(t)}{P(t)} = c_1 \frac{\dot{P}^f(t)}{P^f(t)} + c_2 \frac{\dot{P}^I(t)}{P^I(t)} + c_3 \frac{\dot{P}^m(t)}{P^m(t)}$$

$$\frac{\dot{CL}(t)}{CL(t)} = d_1 + d_2 \frac{\dot{P}(t)}{P(t)} + d_3 \frac{\dot{P}(t-1)}{P(t-1)} + d_4 \frac{\dot{P}(t-2)}{P(t-2)} + d_5 \frac{\dot{P}(t-3)}{P(t-3)}$$

It is important to note that (4.1) is not a closed model because in that system $U(t)/s(t)$ and $\frac{1}{.84-CU(t-1)}$ are endogenous variables whose structural equations we have not written. In the structural equation for $U(t)/s(t)$, the wage rate will be one of the right hand variables and in the structur al equation for $CU(t)$, industrial prices will be one of the right hand variables; therefore, to consider (4.1) as a closed model it is equivalent to leave out this feed back. The only way to eliminate this problem is to consider a complete model and as we said at the begining, that is not possible because of the lack of quarterly national accounts. We tried to build quarterly national account data from quarterly indexes but the results were discouraging. Noting this we decided to formulate a complete model using annual data in the next chapter.

Having this in mind we will study the solution of (4.1) for $\frac{w(t)}{w(t)}$, $\frac{P(t)}{P(t)}$, $\frac{P^I(t)}{P^I(t)}$ and $\frac{CL(t)}{CL(t)}$ ignoring the feed backs.

This case is interesting in itself because it answers questions such as: suppose that the monetary and fiscal authority controls unemployment and the level of demand (see below). Then with these two variables at certain target levels, what will happen to industrial wages, industrial prices, wholesale prices and cost of living?

Before proceeding to study different policy alternative let us study how well the model works during the sampling periods. This test is interesting because until now we have tested how the different equations perform by themselves but not in the context of a simultaneous model.

When we simulated our model for the part of the sampling period that is common in the estimation of our four equations we got the following results:

Table # 4 : Actual and Simulated Values of Rate of Change in Wages (DS).

VARIABLE: $\dot{D}S$ - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5093278	0.4868350	0.0224928	4.62
1964	3	0.4975605	0.5712260	-0.0736655	-12.90
1964	4	0.4639998	0.4601430	0.0038568	0.84
1965	1	0.4063440	0.3491010	0.0572430	16.40
1965	2	0.3941727	0.4356090	-0.0414363	-9.51
1965	3	0.4268641	0.4780120	-0.0511478	-10.70
1965	4	0.4475075	0.4725590	-0.0250515	-5.30
1966	1	0.5141248	0.5202500	-0.0061252	-1.18
1966	2	0.4439697	0.4373180	0.0066517	1.52
1966	3	0.4428312	0.3751780	0.0676532	18.03
1966	4	0.4459516	0.3944690	0.0514826	13.05
1967	1	0.3932936	0.3819060	0.0113876	2.98
1967	2	0.3937480	0.2822590	0.1114890	39.50
1967	3	0.3604976	0.3069060	0.0535916	17.46
1967	4	0.2710520	0.3229710	-0.0519189	-16.08
1968	1	0.2994830	0.3040500	-0.0045670	-1.50
1968	2	0.3089498	0.3171090	-0.0081591	-2.57
1968	3	0.3101956	0.2806440	0.0295516	10.53
1968	4	0.3824940	0.3151520	0.0673420	21.37

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0116142
S ERROR: 0.0437295

Table # 5: Actual and Simulated Values of Rate of Change in Industrial Prices (DQINP).

VARIABLE: DQINP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5632418	0.5556980	0.0075438	1.36
1964	3	0.5429908	0.5293160	0.0136748	2.58
1964	4	0.5097376	0.5233790	-0.0136414	-2.61
1965	1	0.3039706	0.2706820	0.0332886	12.30
1965	2	0.2584108	0.2648500	-0.0064392	-2.43
1965	3	0.2561664	0.2916670	-0.0355006	-12.17
1965	4	0.2556107	0.2851240	-0.0295133	-10.35
1966	1	0.3413119	0.3330540	0.0082579	2.48
1966	2	0.2804431	0.2877250	-0.0072819	-2.53
1966	3	0.2730301	0.2694270	0.0036031	1.34
1966	4	0.2695248	0.2480660	0.0214588	8.65
1967	1	0.2935988	0.2519370	0.0416618	16.54
1967	2	0.2937089	0.2234760	0.0702329	31.43
1967	3	0.2762394	0.2184350	0.0578044	26.46
1967	4	0.2290991	0.2261040	0.0029951	1.32
1968	1	0.2786817	0.2542070	0.0244747	9.63
1968	2	0.2881664	0.2992090	-0.0110426	-3.69
1968	3	0.3187229	0.3475570	-0.0288341	-8.30
1968	4	0.3644831	0.3491560	0.0153271	4.39

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0038458
RMS ERROR: 0.0291201

Table # 6: Actual and Simulated Values of Rate of Change in Whole[illegible] ([illegible]).

VARIABLE: [illegible] - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5189139	0.5220320	-0.0031181	-0.60
1964	3	0.4932775	0.5110590	-0.0177815	-3.48
1964	4	0.4466203	0.4701220	-0.0235017	-5.00
1965	1	0.2546006	0.2481580	0.0064426	2.60
1965	2	0.2447956	0.2423200	0.0024756	1.02
1965	3	0.2298350	0.2447550	-0.0149200	-6.10
1965	4	0.2294881	0.2383100	-0.0088219	-3.70
1966	1	0.2837893	0.2778090	0.0059803	2.15
1966	2	0.2170627	0.2196200	-0.0025573	-1.16
1966	3	0.2349674	0.2173800	0.0175874	8.09
1966	4	0.2277440	0.2064590	0.0212850	10.31
1967	1	0.2293105	0.1931690	0.0361415	18.71
1967	2	0.2469757	0.2007490	0.0462267	23.03
1967	3	0.2221808	0.1857140	0.0364668	19.64
1967	4	0.2099159	0.1936210	0.0162949	8.42
1968	1	0.2763241	0.2688430	0.0074811	2.78
1968	2	0.2785448	0.2853960	-0.0068512	-2.40
1968	3	0.3402002	0.3334950	0.0067052	2.01
1968	4	0.3467675	0.3337380	0.0130295	3.90

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.00[illegible]
[illegible]: 0.[illegible]9

Table # 7: Actual and Simulated Values of Rate of Change in the Cost of Living (DCL).

VARIABLE: DCL - ENDOGENOUS

YEAR	OT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.4583508	0.4879700	-0.0296192	-6.07
1964	3	0.4450257	0.4669900	-0.0219643	-4.70
1964	4	0.4261186	0.4190800	0.0070386	1.68
1965	1	0.3442895	0.3103760	0.0339135	10.93
1965	2	0.2856018	0.3193860	-0.0337842	-10.58
1965	3	0.2462657	0.2728450	-0.0265793	-9.74
1965	4	0.2278933	0.2581390	-0.0302457	-11.72
1966	1	0.2436691	0.2764730	-0.0328039	-11.87
1966	2	0.2327172	0.2056910	0.0270262	13.14
1966	3	0.2307636	0.2410290	-0.0102654	-4.26
1966	4	0.2264033	0.1986740	0.0277293	13.96
1967	1	0.2233030	0.1680550	0.0552480	32.87
1967	2	0.2299031	0.1813590	0.0485441	26.77
1967	3	0.2253854	0.1765330	0.0488524	27.67
1967	4	0.2178515	0.1981370	0.0197145	9.95
1968	1	0.2353216	0.2521630	-0.0168414	-6.68
1968	2	0.2486847	0.2588240	-0.0101393	-3.92
1968	3	0.2795392	0.2730630	0.0064762	2.37
1968	4	0.3016873	0.2788080	0.0228793	8.21

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0044831
RMS ERROR: 0.030034

Table # 8: Plotted Values for Rate of Change in Wages (DS).

VARIABLE PLOTTED - DS

SIMULA = Y   ACTUAL = X

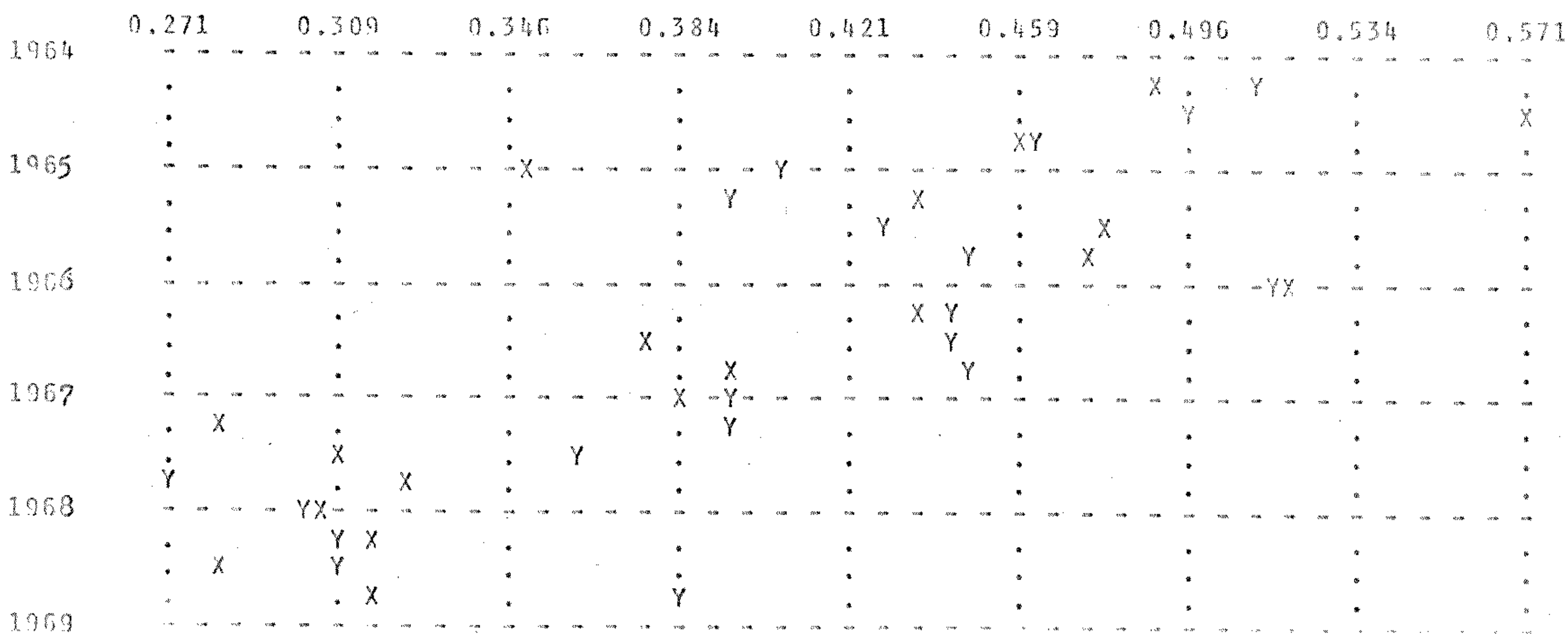


Table # 9: Plotted Values for Rate of Change in Industrial Prices (DQIMP).

VARIABLE PLOTTED - DQIMP

SIMULA = Y ACTUAL = X

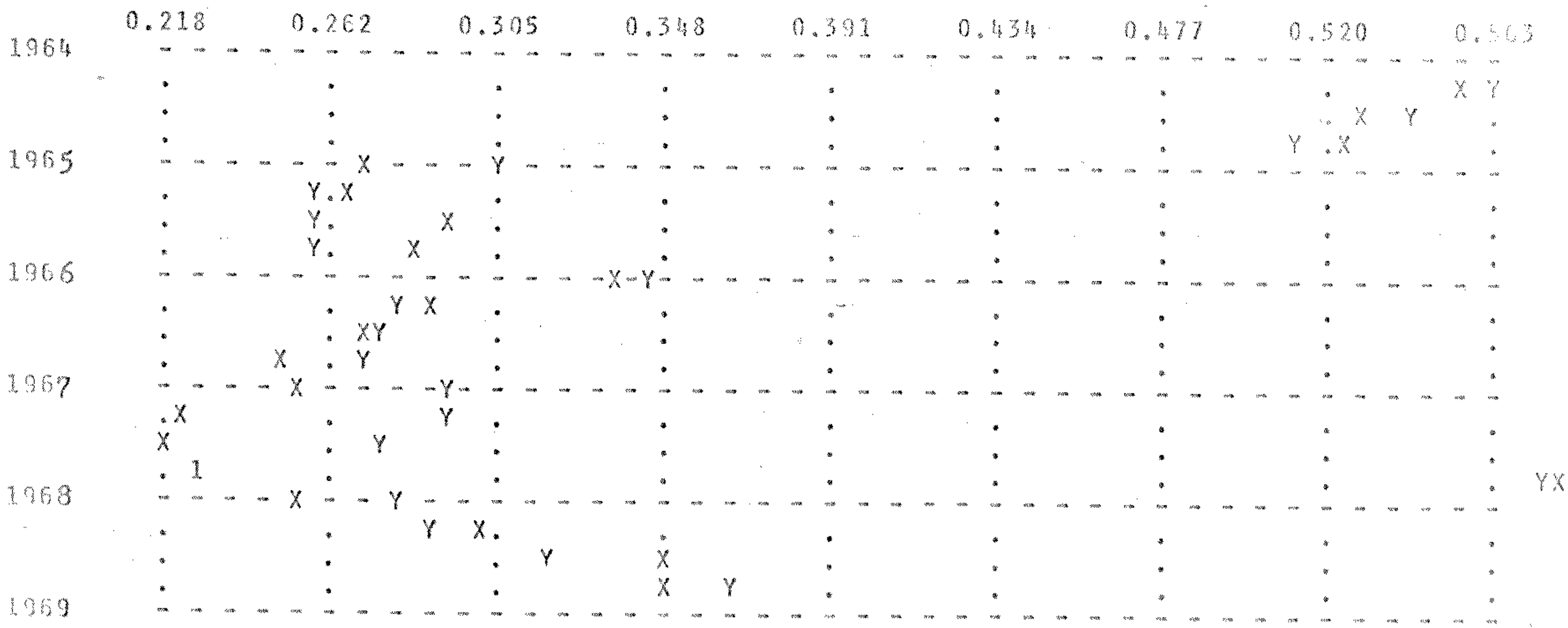


Table # 10: Plotted Values for Rate of Change in Wholesale Prices (DWO).

VARIABLE PLOTTED - DWO

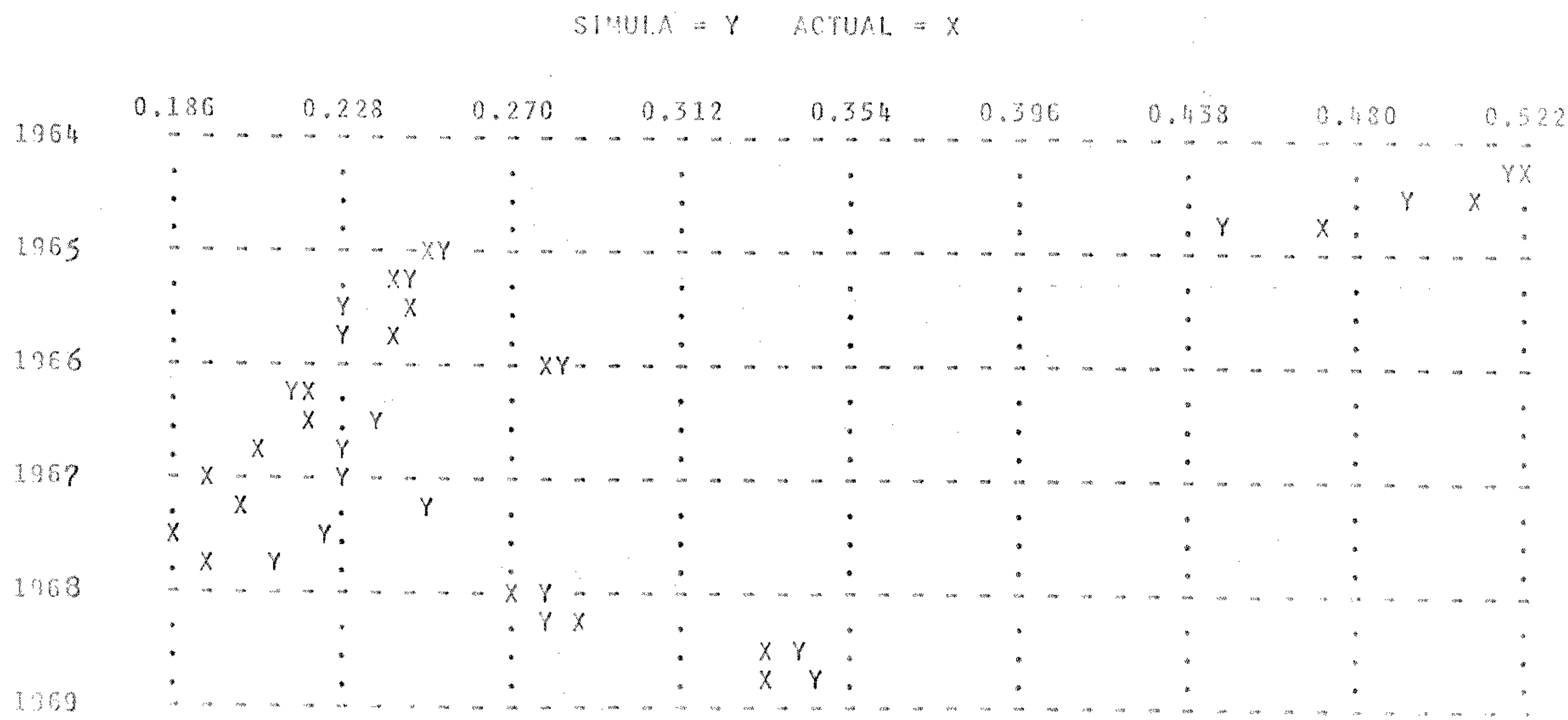
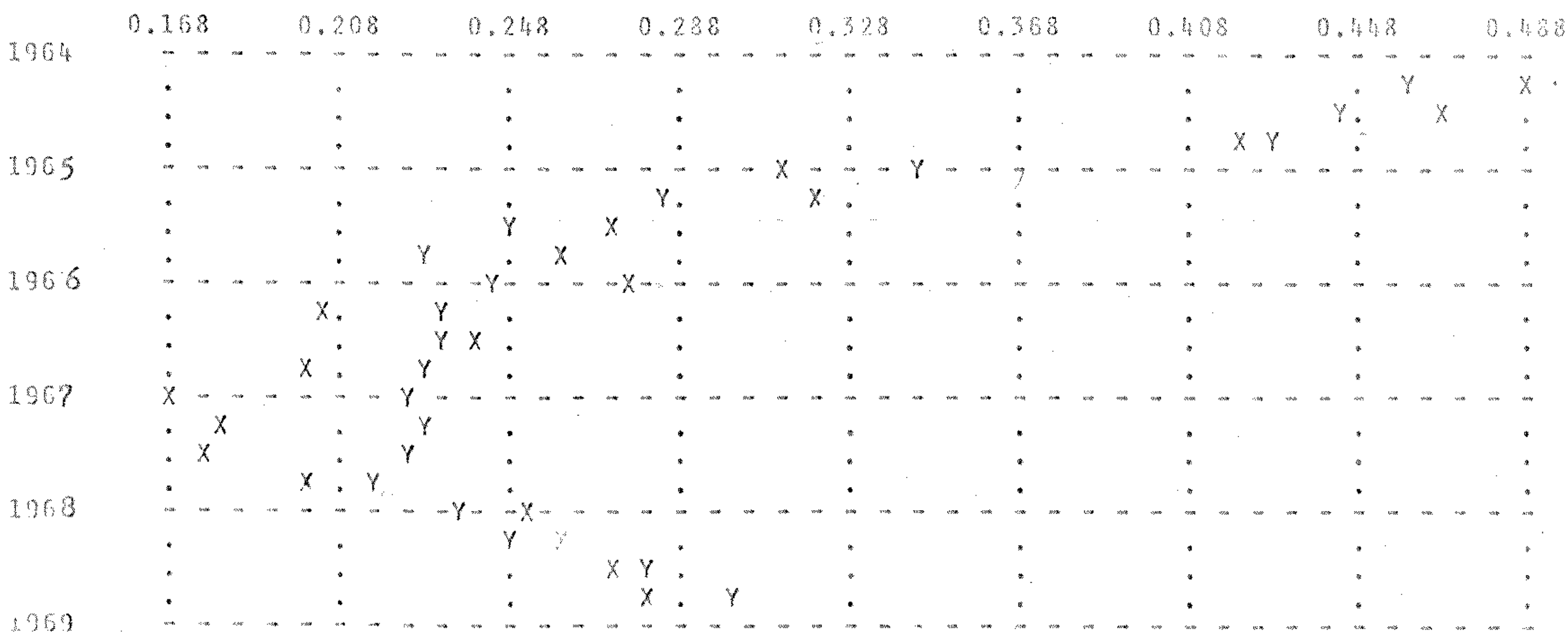


Table # 11: Plotted Values for Rate of Change in Cost of Living (DCL).

VARIABLE PLOTTED - DCI

SIMULA = Y ACTUAL = X



From these tables we can see that on an overall view the model does quite well. The mean squeare errors are very low, the highest being .049 for the wage equation.

The simulation results suggest that from the last quarter of 1966 to the third quarter of 1967 we are missing some thing. Our model systematically over shoots the actual values for the different endogenous variables. If we stop to think what the cause of these results is, we see that this period was characterized by tight controls for the prices of products in the cost of living index.[25] There are two reasons why our model over shoots the actual figures. First, our high simulated rate of change in cost of living creates an over shooting in wages. This over shooting in wages plus the increase in capacity utilized in the industrial sector (associated with the increase in quantity demanded coming from the low reatil prices) implies an over shooting in industrial prices. From here on the dynamics of our model continues working.

It is important to indicate that this expansion in the industrial sector was obtained on top of a decline in economic activity coming mainly from a decrease in government expenditures in public housing. We see that our model does not pick up the impact of these price controls.

The easiest way of including the price controls in our model is through a dummy variable that will take care of the downward pressures in retail prices for the four quarters already discussed.

When we did this in the equation for the cost of living, we got:

25. For a study that shows that with Law N°16464 of 1966 price controls were intensified in the 1966-1967 period, see De La Cuadra, Sergio. El Control de Precios en Chile. Centro de Estudios Socio-Económicos (CESEC). Undated.

(3.1.4.i.v)'
$$\frac{\dot{CL}(t)}{CL(t)} = \underset{(3.708)}{.0598} - \underset{(-2.349)}{.0325}\, d(t) + \underset{(4.615)}{.3237} \frac{\dot{P}(t)}{P(t)} + \underset{(16.56)}{.2277} \frac{\dot{P}(t-1)}{P(t-1)} + \underset{(4.768)}{.1417} \frac{\dot{P}(t-2)}{P(t-2)} + \underset{(2.187)}{.0658} \frac{\dot{P}(t-3)}{P(t-3)}$$

Instruments:

$$\frac{\dot{P}^m(t)}{P^m(t)}, \frac{\dot{P}^m(t-1)}{P^m(t-1)}, \frac{\dot{P}^f(t)}{P^f(t)}, \frac{\dot{M}(t-1)}{M(t-1)}, \frac{\dot{M}(t-2)}{M(t-2)}, C.$$

$T = 21$ Mean Lag = $\underset{(4.823)}{.934}$

Here using a one tail test all the coefficients are significant at a 2.5% level. Therefore we see that the introduction of a dummy for the price controls of the period 1966-4 to 1967-3 captures what we wanted to describe.

To see how the incorporation of equation (3.1.4.i.v)' affects the working of the model let us simulate the model formed by equations (3.1.1.i.v), (3.1.2.i.v)', (3.1.3 olsq) and (3.1.4.i.v)' for the sampling period.

When we ran the simulation we got the following results:

Table # 12: Actual and Simulated Values of Rate of Change in Wages (DS).

(Including a dummy variable in the Cost of Living [illegible]).

VARIABLE: DS - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5068643	0.4868350	0.0200293	4.11
1964	3	0.4954881	0.5712260	-0.0757379	-13.26
1964	4	0.4628269	0.4601430	0.0026839	0.58
1965	1	0.4090424	0.3491010	0.0599414	17.17
1965	2	0.3995998	0.4356090	-0.0360092	-8.27
1965	3	0.4340676	0.4780120	-0.0439444	-9.19
1965	4	0.4555450	0.4725590	-0.0170140	-3.60
1966	1	0.5214971	0.5202500	0.0012472	0.24
1966	2	0.4519317	0.4373180	0.0146137	3.34
1966	3	0.4509206	0.3751780	0.0757426	20.19
1966	4	0.4298078	0.3944690	0.0353389	8.96
1967	1	0.3760811	0.3819060	-0.0058249	-1.53
1967	2	0.3754551	0.2822590	0.0931961	33.02
1967	3	0.3420130	0.3069060	0.0351070	11.44
1967	4	0.2773139	0.3229710	-0.0456571	-14.14
1968	1	0.3060383	0.3040500	0.0019883	0.65
1968	2	0.3156358	0.3171090	-0.0014732	-0.46
1968	3	0.3158477	0.2806440	0.0352038	12.54
1968	4	0.3871923	0.3151520	0.0720403	22.86

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0116564
RMS ERROR: 0.0452638

Table # 13: Actual and Simulated Values of Rate of Change in Industrial Prices (DOIMP).

(Including a dummy variable in the Cost of Living equation).

VARIABLE: DOIMP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5615469	0.5556980	0.0058489	1.05
1964	3	0.5415650	0.5293160	0.0122490	2.31
1964	4	0.5089307	0.5233790	-0.0144483	-2.76
1965	1	0.3058270	0.2706820	0.0351450	12.98
1965	2	0.2621446	0.2648500	-0.0027054	-1.02
1965	3	0.2611223	0.2916670	-0.0305447	-10.47
1965	4	0.2611405	0.2851240	-0.0239835	-8.41
1966	1	0.3463841	0.3330540	0.0133301	4.00
1966	2	0.2859210	0.2877250	-0.0018040	-0.63
1966	3	0.2785956	0.2694270	0.0091686	3.40
1966	4	0.2584179	0.2480660	0.0103519	4.17
1967	1	0.2817567	0.2519370	0.0298197	11.84
1967	2	0.2811235	0.2234760	0.0576475	25.80
1967	3	0.2635219	0.2184350	0.0450869	20.64
1967	4	0.2334073	0.2261040	0.0073033	3.23
1968	1	0.2831918	0.2542070	0.0289848	11.40
1968	2	0.2927663	0.2992090	-0.0064427	-2.15
1968	3	0.3226116	0.3475570	-0.0249454	-7.18
1968	4	0.3677155	0.3491560	0.0185595	5.32

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0088748
RMS ERROR: 0.0247756

Table # 14: Actual and Simulated Values of Rate of Change in Wholesale Prices (DWO).

(Including a dummy variable in the Cost of Living equation).

VARIABLE: DWO - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.5182307	0.5220320	-0.0038013	-0.73
1964	3	0.4926920	0.5110590	-0.0183670	-3.59
1964	4	0.4462848	0.4701220	-0.0238372	-5.07
1965	1	0.2553158	0.2481580	0.0071579	2.88
1965	2	0.2463057	0.2423200	0.0039857	1.64
1965	3	0.2318555	0.2447550	-0.0128995	-5.27
1965	4	0.2317432	0.2383100	-0.0065667	-2.76
1966	1	0.2858768	0.2778090	0.0080678	2.90
1966	2	0.2192863	0.2196200	-0.0003337	-0.15
1966	3	0.2372352	0.2173800	0.0198552	9.13
1966	4	0.2232380	0.2064590	0.0167790	8.13
1967	1	0.2244857	0.1931690	0.0313167	16.21
1967	2	0.2418410	0.2007490	0.0410920	20.47
1967	3	0.2169896	0.1857140	0.0312756	16.84
1967	4	0.2116365	0.1936210	0.0180155	9.30
1968	1	0.2781719	0.2688430	0.0093289	3.47
1968	2	0.2804236	0.2853960	-0.0049724	-1.74
1968	3	0.3417917	0.3334950	0.0082967	2.49
1968	4	0.3480979	0.3337380	0.0143599	4.30

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0073028
RMS ERROR: 0.0182041

Table # 15: Actual and Simulated Values of Rate of Change in the Cost of Living (DCL).

(Including a dummy variable in the Cost of Living equation).

VARIABLE: DCL - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR	PERCENT
1964	2	0.4548514	0.4879700	-0.0331186	-6.79
1964	3	0.4420820	0.4669900	-0.0249080	-5.33
1964	4	0.4244526	0.4190800	0.0053726	1.28
1965	1	0.3481224	0.3103760	0.0377464	12.16
1965	2	0.2933107	0.3193860	-0.0260753	-8.16
1965	3	0.2564978	0.2728450	-0.0163472	-5.99
1965	4	0.2393102	0.2581390	-0.0188288	-7.29
1966	1	0.2541413	0.2764730	-0.0223317	-8.08
1966	2	0.2440269	0.2056910	0.0383359	18.64
1966	3	0.2422542	0.2410290	0.0012252	0.51
1966	4	0.2034718	0.1986740	0.0047978	2.41
1967	1	0.1988535	0.1680550	0.0307985	18.33
1967	2	0.2039189	0.1813590	0.0225599	12.44
1967	3	0.1991288	0.1765330	0.0225958	12.80
1967	4	0.2267462	0.1981370	0.0286092	14.44
1968	1	0.2446331	0.2521630	-0.0075299	-2.99
1968	2	0.2581818	0.2588240	-0.0006422	-0.25
1968	3	0.2875678	0.2730630	0.0145048	5.31
1968	4	0.3083609	0.2788080	0.0295529	10.60

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.004543
RMS ERROR: 0.0233879

Table # 16: Plotted Values for Rate of Change in Wages (DS).

(Including a dummy variable in the Cost of Living equation).

VARIABLE PLOTTED - DS

SIMULA = Y ACTUAL = X

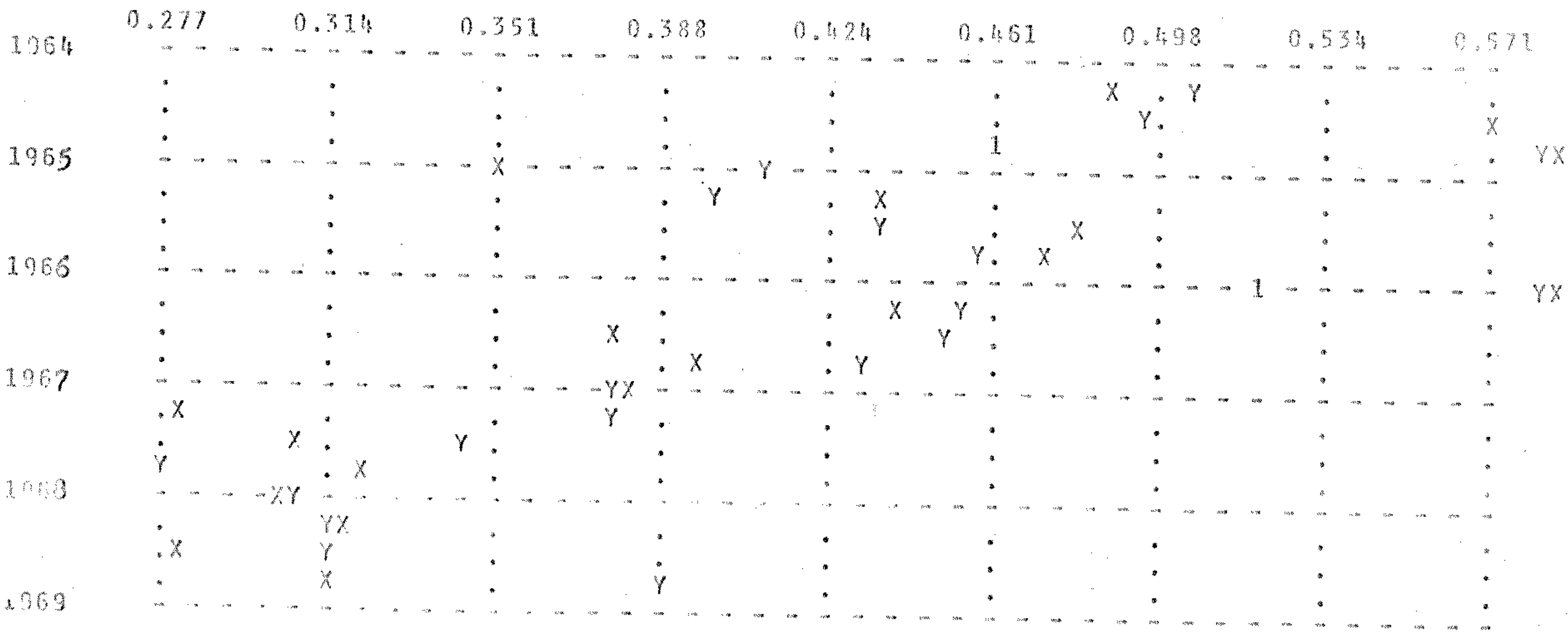


Table # 17: Plotted Values for Rate of Change in Industrial Prices (DQIMP).

(Including a dummy variable in the Cost of Living equation).

VARIABLE PLOTTED - DQIMP

SIMULA = Y   ACTUAL = X

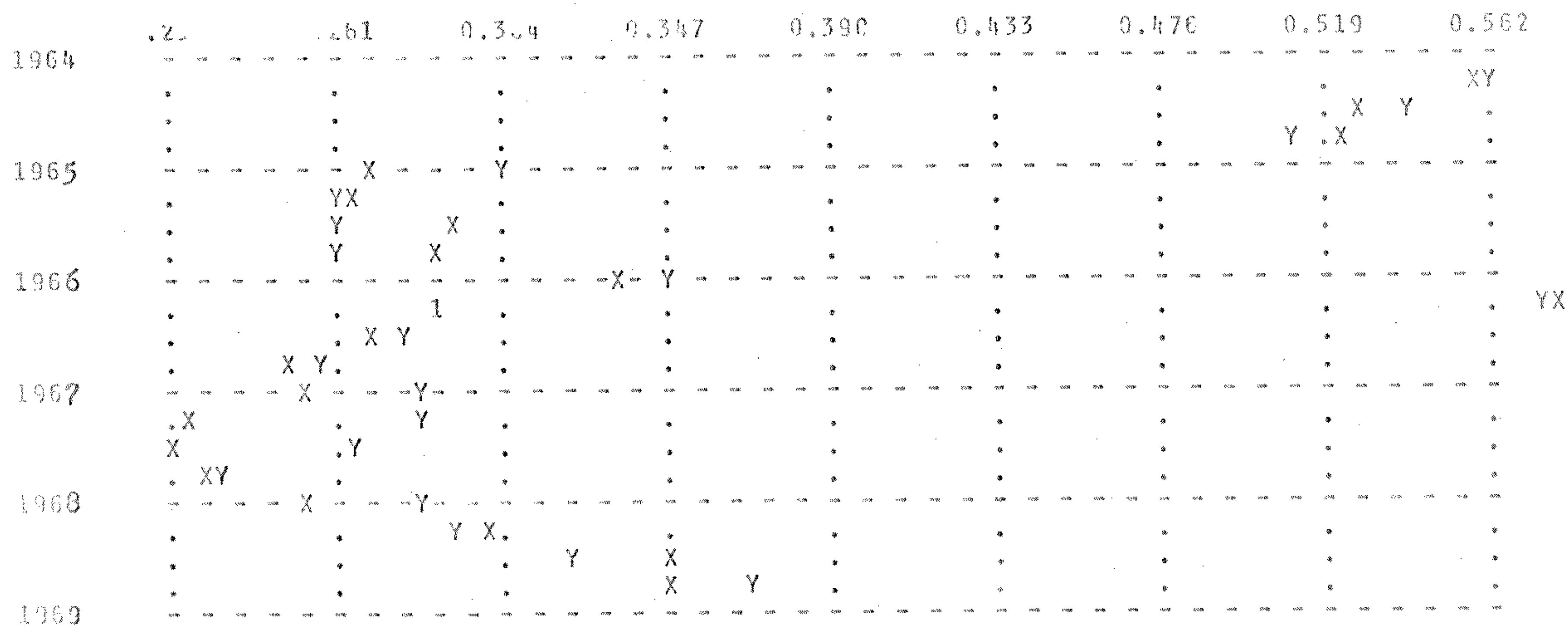


Table # 18: Plotted Values for Rate of Change in Wholesale Prices (DWO).

(Including a dummy variable in the Cost of Living equation).

VARIABLE PLOTTED - DWO

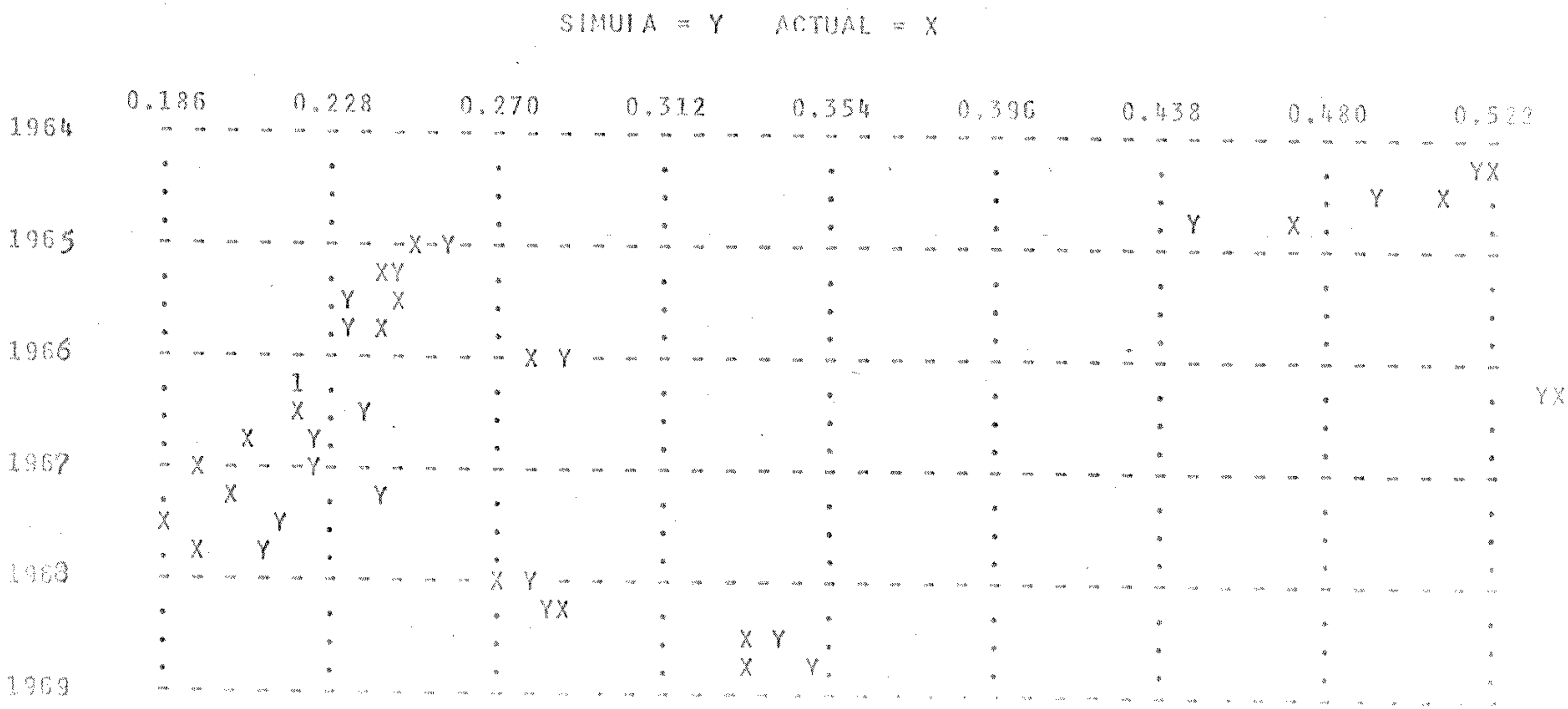
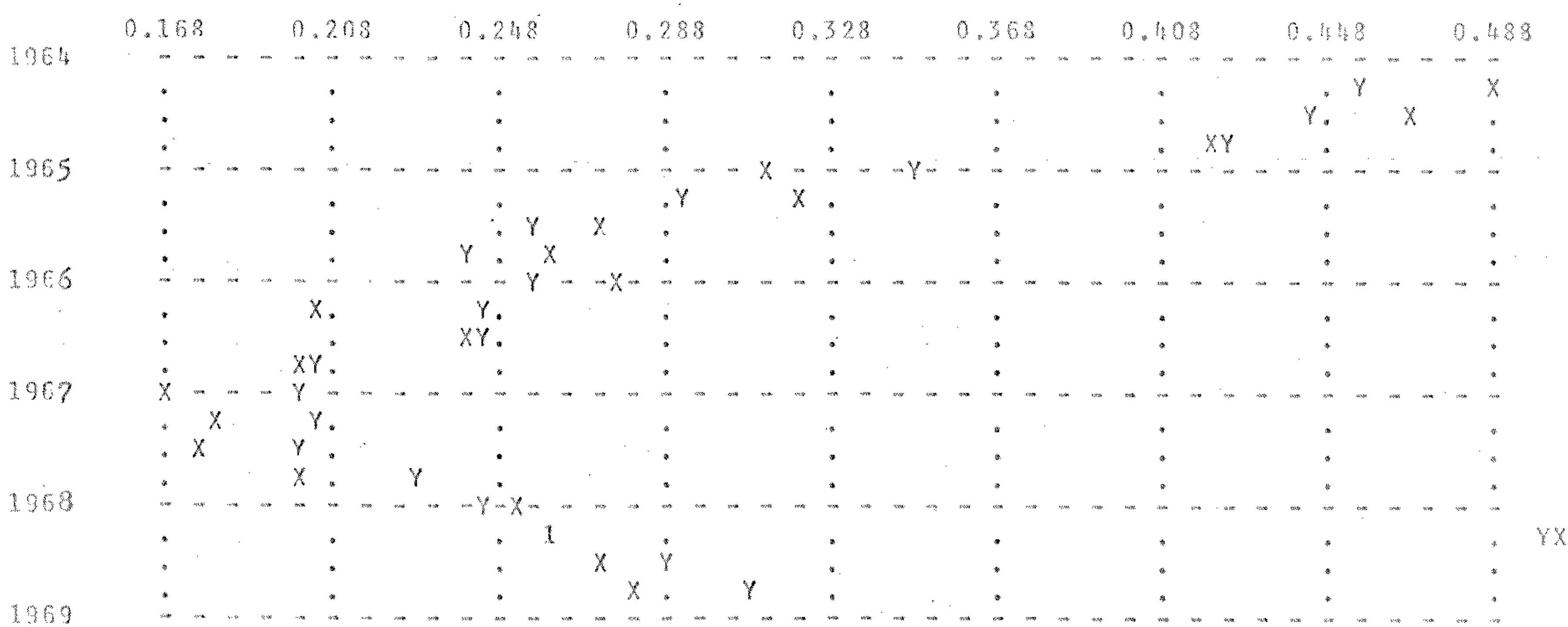


Table # 19: Plotted Values for Rate of Change in Cost of Living (DCL).

(Including a dummy variable in the Cost of Living equation).

VARIABLE PLOTTED - DCL

SIMULA = Y   ACTUAL = X



We see that all the root mean squeare errors are now lower.

Using these simulated values as benchmark values, let us use now this system to study different policies.

Let us consider first a set of fiscal and monetary policies aimed at achieving a 5.0% rate of unemployment (against an average of 5.53 for the period 1960-1968) and to increase the capacity utilized in the industrial sector to .81 (against an average of .796 for the period 1960-68).

When we ran these simulations keeping the obserbed values of $\frac{\dot{P}^f(t)}{P^f(t)}$ and $\frac{\dot{P}^m(t)}{P^m(t)}$ we got:

Table # 20: Simulation Results for DS with $\frac{U(t)}{s(t)} = .05$ and $CU(t) = .81$

VARIABLE: DS - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5343138	0.5068643	0.0274495
1964	3	0.5250426	0.4954881	0.0295545
1964	4	0.5141847	0.4628269	0.0513578
1965	1	0.4619680	0.4090424	0.0529256
1965	2	0.4265022	0.3995998	0.0269024
1965	3	0.4019272	0.4340676	-0.0321403
1965	4	0.3906563	0.4555450	-0.0648887
1966	1	0.3992848	0.5214971	-0.1222123
1966	2	0.3951413	0.4519317	-0.0567904
1966	3	0.3958131	0.4509206	-0.0551075
1966	4	0.3690840	0.4298078	-0.0607238
1967	1	0.3683904	0.3760811	-0.0076908
1967	2	0.3743169	0.3754551	-0.0011382
1967	3	0.3749201	0.3420130	0.0329071
1967	4	0.4025277	0.2773139	0.1252138
1968	1	0.4203412	0.3060383	0.1143029
1968	2	0.4327526	0.3156358	0.1171168
1968	3	0.4563393	0.3158477	0.1404916
1968	4	0.4684225	0.3871923	0.0812303

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0209374
RMS ERROR: 0.075344

Table # 21: Simulation Results for DQINP with $\frac{U(t)}{s(t)} = .05$ and $CU(t) = .01$.

VARIABLE: DQINP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5302197	0.5615469	-0.0313272
1964	3	0.5293545	0.5415650	-0.0122105
1964	4	0.5137684	0.5089307	0.0048377
1965	1	0.3130154	0.3058270	0.0071883
1965	2	0.2899709	0.2621446	0.0278263
1965	3	0.2842893	0.2611223	0.0231670
1965	4	0.2869691	0.2611405	0.0258286
1966	1	0.3485815	0.3463841	0.0021974
1966	2	0.3367407	0.2859210	0.0508197
1966	3	0.3256197	0.2785956	0.0470240
1966	4	0.2977459	0.2584179	0.0393280
1967	1	0.3458669	0.2817567	0.0641102
1967	2	0.3573214	0.2811235	0.0761979
1967	3	0.3647565	0.2635219	0.1012346
1967	4	0.3946918	0.2334073	0.1612846
1968	1	0.4448517	0.2831918	0.1616599
1968	2	0.4535897	0.2927663	0.1608234
1968	3	0.5028333	0.3226116	0.1802217
1968	4	0.5068754	0.3677155	0.1391599

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0647038
RMS ERROR: 0.0916371

Table # 22: Simulation Results for DWO with $\frac{U(t)}{s(t)} = .05$ and $CU(t) = .81$.

VARIABLE: DWO - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5054982	0.5182307	-0.0127325
1964	3	0.4876802	0.4926920	-0.0050118
1964	4	0.4482320	0.4462848	0.0019471
1965	1	0.2582450	0.2553158	0.0029292
1965	2	0.2576266	0.2463057	0.0113209
1965	3	0.2413149	0.2318555	0.0094594
1965	4	0.2422771	0.2317432	0.0105339
1966	1	0.2868103	0.2858768	0.0009335
1966	2	0.2399448	0.2192863	0.0206584
1966	3	0.2564269	0.2372352	0.0191918
1966	4	0.2392959	0.2232380	0.0160579
1967	1	0.2506039	0.2244857	0.0261182
1967	2	0.2729109	0.2418410	0.0310699
1967	3	0.2582542	0.2169896	0.0412646
1967	4	0.2773467	0.2116365	0.0657102
1968	1	0.3441286	0.2781719	0.0659567
1968	2	0.3460408	0.2804236	0.0656172
1968	3	0.4152918	0.3417917	0.0735001
1968	4	0.4049393	0.3480979	0.0568414

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0263877
RMS ERROR: 0.0373738

Table # 23: Simulation Results for DCL with $\frac{U(t)}{s(t)} = .05$ and $CU(t) = .81$.

VARIABLE: DCL - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4507299	0.4548514	-0.0041215
1964	3	0.4375606	0.4420820	-0.0045214
1964	4	0.4221374	0.4244526	-0.0023151
1965	1	0.3479659	0.3481224	-0.0001565
1965	2	0.2975884	0.2933107	0.0042777
1965	3	0.2626807	0.2564978	0.0061829
1965	4	0.2466709	0.2393102	0.0073607
1966	1	0.2589273	0.2541413	0.0047860
1966	2	0.2530417	0.2440269	0.0090148
1966	3	0.2539958	0.2422542	0.0117416
1966	4	0.2160284	0.2034718	0.0125566
1967	1	0.2150431	0.1988535	0.0161897
1967	2	0.2234615	0.2039189	0.0195426
1967	3	0.2243183	0.1991288	0.0251895
1967	4	0.2635336	0.2267462	0.0367875
1968	1	0.2888370	0.2446331	0.0442039
1968	2	0.3064668	0.2581818	0.0482850
1968	3	0.3399707	0.2875678	0.0524028
1968	4	0.3571343	0.3083609	0.0487734

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0176937
RMS ERROR: 0.0257472

From these tables we see that these targets with respect to unemployment and capacity utilization, imply and increase in the rate of growth in cost of living of around 1.8%. Furthermore for the year 1968 this increase is around 4.8%.

Let us study now the implications of a policy having the same targets with respect to capacity utilized and unemployment but assuming that tariffs and international prices are constant and that the devaluation rate is equal to the rate of change in the cost of living index and that the real agricultural prices improve at a 2% rate with respect to the cost of living. This set of policies is very near to what was proposed at the beginning of 1965.

When we ran the simulations with these assumptions we got the following results:

Table #24: Simulation Results for DS with $\frac{U(t)}{s(t)} = .05$, CU(t) = .81 and DQMRM and DQAGR endogenous.

DQMRM = Rate of Change in Imported Raw Material Prices.

DQAGR = Rate of Change in Agriculture Prices.

VARIABLE: DS - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5313910	0.5068643	0.0245267
1964	3	0.5207773	0.4954881	0.0252892
1964	4	0.5168711	0.4628269	0.0540442
1965	1	0.5114286	0.4090424	0.1023862
1965	2	0.5079782	0.3995998	0.1083784
1965	3	0.5054685	0.4340676	0.0714010
1965	4	0.5035100	0.4555450	0.0479650
1966	1	0.5020868	0.5214971	-0.0194104
1966	2	0.5010267	0.4519317	0.0490950
1966	3	0.5002360	0.4509206	0.0493154
1966	4	0.4670917	0.4298078	0.0372838
1967	1	0.4562341	0.3760811	0.0801530
1967	2	0.4463068	0.3754551	0.0708517
1967	3	0.4380646	0.3420130	0.0960516
1967	4	0.4650771	0.2773139	0.1877632
1968	1	0.4712390	0.3060383	0.1652007
1968	2	0.4776650	0.3156358	0.1620292
1968	3	0.4833263	0.3158477	0.1674785
1968	4	0.4869463	0.3871923	0.0997541

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0831346
RMS ERROR: 0.0994375

Table #25: Simulation Results for DQINP with $\frac{U(t)}{s(t)} = .05$, $CU(t) = .81$ and DQMRM and DQAGR endogenous.

VARIABLE: DQINP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5474077	0.5615469	-0.0141391
1964	3	0.5339845	0.5415650	-0.0075805
1964	4	0.5290443	0.5089307	0.0201136
1965	1	0.5221611	0.3058270	0.2163341
1965	2	0.5177975	0.2621446	0.2556529
1965	3	0.5146235	0.2611223	0.2535011
1965	4	0.5121465	0.2611405	0.2510060
1966	1	0.5103465	0.3463841	0.1639625
1966	2	0.5090059	0.2859210	0.2230849
1966	3	0.5080058	0.2785956	0.2294102
1966	4	0.4660881	0.2584179	0.2076701
1967	1	0.4523564	0.2817567	0.1705998
1967	2	0.4398014	0.2811235	0.1586779
1967	3	0.4293774	0.2635219	0.1658554
1967	4	0.4635403	0.2334073	0.2301330
1968	1	0.4713332	0.2831918	0.1881414
1968	2	0.4794602	0.2927663	0.1866939
1968	3	0.4866201	0.3226116	0.1640085
1968	4	0.4911984	0.3677155	0.1234829

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1677162
RMS ERROR: 0.1863281

Table #26: Simulation Results for DWO with $\frac{U(t)}{s(t)}$ =.05, CU(t) =.81 and DQMRM and DQACR endogenous.

VARIABLE: DWO - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4922542	0.5182307	-0.0259765
1964	3	0.4779783	0.4926920	-0.0147137
1964	4	0.4726392	0.4462848	0.0263544
1965	1	0.4653097	0.2553158	0.2099939
1965	2	0.4606333	0.2463057	0.2143276
1965	3	0.4572369	0.2318555	0.2253814
1965	4	0.4545283	0.2317432	0.2228450
1966	1	0.4526621	0.2858768	0.1667854
1966	2	0.4512279	0.2192863	0.2319416
1966	3	0.4501580	0.2372352	0.2129229
1966	4	0.4057558	0.2232380	0.1825178
1967	1	0.3908791	0.2244857	0.1663934
1967	2	0.3774720	0.2418410	0.1356310
1967	3	0.3663319	0.2169896	0.1493423
1967	4	0.4024297	0.2116365	0.1907932
1968	1	0.4109549	0.2781719	0.1327829
1968	2	0.4196248	0.2804236	0.1392013
1968	3	0.4272726	0.3417917	0.0854809
1968	4	0.4321786	0.3480979	0.0840807

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1440045
RMS ERROR: 0.1635964

Table # 27: Simulation Results for DCL with $\frac{U(t)}{s(t)} = .05$, $CU(t) = .81$ and DQMMM and DQAGR endogenous.

VARIABLE: DCL - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4465781	0.4548514	-0.0082733
1964	3	0.4315018	0.4420820	-0.0105802
1964	4	0.4259533	0.4244526	0.0015007
1965	1	0.4182224	0.3481224	0.0701000
1965	2	0.4133214	0.2933107	0.1200107
1965	3	0.4097565	0.2564978	0.1532586
1965	4	0.4069745	0.2393102	0.1676643
1966	1	0.4049528	0.2541413	0.1508116
1966	2	0.4034470	0.2440269	0.1594202
1966	3	0.4023239	0.2422542	0.1600696
1966	4	0.3552438	0.2034718	0.1517720
1967	1	0.3398212	0.1988535	0.1409677
1967	2	0.3257199	0.2039189	0.1218010
1967	3	0.3140122	0.1991288	0.1148834
1967	4	0.3523823	0.2267462	0.1256361
1968	1	0.3611349	0.2446331	0.1165018
1968	2	0.3702628	0.2581818	0.1120809
1968	3	0.3783044	0.2875678	0.0907366
1968	4	0.3834465	0.3083609	0.0750856

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1059709
RMS ERROR: 0.1195629

Table #28: Simulation Results for DQMRM with $\frac{U(t)}{s(t)}$ =.05, CU(t)=.81 and DQMRM and DQAGR endogenous.

VARIABLE: DQMRM - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4465781	0.3992900	0.0472881
1964	3	0.4315018	0.4128700	0.0186318
1964	4	0.4259533	0.3928800	0.0330733
1965	1	0.4182224	-0.0131000	0.4313224
1965	2	0.4133214	-0.0097600	0.4230814
1965	3	0.4097565	0.0178900	0.3918665
1965	4	0.4069745	0.0435900	0.3633845
1966	1	0.4049528	0.1807230	0.2242299
1966	2	0.4034470	0.1585800	0.2448671
1966	3	0.4023239	0.1300500	0.2722739
1966	4	0.3552438	0.1066900	0.2485539
1967	1	0.3398212	0.2263900	0.1134312
1967	2	0.3257199	0.2445600	0.0811599
1967	3	0.3140122	0.2618510	0.0521612
1967	4	0.3523823	0.2888000	0.0635823
1968	1	0.3611349	0.3821600	-0.0210251
1968	2	0.3702628	0.3826500	-0.0123872
1968	3	0.3783044	0.4639700	-0.0856656
1968	4	0.3834465	0.4534500	-0.0700035

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1484119
RMS ERROR: 0.2223705

Table #29: Simulation Results for DQAGR with $\frac{U(t)}{s(t)} = .05$, CU(t)=.81 and DQMRM and DQAGR endogenous.

VARIABLE: DQAGR - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4755097	0.5686070	-0.0930973
1964	3	0.4601319	0.5077000	-0.0475681
1964	4	0.4544723	0.4244340	0.0300383
1965	1	0.4465869	0.3923330	0.0542539
1965	2	0.4415878	0.4165370	0.0250508
1965	3	0.4379516	0.3559590	0.0819926
1965	4	0.4351140	0.3374600	0.0976540
1966	1	0.4330519	0.2979610	0.1350909
1966	2	0.4315160	0.1896700	0.2418460
1966	3	0.4303703	0.2715860	0.1587844
1966	4	0.3823487	0.2710820	0.1112667
1967	1	0.3666176	0.1624530	0.2041646
1967	2	0.3522343	0.2013020	0.1509323
1967	3	0.3402924	0.1370750	0.2032174
1967	4	0.3794299	0.1383690	0.2410609
1968	1	0.3883576	0.2087560	0.1796016
1968	2	0.3976680	0.2033950	0.1942730
1968	3	0.4058705	0.2907270	0.1151435
1968	4	0.4111154	0.2626930	0.1484224

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1174804
RMS ERROR: 0.1478177

From these tables we see that in this case the rate of inflation would have been around 10.6% higher than the actual one. This casts some additional light on the importance of imported raw materials prices in the rate of inflation. Furthermore this explains also the role of the decline in the rate of growth of the price of imported raw materials in the years 1965-1966 in the deceleration of the inflation.

Let us assume now that fiscal and monetary policy are oriented toward a 4.5% unemployment rate and a .82 capacity utilization in the industrial sector. When we ran the simulations with the historical figures for $\frac{\dot{P}^m(t)}{P^m(t)}$ and $\frac{\dot{P}^f(t)}{P^f(t)}$ we got the following results:

Table # 30: Simulation Results for DS with $\frac{U(t)}{s(t)} = .045$ and $CU(t) = .82$.

VARIABLE: DS - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.6303045	0.5068643	0.1234402
1964	3	0.6314960	0.4954881	0.1360079
1964	4	0.6276578	0.4628269	0.1648309
1965	1	0.5791246	0.4090424	0.1700823
1965	2	0.5442041	0.3995998	0.1446043
1965	3	0.5198643	0.4340676	0.0857967
1965	4	0.5086728	0.4555450	0.0531278
1966	1	0.5173200	0.5214971	-0.0041772
1966	2	0.5131831	0.4519317	0.0612514
1966	3	0.5138568	0.4509206	0.0629362
1966	4	0.4871283	0.4298078	0.0573205
1967	1	0.4864348	0.3760811	0.1103537
1967	2	0.4923614	0.3754551	0.1169063
1967	3	0.4929646	0.3420130	0.1509516
1967	4	0.5205722	0.2773139	0.2432583
1968	1	0.5383858	0.3060383	0.2323475
1968	2	0.5507972	0.3156358	0.2351614
1968	3	0.5743839	0.3158477	0.2585361
1968	4	0.5864671	0.3871923	0.1992748

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.1369479
RMS ERROR: 0.1548491

Table #31: Simulation Results for DQINP with $\frac{U(t)}{[illegible](t)}$ = .045 and CU(t) = .82.

VARIABLE: DQINP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.6797612	0.5615469	0.1182144
1964	3	0.6860945	0.5415650	0.1445294
1964	4	0.6753378	0.5089307	0.1664072
1965	1	0.4771191	0.3058270	0.1712921
1965	2	0.4544499	0.2621446	0.1923052
1965	3	0.4489299	0.2611223	0.1878076
1965	4	0.4516644	0.2611405	0.1905239
1966	1	0.5132897	0.3463841	0.1669056
1966	2	0.5014534	0.2859210	0.2155324
1966	3	0.4903338	0.2785956	0.2117381
1966	4	0.4624604	0.2584179	0.2040425
1967	1	0.5105815	0.2817567	0.2288248
1967	2	0.5220360	0.2811235	0.2409125
1967	3	0.5294712	0.2635219	0.2659492
1967	4	0.5594065	0.2334073	0.3259992
1968	1	0.6095664	0.2831918	0.3263746
1968	2	0.6183043	0.2927663	0.3255380
1968	3	0.6675479	0.3226116	0.3449364
1968	4	0.6715900	0.3677155	0.3038746

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.2279846
RMS ERROR: 0.2375806

Table #32: Simulation Results for DWO with $\frac{U(t)}{s(t)} = .045$ and $CU(t) = .82$.

VARIABLE: DWO - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5662774	0.5182307	0.0480467
1964	3	0.5516189	0.4926920	0.0589269
1964	4	0.5141448	0.4462848	0.0678599
1965	1	0.3251954	0.2553158	0.0698796
1965	2	0.3247334	0.2463057	0.0784277
1965	3	0.3084880	0.2318555	0.0766326
1965	4	0.3094728	0.2317432	0.0777295
1966	1	0.3540112	0.2858768	0.0681344
1966	2	0.3071475	0.2192863	0.0878612
1966	3	0.3236303	0.2372352	0.0863951
1966	4	0.3064994	0.2232380	0.0832614
1967	1	0.3178075	0.2244857	0.0933218
1967	2	0.3401145	0.2418410	0.0982734
1967	3	0.3254577	0.2169896	0.1084681
1967	4	0.3445503	0.2116365	0.1329138
1968	1	0.4113322	0.2781719	0.1331602
1968	2	0.4132444	0.2804236	0.1328208
1968	3	0.4824954	0.3417917	0.1407037
1968	4	0.4721429	0.3480979	0.1240450

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0929927
RMS ERROR: 0.0960125

Table #33: Simulation Results for DCL with $\frac{U(t)}{s(t)}=.045$ and $CU(t)=.82$.

VARIABLE: DCL - ENDOGENOUS

YEAR OT		SIMULATED	ACTUAL	ERROR
1964	2	0.4704041	0.4548514	0.0155527
1964	3	0.4720966	0.4420820	0.0300146
1964	4	0.4666447	0.4244526	0.0421921
1965	1	0.3977055	0.3481224	0.0495831
1965	2	0.3481024	0.2933107	0.0547917
1965	3	0.3135288	0.2564978	0.0570310
1965	4	0.2976318	0.2393102	0.0583216
1966	1	0.3099148	0.2541413	0.0557735
1966	2	0.3040385	0.2440269	0.0600116
1966	3	0.3049955	0.2422542	0.0627412
1966	4	0.2670289	0.2034718	0.0635570
1967	1	0.2660438	0.1988535	0.0671903
1967	2	0.2744623	0.2039189	0.0705434
1967	3	0.2753191	0.1991288	0.0761903
1967	4	0.3145344	0.2267462	0.0877883
1968	1	0.3398378	0.2446331	0.0952046
1968	2	0.3574676	0.2581818	0.0992858
1968	3	0.3909715	0.2875678	0.1034036
1968	4	0.4081351	0.3083609	0.0997742

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.0657342
RMS ERROR: 0.0696975

From these tables we see that an additional .5% cut in the unemployment rate and an additional 1% increase in capacity utilization in the industrial sector, increase the inflation rate by 4.8%. Al these results were estimated assuming no change in $\frac{\dot{P}^m(t)}{P^m(t)}$ and $\frac{\dot{P}f(t)}{P^f(t)}$. When we studied again the case with:

$$\frac{\dot{CL}(t)}{CL(t)} = \frac{\dot{P}^m(t)}{P^m(t)} \quad \text{and} \quad \frac{\frac{\dot{P}^f(t)}{P^f(t)} - \frac{\dot{CL}(t)}{CL(t)}}{1 + \frac{\dot{CL}(t)}{CL(t)}} = 0.02$$

we got the following results:

Table # 34: Simulation Results for DS with $\frac{U(t)}{s(t)} = .045$, $CU(t) = .82$ and DQMBM and DQAGR endogenous.

VARIABLE: DS - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.6310221	0.5068643	0.1241578
1964	3	0.6398706	0.4954881	0.1443825
1964	4	0.6537487	0.4628269	0.1909218
1965	1	0.6631456	0.4090424	0.2541032
1965	2	0.6696832	0.3995998	0.2700834
1965	3	0.6748361	0.4340676	0.2407686
1965	4	0.6785964	0.4555450	0.2230514
1966	1	0.6813849	0.5214971	0.1598878
1966	2	0.6834681	0.4519317	0.2315364
1966	3	0.6850126	0.4509206	0.2340920
1966	4	0.6536025	0.4298078	0.2237946
1967	1	0.6440344	0.3760811	0.2679533
1967	2	0.6350654	0.3754551	0.2596103
1967	3	0.6275353	0.3420130	0.2855223
1967	4	0.6550771	0.2773139	0.3777632
1968	1	0.6616323	0.3060383	0.3555940
1968	2	0.6683506	0.3156358	0.3527149
1968	3	0.6742292	0.3158477	0.3583815
1968	4	0.6780107	0.3871923	0.2908185

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.2550072
RMS ERROR: 0.2645051

Table #35: Simulation Results for DQINP with $\frac{U(t)}{s(t)} = .045$, CU(t) = .82 and DQNRM and DQAGR endogenous.

VARIABLE: DQINP - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.7095411	0.5615469	0.1479942
1964	3	0.7207318	0.5415650	0.1791668
1964	4	0.7382836	0.5089307	0.2293529
1965	1	0.7501678	0.3058270	0.4443408
1965	2	0.7584360	0.2621446	0.4962914
1965	3	0.7640529	0.2611223	0.5038306
1965	4	0.7697086	0.2611405	0.5085681
1966	1	0.7732352	0.3463841	0.4268511
1966	2	0.7758698	0.2859210	0.4899488
1966	3	0.7778231	0.2785956	0.4992274
1966	4	0.7380986	0.2584179	0.4796807
1967	1	0.7259979	0.2817567	0.4442412
1967	2	0.7146547	0.2811235	0.4335312
1967	3	0.7051314	0.2635219	0.4416094
1967	4	0.7399636	0.2334073	0.5065563
1968	1	0.7482540	0.2831918	0.4650622
1968	2	0.7567507	0.2927663	0.4639844
1968	3	0.7641854	0.3226116	0.4415738
1968	4	0.7689679	0.3677155	0.4012524

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.4212139
RMS ERROR: 0.4346131

Table E 36: Simulation Results for DWO with $\frac{U(t)}{s(t)} = .045$, $CU(t) = .82$ and [illegible] and DOAGR endogenous.

VARIABLE: DWO - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5719516	0.5182307	0.0537209
1964	3	0.5847731	0.4926920	0.0920811
1964	4	0.6034537	0.4462848	0.1571689
1965	1	0.6161801	0.2553158	0.3608642
1965	2	0.6250318	0.2463057	0.3787261
1965	3	0.6319998	0.2318555	0.4001443
1965	4	0.6370885	0.2317432	0.4053453
1966	1	0.6408615	0.2858768	0.3549847
1966	2	0.6436800	0.2192863	0.4243937
1966	3	0.6457697	0.2372352	0.4085345
1966	4	0.6037140	0.2232380	0.3804760
1967	1	0.5905820	0.2244857	0.3660963
1967	2	0.5784714	0.2418410	0;3366304
1967	3	0.5682949	0.2169896	0.3513053
1967	4	0.6051088	0.2116365	0.3934724
1968	1	0.6141662	0.2781719	0.3359943
1968	2	0.6232317	0.2804236	0.3428081
1968	3	0.6311734	0.3417917	0.2893818
1968	4	0.6362979	0.3480979	0.2882000

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4

MEAN ERROR: 0.3221225

RMS ERROR: 0.3383181

Table # 37: Simulation Results for DCL with $\frac{U(t)}{s(t)} = .045$, $CU(t) = .82$ and DQMRM and DQAGR endogenous.

VARIABLE: DCL - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4714234	0.4548514	0.0165720
1964	3	0.4839923	0.4420820	0.0419103
1964	4	0.5037056	0.4244526	0.0792530
1965	1	0.5170534	0.3481224	0.1689310
1965	2	0.5263398	0.2933107	0.2330292
1965	3	0.5336593	0.2564978	0.2771615
1965	4	0.5390007	0.2393102	0.2996904
1966	1	0.5429616	0.2541413	0.2888203
1966	2	0.5459206	0.2440269	0.3018938
1966	3	0.5481145	0.2422542	0.3058602
1966	4	0.5034979	0.2034718	0.3000261
1967	1	0.4899069	0.1988535	0.2910534
1967	2	0.4771668	0.2039189	0.2732479
1967	3	0.4664706	0.1991288	0.2673418
1967	4	0.5055925	0.2267462	0.2788464
1968	1	0.5149039	0.2446331	0.2702708
1968	2	0.5244470	0.2581818	0.2662652
1968	3	0.5327972	0.2875678	0.2452294
1968	4	0.5381687	0.3083609	0.2298078

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.2334321
RMS ERROR: 0.2493575

Table #38: Simulation Results for DQMRM with $\frac{U(t)}{s(t)} = .045$, $CU(t) = .82$ and DQMRM and DQAGR endogenous.

VARIABLE: DQMRM - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.4714234	0.3992900	0.0721334
1964	3	0.4839923	0.4128700	0.0711223
1964	4	0.5037056	0.3928800	0.1108256
1965	1	0.5170534	-0.0131000	0.5301534
1965	2	0.5263398	-0.0097600	0.5360999
1965	3	0.5336593	0.0178900	0.5157693
1965	4	0.5390007	0.0435900	0.4954107
1966	1	0.5429616	0.1807230	0.3622386
1966	2	0.5459206	0.1585800	0.3873406
1966	3	0.5481145	0.1300500	0.4180645
1966	4	0.5034979	0.1066900	0.3968079
1967	1	0.4899069	0.2263900	0.2635169
1967	2	0.4771668	0.2445600	0.2326068
1967	3	0.4664706	0.2618510	0.2046196
1967	4	0.5055925	0.2888000	0.2167925
1968	1	0.5149039	0.3821600	0.1327439
1968	2	0.5244470	0.3826500	0.1417970
1968	3	0.5327972	0.4639700	0.0688272
1968	4	0.5381687	0.4534500	0.0847187

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.2758731
RMS ERROR: 0.3226535

Table #39: Simulation Results for DQAGR with $\frac{U(t)}{s(t)} = .045$, $CU(t) = .82$ and DQMRM and DQAGR endogenous.

VARIABLE: DQAGR - ENDOGENOUS

YEAR	QT	SIMULATED	ACTUAL	ERROR
1964	2	0.5008519	0.5686070	-0.0677551
1964	3	0.5136722	0.5077000	0.0059722
1964	4	0.5337797	0.4244340	0.1093457
1965	1	0.5473945	0.3923330	0.1550615
1965	2	0.5568666	0.4165370	0.1403296
1965	3	0.5643325	0.3559590	0.2083735
1965	4	0.5697807	0.3374600	0.2323207
1966	1	0.5738208	0.2979610	0.2758598
1966	2	0.5768390	0.1896700	0.3871690
1966	3	0.5790767	0.2715860	0.3074907
1966	4	0.5335678	0.2710820	0.2624858
1967	1	0.5197050	0.1624530	0.3572520
1967	2	0.5067101	0.2013020	0.3054081
1967	3	0.4958000	0.1370750	0.3587250
1967	4	0.5357044	0.1383690	0.3973354
1968	1	0.5452020	0.2087560	0.3364460
1968	2	0.5549359	0.2033950	0.3515409
1968	3	0.5634532	0.2907270	0.2727262
1968	4	0.5689321	0.2626930	0.3062391

ERROR STATISTICS, 19 OBSERVATIONS: 1964 2 TO 1968 4
MEAN ERROR: 0.2474908
RMS ERROR: 0.2771624

From these tables we observe that for a situation with constant tariffs and international prices in which the devaluation rate is equal to the inflation rate and there is an improvement of 2% in agricultural prices, the increase in the rate of inflation is dramatic. The average increase is of 23% in the four quarters rate of change. This result is substantially higher than the 7% we got for the case in which the rates of change of these two prices were kept at their historical levels. These results again are due to the strong dynamic, from cost and demand to prices, that exists in the short run.

Let us consider now this last model in a steady-state situation characterized by:

$$\frac{1}{U(t)/s(t)} = \alpha \ , \quad \frac{1}{.84-CU(t)} = \beta \ , \quad \frac{\dot{P}^m(t)}{P^m(t)} = \gamma \ , \quad \frac{\dot{P}^f(t)}{P^f(t)} = \delta$$

for all t.-

In this case the model reduces to the following system of difference equations:[26]

$$\frac{\dot{w}^I(t)}{w^I(t)} = - .523 + .037\alpha + .704 \frac{\dot{CL}(t)}{CL(t)}$$

$$\frac{\dot{P}^I(t)}{P^I(t)} = - .166 + .688 \frac{\dot{w}^I(t)}{w^I(t)} + .005\beta + .406\gamma$$

$$(4.2) \quad \frac{\dot{P}(t)}{P(t)} = .408 \frac{\dot{P}^I(t)}{P^I(t)} + .240\gamma + .340\delta$$

$$\frac{\dot{CL}(t)}{CL(t)} = .0598 + .3237 \frac{\dot{P}(t)}{P(t)} + .2277 \frac{\dot{P}(t-1)}{P(t-1)} + .1417 \frac{\dot{P}(t-2)}{P(t-2)} + .0658 \frac{\dot{P}(t-3)}{P(t-3)}$$

26. This is so for the periods in which the dummy variable of cost of living equation is equal to zero.

From this system we want to study the behavior of the cost of living variable.

Solving (4.2) for $\frac{\dot{CL}(t)}{CL(t)}$ we get:

$$(4.3) \quad \frac{\dot{CL}(t)}{CL(t)} = -.1101 + .0084\,\alpha + .0017\,\beta + .3289\gamma +$$

$$+ .2757\delta + .0481\,\frac{\dot{CL}(t-1)}{CL(t-1)} + .0299\,\frac{\dot{CL}(t-2)}{CL(t-2)} +$$

$$+ .0139\,\frac{\dot{CL}(t-3)}{CL(t-3)}$$

From the characteristic equation of this difference equation we get that the three roots are:

$-.2641;\ .15603 + .0965\ \sqrt{-3}\ ;\ .15603\ -\ .0965\ \sqrt{-3}.$

Therefore all roots are within the unit circle and the stationary equilibrium level for the rate of change in the cost of living is given by:

$$(4.4) \quad Z = -\ .1212 + .0093\alpha + .0019\beta + .3622\gamma + .3036\delta$$

Let us study now the behavior of Z as a function of the different parameters involved.

From (4.4) we have:

$$\frac{\partial Z}{\partial \gamma} = .3622$$

This means that for a 10% increase in the rate of growth of the price of imported raw materials (via devaluation, say), the rate of growth in the cost of living increases by a 3.62%.

$\frac{\partial Z}{\partial \delta}$ = .3036, for a 10% increase in the rate of growth of the price of farm products, the rate of growth of cost of living increases by 3.036%.

Let us first consider what the trade-off between unemployment and cost of living is for $\gamma = \delta = 0$ and a capacity utilization level equal to its average ($\beta = \frac{1}{.84 - .80} = 25$). In this case we get from (4.4):

$$(4.5) \qquad Z = -.0737 + .0093\,\alpha$$

Solving (4.5) for α when Z = 0, we get what is called the "natural rate of unemployment". In this case we get 12.6%. Therefore, we get that with constant prices of imported raw materials and with constant prices of farm products, stability in the cost of living requires an unemployment rate in the industrial sector of 12.6%.

Now we shall study what happens to Z under different fiscal and monetary policies.

We will try to consider the closest case to Chilean reality. Assuming that the government follows a monetary and fiscal policy oriented toward keeping the unemployment rate in the industrial sector at 5% (against a 1960-68 average of 5.53%) and toward keeping capacity utilized at the average for the period ($\beta = 25.0$) and toward a long run policy of improving the terms of trade for agriculture products by 100s per cent per period ($\delta - Z = s(1 + Z)$, (this last policy to incentive agricultural production), then from (4.4) we will have:

$$Z = \frac{.1123}{1 - .3036(1+s)} + \frac{.3622\,\gamma}{1 - .3036(1+s)} + \frac{.3036\,s}{1 - .3036(1+s)}$$

Let us assume now that the situation in the foreign trade sector is such that we do not need to devalue ($\gamma = 0$).

In this case even if we keep constant the agricultural terms of trade (s = 0), inflation will be 16.1%. If the four quarters devaluation rate is 25% and the improvement in the agricultural prices is 3%, then we get a four quarter rate of inflation of 30.5%. This rate is very close to the actual rate in Chile.

We conclude from this simple model, that the problems facing the Chilean economy are more fundamental than the structuralist's thesis postulates. Even without structural problems (in the sense that the development of the agriculture and foreign trade sector allows growth with ($\gamma = s = 0$)), stability requires an unemployment rate in the industrial sector of 12.6%.

This unemployment rate was obtained without considering the effect of the generation of employment in the agricultural and foreign trade sectors on the cost of living - industrial unemployment trade off.

Although this simple model is very powerful in the explanation of price behavior, in Chile the role of fiscal and monetary policy appears only implicity. To study this explicitly, we go to the following chapter, where we study a complete macreoeconomic model.