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Changes of the aggregate supply conditions in Italy: a small econometric model of wages and prices dynamics

Abstract

Through the estimation of a small econometric model of the nominal wages and prices dynamics in Italy, obtained within a cointegrated VAR framework, this paper intends to identify some changes that occurred in aggregate supply conditions from the seventies to the end of the nineties of the last century. The paper analyses the changes in the static equations of the demand and supply real wage and the sets of dynamic responses of nominal wages, prices, unemployment, productivity and real exchange rate. The analysis is based on a 'competing claims' model inspired by a well-known work of Modigliani and Padoa Schioppa (1977). The empirical analysis makes it possible to evaluate the evolution of the Phillips curve in the three decades examined and to highlight some macroeconomic evidence of the tendency towards a more flexible labour market observed in the Eighties and Nineties.

Keywords: Wages, prices, Phillips curve, cointegration, dynamic econometric models.
JEL Classification: C32, C51, E31.

Contents

I. Introduction

This paper provides a theoretical guide for the empirical specification of a wage-price model of the Italian economy. Its objective is to estimate a cointegrated VAR (*Vector Autoregressive Representation*) model for the identification of the main changes occurring in the aggregate supply conditions during the period from the early 1970s to the end of the 1990s of the last century.

The purpose of the analysis is to answer the following question: was there a significant change in the supply conditions in Italy over the span of time considered and, in particular, during the macroeconomic changes that took place from the start of the 80' onwards? What were the features and effects of that change? In particular, we will investigate whether, during this time span, there were any changes in the characteristics of the static equations of the real demand and supply wage, and we will examine the set of possible dynamic responses indicated by the model. The investigation will compare two periods, prior and subsequent to the early 1980s, which have been described in the literature[1] as characterized by considerably different supply systems due to: a) changes in industrial relations[2] and their effects on contract systems (gradual wage de-indexation), social legislation and industrial productivity; (b) progressive European integration and liberalization of the financial markets and the labour market, as well as changes in the exchange rate regime; finally, (c) the oil countershocks.

It is widely claimed in the literature that these changes exerted a positive effect on supply conditions, leading in a direction favourable towards reduction in equilibrium unemployment[3]. Such an assessment is based on empirical studies which mainly analyze the characteristics of the static equilibrium equations[4]. In particular, according to the conventional description found in the literature, the supply wage is influenced by labour market conditions through the unemployment rate. Furthermore, the supply wage is regarded as fully reflecting (with a unit coefficient) the productivity trend, and also sometimes reacting to the tax wedge and to a set of other variables that express the trade unions' power and institutional factors.

[1]See Juselius (2001), Marcellino and Mizon (2000), (2001) and, for a historical-economic approach, Rossi (1998), Signorini and Visco (2002).

[2]We are referring to the slow process of change in industrial relations, which started with the Turin demonstration of October 1980 and continued later with the government-trade union-Confindustria agreement on the '*punto unico di contingenza*' of 1983 and the referendum for the repeal of the '*scala mobile*' in 1985. These were the warning signals of a deep change that would lead, over the next decade and through the 1993 agreements, to the '*concertation*' policy.

[3]The fact that unemployment in the main continental Europe countries did not respond positively to the change in supply conditions led several authors to reject the assumption that European unemployment presents equilibrium characteristics and to assume, instead, that demand factors are to be identified as its main causes. See Modigliani (1995), Modigliani and Ceprini (2000), Lombard (2000) and the literature quoted therein.

[4]See Juselius (2001), (2002), Marcellino and Mizon (2000), (2001), Chiarini and Piselli (1997).

The real demand wage is likewise held to be sensitive to the level of activity and fully incorporates growth in productivity and the dynamics of the real price of raw materials. We will show that this representation is not fully compatible with some aspects of the Italian macroeconomic experience over the last thirty years: in particular, we will underline the importance of the real import price in the supply wage equation and the changes in the role of this variable that occurred following the process of wage de-indexation. In addition, we will demonstrate that both the real wage response to labour market conditions (and therefore the degree of rigidity of the real wage) and also the role of productivity in the two static equations underwent important changes during the period considered.

However, we will focus, in particular, on the identification and theoretically consistent interpretation of dynamic mechanisms: the endogenous response of price and wage inflation, but also of unemployment, productivity and the real import price will be evaluated - within the framework of a 'competing claims' model - in the light of the theoretical model. Our findings, which highlight some elements of discontinuity between the two subperiods considered, show that the divergence is more pronounced than would appear from the static equations.

In synthesis, we will focus on two aspects: 1) changes in the variables, the sign and dimension of the static equation coefficients; 2) changes in the coefficients of reaction to "distributive disequilibrium" and in the variables responding to this disequilibrium.

Our analysis of the macroeconomic events of the period differs in some respects from that prevailing in the literature. For the 1970s the usual reading underlines the role of trade union-derived shocks on the supply wage, and that of oil shocks on the demand wage. In our analysis it was not possible to detect a role of trade union variables, while the importance of the real import prices emerged very clearly. However, this variable mainly exerted its effects on supply wage (and therefore through *wage resistance*) rather than demand wage. Such a result appears to be more consistent with the behaviour of real wages and the wage share during the period examined. For the 1980s, the pattern of static equations is once again in line with the conventional picture, while the dynamic analysis shows the emergence of endogenous responses to disequilibrium (productivity and unemployment), which were not present during the previous period.

The empirical model presented in this paper also allows for an assessment of how the characteristics of the Phillips curve evolved during the three decades considered. It is thus possible to underscore the process whereby real wages were made increasingly flexible during the 1980s and 1990s.

In Section II we will introduce the theoretical model used as reference for our empirical analysis. This model is based on a well-known work by Modigliani and Padoa-Schioppa (1977), modified in order to adapt it to the description of the macroeconomic characteristics of the Italian economy during the 1980s and 1990s and also to endow it with a formulation closer to the requirements of empirical testing. After a brief comment on the time series (Section III.A), we will introduce

(Section III.B) a small aggregate econometric model of the dynamics of nominal wages and prices for Italy that can be immediately compared with the theoretical model. Since the relevant macroeconomic time series are obviously non-stationary, our analysis will be developed in the framework of the cointegrated VAR class of models. In particular, after introducing the unrestricted VAR representation of the labour market model, we will use the cointegration approach to identify long-run equations among variables of interest (Section III.C). Finally, by applying the 'general to specific' strategy, we will draw up a model capable of describing the short-run dynamics and of incorporating information regarding long-run equations (Section III.D). The main empirical results will be extensively discussed in section IV. In the section V preceding the general conclusions we will estimate an alternative model for the eighties and nineties.

II. A model of wages and prices

In this section we will briefly introduce a simple aggregated wage-price model characterized by distributive conflict in the labour market and by imperfect competition in the product market. The model draws inspiration from the work carried out by Modigliani and Padoa Schioppa in 1977[5], with adjustments suggested by the requirements of the empirical analysis.The discussion of this section will be of a heuristic nature and serve the purpose of briefly and intuitively introducing the most significant issued to be addressed in the subsequent analysis.

In a situation such as that of Italy, where wages are mainly determined on the basis of collective agreements and firms have the power, to a certain extent, to set prices in the product market, it is usually assumed[6] that the distributive objectives of firms and trade unions may be rendered compatible through an endogenous mechanism, whose operation crucially relies on the condition that the mark-up desired by firms and/or the wages aimed at by trade unions are linked to the level of economic activity. Therefore, it is assumed that the distributive conflict may be resolved through changes in the level of activity. If the unemployment rate associated with equilibrium is socially unacceptable, the political authority may intervene to maintain employment at higher levels, insofar as this is compatible with balance of payments deficits and with the inflationary cost of the policy adopted. The extent and duration of the advantages in terms of employment which can be obtained by taking this route depend on two mechanisms through which the political authority affects - by resorting to demand

[5]The model is discussed in detail in Ghiani (2004) to which we refer readers for further analysis and evidence. For a simpler introduction to a model with a similar structure, see Casarosa (1996), Chap. 10. For a model in the same theoretical line to the one presented here see Kolsrud and Nymoen (1998); for an empirical application of this model see Bardsen and Fisher (1999).

[6]This assumption characterises, for instance, the analysis of imperfect competition models by Carlin and Soskice (1990), by Layard and Nickell (1986), and by Layard, Nickell and Jackman (1991).

policies - the income distribution actually achieved in the country:

a) firstly, one mechanism was highlighted under the category of cost-induced inflation models. Even in the presence of a wage indexation system and a high degree of protection against inflation, if nominal wages have a finite frequency of adjustment to prices and if adjustment of prices to wages is not instantaneous, economic policy authorities can make use of demand policies in order to reach a distributive compromise founded on inflation. This compromise implies that the firms and/ or trade unions temporarily accept a mark-up and a real wage not in line with their objective; the degree of temporariness of this compromise depends: i) on the extent to which the frequency of adjustment of wages to prices is affected, through the reaction of trade unions, by the magnitude of the distributive disequilibrium realised; ii) on the extent to which the mark-up disequilibrium drives firms to increase the speed of price-to-wage adjustment;

b) if, as can be reasonably argued, both the real wages negotiated and the mark-up desired by firms are a function of the real exchange rate[7], the inflation generated by the distributive conflict associated with high activity levels may determine, for a given nominal exchange rate and for given worldwide prices in dollars, a variation in the real exchange rate leading to (total or partial) re-absorption of the distributive conflict and the inflation generated therefrom. In the situation described, inflation has the effect of improving the terms of trade in the country by increasing the distributive share of wages and profits (as a whole) to the detriment of the foreign sector, and this contributes to settling the internal distributive conflict. In these conditions, the factors driving a revision of the frequency of adjustment of wages or a revision of the speed of adjustment of prices to wages tend to be eliminated or attenuated, and the only constraint for economic policy authorities is the financing of the disequilibrium of current account balances and/or the sustainability of the foreign debt accumulated.

Both these mechanisms characterize the simple dynamic model of distributive conflict introduced in the following section[8].

II.A. The equations of the model

The static equilibrium equation of the real supply wage has a conventional nature and can be derived from a standard negotiation model[9]:

[7] The role of the real exchange rate as a factor contributing to determination of the demand and supply wage will be discussed in the following pages. For further analysis, see Ghiani (2004).

[8] We have already stated that the analysis carried out in this paragraph is based on the model conceived by Modigliani and Padoa Schioppa (1977). Some of the changes made and expository devices introduced have been taken up by Casarosa (1996) Chap. 10. For a detailed derivation and a discussion of the model, see Ghiani (2004).

[9] See Ghiani (2004). More generally, the static equilibrium equations of wages and prices draw inspiration from some well-known contributions by the macroeconomic literature on the labour market in the 90's; the main reference is Layard, Nickell and Jackman (1991).

$$\frac{W_t}{P_t} = U_t^{-\alpha_1} \left(\tfrac{i_t}{P_t}\right)^{(1-\sigma)(1-\alpha_0)} \prod_{j=1}^{p} Z_{w_j,t}^{\alpha_{2j}} \tag{1}$$

where W_t indicates the money wage, P_t the GDP deflator, U_t the unemployment rate, $Z_{w_j,t}$ refers to a set of p variables that include productivity π_L, the indicators of the trade unions' bargaining power, unemployment benefits, tax rates and other variables that contribute to determining the *reservation* wage and the relevant mark-up, i_t is the import price in domestic currency, σ indicates the share of nationally produced consumer goods in the basket used as the basis for calculation of the consumption price index; α_0, α_1 and α_{2j} are parameters.

For the price equation, we assume that firms operate in imperfectly competitive markets with a Cobb-Douglas production function with two variable factors (labour and raw materials) and a fixed factor $Q_t = A_0 L^a M^b K^g$, where L, M and K are, respectively: labour, raw materials and a fixed factor. We assume that raw materials are imported goods and, for the sake of simplicity, we will identify their price with the value of imports in domestic currency $i = eP^*$, where P^* indicates the import price in "dollars" and e the nominal exchange rate. Remembering that the optimal condition for an imperfectly competitive firm implies $P = CM_g(1-1\backslash|\upsilon|)^{-1}$ where CM_g indicates the marginal cost, υ is the elasticity of demand and $(1-1\backslash|\upsilon|)^{-1}$ is the mark-up, we can write[10]:

$$P_t = m_t \left(\frac{W_t st}{\pi_{L,t}}\right)^{\beta_1} \left(\frac{i_t}{\pi_{M,t}}\right)^{\beta_0} \quad \text{con } \beta_0 + \beta_1 = 1 \tag{2}$$

where $\pi_L = Q/L$ and $\pi_M = Q/M$, $s = 1+$ (*tax rate for social security contributions*), $t = 1+$ (*indirect taxation rate*); subsequently, we will assume π_M as constant. We will hypothesize that the mark-up is linked to the level of economic activity and we will measure the latter with the unemployment rate U. Since the elasticity of demand υ depends on the real exchange rate through the effects on foreign competition, we will suppose that the mark-up function is:

$$m_t = U_t^{-\beta_2} \left(\frac{i_t}{P_t}\right)^{\beta_3} m_0 \tag{3}$$

where m_0 expresses the extent to which the mark-up is affected by institutional exogenous factors that determine the degree of competition in the product market [11]. Equations (2) and (3) produce the expression for the real wage desired by firms:

[10] For the complete derivation, see Binotti (1983).

[11] For an analysis of how such factors affect the mark-up, see Blanchard (1997), (2000), Blanchard and Giavazzi (2001).

$$\frac{W_t}{P_t} = m^{-\frac{1}{\beta_1}} \pi_{L,t} \left(\frac{i_t}{P_t \pi_{M,t}} \right)^{-\frac{\beta_0}{\beta_1}} =$$
$$= \pi_{L,t} U_t^{\frac{\beta_2}{\beta_1}} \left(\frac{i_t}{P_t} \right)^{-\frac{\beta_3+\beta_0}{\beta_1}} \left(\frac{1}{\pi_{M,t}} \right)^{-\frac{\beta_0}{\beta_1}} m_0^{-\frac{1}{\beta_1}} \tag{4}$$

which is inversely proportional to the real exchange rate both through the influence the latter has on the mark-up and through production costs.

We assume that nominal wages react to the existence of a difference compared to the equilibrium value determined by (1) according to the following partial proportional adjustment equation[12]:

$$\frac{W_t}{W_{t-1}} = \left[\frac{U_t^{-\alpha_1} \left(\frac{i_t}{P_t} \right)^{(1-\sigma)(1-\alpha_0)} \prod_{j=1}^{p} Z_{w_j,t}^{\alpha_{2j}}}{\frac{W_{t-1}}{P_{t-1}}} \right]^{\gamma} \left(\frac{P_t}{P_{t-1}} \right)^{\phi_w} U^{-\delta_w} \tag{5}$$

where the numerator of the expression in square brackets is given by equation (1). So we will suppose that if $\gamma \neq 0$ then we will have $\delta_w = 0$, alternatively, if $\gamma = 0$ then wages respond to the unemployment rate according to the logic of a traditional Phillips curve, and therefore we will have $\delta_w \neq 0$.

Similarly, we can write the equation that describes the reaction of prices to the disequilibrium compared to equation (4)[13]:

$$\frac{P_t}{P_{t-1}} = \left[\frac{\pi_{L,t} U_t^{\frac{\beta_2}{\beta_1}} \left(\frac{i_t}{P_t} \right)^{-\frac{\beta_3+\beta_0}{\beta_1}} \left(\frac{1}{\pi_M} \right)^{-\frac{\beta_0}{\beta_1}} m_0^{-\frac{1}{\beta_1}}}{\frac{W_{t-1}}{P_{t-1}}} \right]^{-\eta} \left(\frac{W_t}{W_{t-1}} \right)^{\phi_p} U^{\delta_p} \tag{6}$$

where the numerator of the expression in square brackets is given by equation (4). In this case too, we will assume that prices react to the unemployment rate if the response to the disequilibrium of the desired wage is not in operation, and therefore $\delta_p \neq 0$ only if $\eta = 0$.

For purposes of adaptation to the empirical model, we will change the previous equations and introduce a lag; then we will assume that the proportional change in wages takes place to an extent that corresponds not to the excess of the current equilibrium wage as compared to the wage earned in the previous period,

[12]For the derivation and a discussion of equation (5), see Ghiani (2004). The hypotheses on the disequilibrium behaviour of monetary wages and prices express, in terms of proportional variations, the corresponding assumptions put forward, for example, by Modigliani and Padoa Schioppa (1977). See also Kolsrud and Nymoen (1998).

[13]See previous note.

but rather to the excess of the equilibrium wage of the previous period. The same assumption will be also used for prices. Therefore, the two main dynamic equations will have the following general formulation:

$$\frac{W_t}{W_{t-1}} = \left(\frac{w^L_{t-1}}{wr_{t-1}}\right)^{\gamma} \left(\frac{P_t}{P_{t-1}}\right)^{\phi_w} U^{\delta_w}_{t-1} \tag{7}$$

$$\frac{P_t}{P_{t-1}} = \left[\frac{w^I_{t-1}}{wr_{t-1}}\right]^{-\eta} \left(\frac{W_t}{W_{t-1}}\right)^{\phi_p} U^{\delta_p}_{t-1} \tag{8}$$

where w^L_t and w^I_t indicate the real equilibrium wage of workers and firms indicated respectively by (1) and (4) and $wr_t = \frac{W_t}{P_t}$.

In our next analysis, we will assume that productivity, the real exchange rate and unemployment can all present an endogenous response to the disequilibrium in the supply and demand wage[14]. So, we will consider the following three equations:

$$\frac{\pi_{Lt}}{\pi_{Lt-1}} = \left(\frac{w^L_{t-1}}{wr_{t-1}}\right)^{-\tau_L} \left(\frac{w^I_{t-1}}{wr_{t-1}}\right)^{-\tau_P} \tag{9}$$

$$\frac{U_t}{U_{t-1}} = \left(\frac{w^L_{t-1}}{wr_{t-1}}\right)^{-s_L} \left(\frac{w^I_{t-1}}{wr_{t-1}}\right)^{-s_P} \tag{10}$$

$$\frac{\frac{i_t}{P_t}}{\frac{i_{t-1}}{P_{t-1}}} = \left(\frac{w^L_{t-1}}{wr_{t-1}}\right)^{-\zeta_L} \left(\frac{w^I_{t-1}}{wr_{t-1}}\right)^{-\zeta_P} \tag{11}$$

where parameters τ, s and ζ express the speed at which productivity, unemployment and the real exchange rate respectively react to the distributive disequilibrium.

Equations (7) and (8) form a system of simultaneous equations in $\frac{W_t}{W_{t-1}}$ and $\frac{P_t}{P_{t-1}}$, which we can therefore resolve for these two variables and obtain:

[14]The analysis of the *weakly* exogenous nature of variables conducted in the framework of the cointegrated VAR approach may highlight the existence of dynamic responses such as those described by equations (9), (10) and (11). The possible endogenous response of productivity may be linked to the fact that firms, in situations of distributive disequilibrium, resort to measures to rationalize their production processes and reduce labour hoarding by expelling the workforce, with the effect of increasing productivity. The workers' reaction to the disequilibrium may also affect the product per employed worker. The endogenous response of unemployment may be linked to the features of the reaction function of the monetary authority. Finally, the real exchange rate response is linked to the mechanism mentioned in Section 2, point b). For a more detailed theoretical justification of these hypotheses, see Ghiani (2004).

$$\frac{W_t}{W_{t-1}} = U_{t-1}^{\Omega_0} \left(\frac{i_{t-1}}{P_{t-1}}\right)^{\Omega_1} wr_{t-1}^{\Omega_2} \Psi_w \tag{12}$$

$$\frac{P_t}{P_{t-1}} = U_{t-1}^{\Pi_0} \left(\frac{i_{t-1}}{P_{t-1}}\right)^{\Pi_1} wr_{t-1}^{\Pi_2} \Psi_P \tag{13}$$

where Ω_0, Ω_1, Π_1, D, Ψ_P are parameters whose expressions are shown in Appendix C.

Equations (12) and (13) describe the relations holding between inflation (of wages and prices) and the real wage of the previous period; such relations constitute the phase diagram of the real wage, conditional upon the real exchange rate $\dfrac{i_{t-1}}{P_{t-1}}$ and level of activity U_{t-1}. Hence we derive the two dynamic reduced form equations that describe the trends of real wages and real exchange rates over time:

$$wr_t = U_{t-1}^{\Phi_0} \left(\frac{i_{t-1}}{P_{t-1}}\right)^{\Phi_1} wr_{t-1}^{\Phi_2} \Psi_w \Psi_P^{-1} \tag{14}$$

$$\frac{i_t}{P_t} = \frac{i_t}{i_{t-1}} U_{t-1}^{\Gamma_0} \left(\frac{i_{t-1}}{P_{t-1}}\right)^{\Gamma_1} wr_{t-1}^{\Gamma_2} \Psi_P^{-1} \tag{15}$$

where Φ_0, Φ_1, Φ_2, Γ_0, Γ_1, Γ_2 are parameters whose expressions are referenced in the Appendix C.

For each given level of imported inflation $\frac{i_t}{i_{t-1}}$ (which we may assume as being exogenously determined by external inflation in dollars, by the nominal exchange rate policy) and the unemployment rate, the two equations describe the process through which the real wage and the exchange rate converge (in the case of stability) to a steady state equilibrium value[15]. The steady state equilibrium solution of the system consisting of equations (14) and (15) is:

$$wr_t = U_t^{\frac{[\Phi_0(1-\Gamma_1)+\Phi_1\Gamma_0]}{D}} \left(\frac{i_t}{i_{t-1}}\right)^{\frac{\Phi_1}{D}} \Psi_w^{\frac{1-\Gamma_1}{D}} \Psi_P^{-\frac{1-\Gamma_1-\Phi_1}{D}} \tag{16}$$

$$\frac{i_t}{P_t} = U_t^{\frac{\Phi_0\Gamma_2-(\Phi_2-1)\Gamma_0}{D}} \left(\frac{i_t}{i_{t-1}}\right)^{\frac{1-\Phi_2}{D}} \Psi_P^{\frac{1-\Phi_2-\Gamma_2}{D}} \Psi_P^{-\frac{\Gamma_2}{D}} \tag{17}$$

[15]Therefore we have a system with two equations for the differences in the two real variables wr_t and $\frac{i_t}{P_t}$; under reasonable assumptions on the values of coefficients, the steady state equilibrium solutions for these variables are stable if the following conditions occur simultaneously: monetary wages respond to the disequilibrium in wages on the supply side ($\gamma > 0$); prices response to the disequilibrium in wages on the demand side ($\eta > 0$); workers defend the purchasing power of their wages in the presence of increases in consumer prices ($1 - \alpha_0 > 0$) and/or the prices set by firms depend on the exchange rate ($\frac{\beta_3+\beta_0}{\beta_1} > 0$). See the demonstration illustrated in Ghiani (2004).

where $D = (1-\Gamma_1)(1-\Phi_2) - \Gamma_2\Phi_1$. Therefore, if stability conditions are met, both the real wage and the real exchange rate tend to reach the level indicated by (16) and (17) for a given level of activity and a given imported inflation rate.

We can now identify the possible connection between the static equilibrium model, the dynamic assumptions we have advanced and the existence of a short and long term Phillips curve[16].Let us return to the previous equations (12), (13), (14) and (15) and write them in logarithmic form [17]:

$$g_{w,t} = \Omega_0 \ln U_{t-1} + \Omega_1 \ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + \Omega_2 \ln\left(\frac{W_{t-1}}{P_{t-1}}\right) + \ln \Psi_w \tag{18}$$

$$g_{p,t} = \Pi_0 \ln U_{t-1} + \Pi_1 \ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + \Pi_2 \ln\left(\frac{W_{t-1}}{P_{t-1}}\right) + \ln \Psi_P \tag{19}$$

$$\ln\left(\frac{W_t}{P_t}\right) = \Phi_0 \ln U_{t-1} + \Phi_1 \ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + \Phi_2 \ln\left(\frac{W_{t-1}}{P_{t-1}}\right) + \ln\left(\Psi_w \Psi_P^{-1}\right) \tag{20}$$

$$\ln\frac{i_t}{P_t} = \ln\left(\frac{i_t}{i_{t-1}}\right) + \Gamma_0 \ln U_{t-1} + \Gamma_1 \ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + \Gamma_2 \ln\left(\frac{W_{t-1}}{P_{t-1}}\right) + \ln\left(\Psi_P^{-1}\right) \tag{21}$$

where $g_{w,t}$ and $g_{p,t}$ indicate the wage inflation rate and the price inflation rate, respectively. We obtain from (20) the steady state equilibrium wage (partial equilibrium, inasmuch as it is affected by unemployment and the real exchange rate):

$$\ln\left(\frac{W_t}{P_t}\right) = \frac{\Phi_0}{1-\Phi_2}\ln U_{t-1} + \frac{\Phi_1}{1-\Phi_2}\ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + \frac{1}{1-\Phi_2}\ln\left(\Psi_w\Psi_P^{-1}\right) \tag{22}$$

if we replace the expression for the wage thus obtained in (18) or in (19) , we will obtain the partial steady state equilibrium inflation rate (of prices or wages), which we can write in a simplified form as follows:

$$g_w = G(\ln U, \ln\left(\frac{i}{P}\right), \Psi) \tag{23}$$

where Ψ is a parameter vector and we have eliminated the time index, since this is a static equilibrium relation. The equation (23) indicates the inflation rate that tends to arise in the system upon convergence (based on eq. (20)) of the real wage to its steady state equilibrium value, for a given unemployment rate and real exchange rate level. The relation between unemployment rate and inflation described in this equation represents a long term negatively-sloping Phillips curve.

[16] As pointed out by Gordon (1997), the Phillips curve has become a general term to indicate a relation between inflation and unemployment, regardless of its theoretical foundation.

[17] We will resort to the simplification where $\ln\frac{x_t}{x_{t-1}} = \Delta \ln x_t \simeq g_x$ and $g_x = \frac{x_t - x_{t-1}}{x_{t-1}}$.

The map of short term curves is described by equation (20), which can be easily re-formulated as shown below:

$$g_{w,t} = g_{p,t} + \Phi_0 \ln U_{t-1} + \Phi_1 \ln\left(\frac{i_{t-1}}{P_{t-1}}\right) + (\Phi_2 - 1)\ln\left(\frac{W_{t-1}}{P_{t-1}}\right) + \ln\left(\Psi_w \Psi_P^{-1}\right); \quad (24)$$

we may observe that if $\Phi_2 = 1$, then a traditional Phillips curve (without *error correction*) is obtained (vertical in the long run): the real wage increases at a constant rate that depends on the unemployment rate and on the real exchange rate. For $\Phi_2 < 1$, instead, an *error correction* mechanism (ECM) is present, which ensures the convergence of real wage and inflation to a stable value. Thus, we can state that, in our model, the presence of an ECM leads to a negatively-sloping Phillips curve, while its absence produces a vertical curve. Since $\Phi_2 = 1 - [\beta_1 D\,[\eta(1-\phi_w) + \gamma(1-\phi_p)]]$, it follows that the case of a vertical Phillips curve occurs for $\phi_w = \phi_p = 1$, that is, when the two fundamental dynamic real equations that show the reaction to the disequilibrium of wages and prices describe two real wage processes that are incompatible with one another (the model is not capable of achieving a distributive compromise).

Our analysis suggests that we should expect the Phillips curve to be negatively sloping in the long term if the following conditions coexist: a) no dynamic homogeneity of wages and prices; b) the real exchange rate does not affect the demand and supply wage to an appreciable extent; or b') a policy of relative stability of the real exchange rate is pursued (and implemented). In the presence of condition a), but not of condition b) or b'), the long term Phillips curve will be horizontal. Finally, in the absence of condition a), the Phillips curve will be vertical and described by a traditional equation without ECM.

In conclusion, our model includes: a) two structural relations of static equilibrium for the real demand and supply wage; b) two dynamic equations for the adjustment of money wages and prices towards such equilibria in the form of an error correction model (ECM); c) dynamic reduced forms for the real wage, the real exchange rate and the short term Phillips curve; d) reduced form static (or, more general, *steady state*) equilibrium equations, which configure the equilibrium positions of *distributive compromise* for the main variables (real wage, exchange rate and inflation); e) equations of the possible reactions to disequilibrium of unemployment and productivity . This is the theoretical basis for an analysis of the changes that occurred during the last three decades of the XX century, both in the macroeconomic static relations of the Italian labour market (wage equations) and also in its dynamic characteristics (price flexibility, Phillips curve, dynamic responses to productivity and employment). The empirical analysis presented in the following sections will be constantly linked to the general layout we have just outlined: we believe that within the framework of cointegrated VAR modelling, the empirical results can be deemed acceptable only if they are strictly coherent with the theoretical model.

III. Empirical analysis

III.A. A brief description of the time series

Figures 1 and 2 show the trends of the main variables that characterise our investigation and their growth rates[18]. All variables are expressed in logarithms. Small-case letters have been used to indicate the logarithm of a variable, and we have also assumed $\ln i_t = pm_t$ and $\ln \pi_{L,t} = pr_t$. The main variables are: the nominal wage w_t, the GDP deflator p_t, the real wage $(w-p)_t$, a measure of productivity pr_t, the wage share $(w-p-pr)_t$, the unemployment rate u_t, the import price pm_t and the real import price $(pm-p)_t$, which we will also consider as a proxy for the real exchange rate.

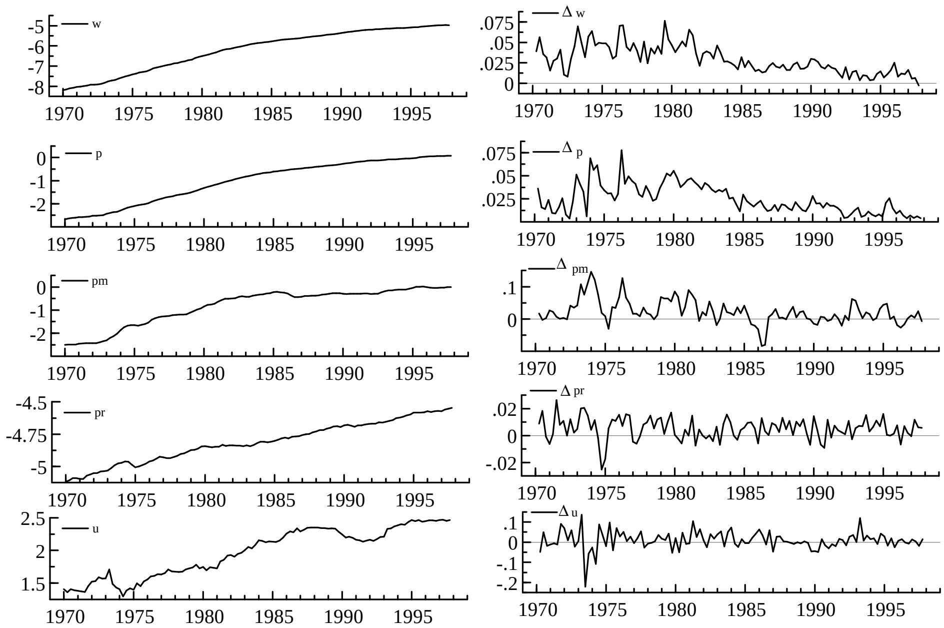

Figure 1: Full-sample levels and first differences

From a simple examination of the graphs, we can obtain a first confirmation of the outcome of the recursive regressions and, subsequently, of the outcome of multivariate analysis: there is a clear change in the real wage, productivity, inflation and real exchange rate, and this change is revealed in the variability of the series, during the transition from the Seventies to the subsequent period. As pointed out by Marcellino and Mizon (2001), and as our analysis will show, there is also an evident change in the relation between real wages, unemployment and real import price, and between inflation and unemployment.

[18]For a statistical definition of the data, see Appendix B.

A particular interesting subject for our study is the real import price (figure 2). This graph shows that there were two periods of stationary prices - even though with broad fluctuations - between 1977 and 1984, and after September 1992. In addition, there was a phase of strong real devaluation between 1972 and 1976; and an equally important phase of real revaluation between 1985 and 1992. However, the periods of relative stability in the real exchange rate are the outcome of different behaviour of the nominal exchange rate, and they are also the result of the differential between internal and external inflation.

The considerable improvement in the terms of trade that occurred between 1985 and 1992 corresponds to a definitive stabilisation phase for the Lira compared to the Mark, considerable appreciation compared to the dollar, oil price reduction after 1985, and maintenance of a non negligible inflation rate differential compared to the average of more developed countries. Finally, the increase in the import price in the early 1970s, due to both the first oil shock and the monetary instability linked to the end of the Bretton Woods system, was concentrated over three years and was not reabsorbed until the subsequent 1986 countershock and the recovery of the Lira over the dollar. In contrast, the effects of the second oil price shock (1986) were different, and were rapidly reabsorbed by the inflation rate differential.

The graph depicting the real wage (figure 2) shows the effects of the strong wage shock of the 1970s. Wages were characterised by a positive trend as well as a lack of sensitivity to unemployment, which was showing an increased cyclical variability precisely in those years. The subsequent phase shows a downturn in the wage dynamic linked to the cyclical slowing down of 1981 and 1982, a basic stability until 1985 and then a definite upswing during the expansion of the Italian economy in the second half of the 1980s, with a return to a stationary profile during the recession phase of the early 1990s. Clearly a closer connection exists between real wages and the level of aggregate economic activity during the 1980s and 90s. Figure 2 also allows us to highlight the connection between the real import price trend and the real wage trend up to the early 1980s, a period that was characterised by a high degree of indexation and in which wage resistance to the price changes, in Liras, of imported consumer goods remained high. During the long phase of improvement of the terms of trade prior to the 1992 devaluation, real wages showed differentiated behaviour, suggesting - given that indexation had meanwhile been attenuated - a greater independence of wages from the real prices of raw materials. Finally, the joint behaviour of real wages and productivity (figure 2) contributed to determining the *humped-shaped* trend of the distributive labour share, a trend that has been the object of careful analysis in the literature[19]. While, until 1977, an increase in wages was matched by an increase in the wage share, in the following years the wage share continued to decrease persistently even during the recovery of the wage trend in the years

[19]See Blanchard (2000), Blanchard, and Giavazzi (2001), Rowthorn (1999).

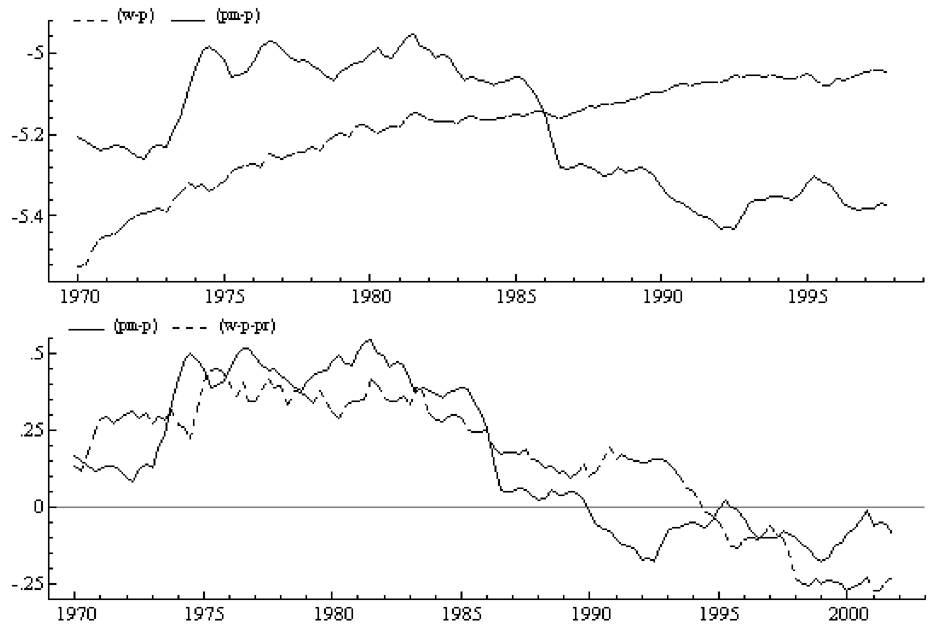

Figure 2: The log of real import prices, real wages and wage share

1985-1990, until at the start of the new millennium it reached 1960s levels. Figure 2 suggests that the behaviour of the wage share is correlated with the real price of raw materials, as well as with real wages; at the beginning of the 1980's, an important change occurred in the correlation among these variables - a change whose origins deserve to be investigated in the next few pages.

III.B. Econometric model

The vector of the relevant variables obtained through the model formed by equations (1), (4), (7), (8), (9), (10), (11) is:

$$X_t' = \left[\ln W_t, \ln P_t, \ln U_t, \ln\left(\frac{i_t}{P_t}\right), \ln \pi_{L,t}, \ln Z_{w,t}, \ln Z_{P,t}\right] \tag{25}$$

where $Z_{w,t}$ is the vector of the variables Z_{w_j} and $Z_{P,t}$ is the vector of the variables that we consider as exogenous in the price equation. Since the time series are clearly non-stationary, the analysis of the relations among the main variables will be carried out within the framework of the specification of a closed, unrestricted VAR:

$$x_t = \sum_{i=1}^{k} \Pi_i x_{t-i} + \Psi D_t + e_t, \quad e_t \sim IN(0, \Lambda) \tag{26}$$

where $x_t' = [w_t, p_t, pr_t, u_t, (pm-p)_t]$, Π_i is a matrix of autoregressive coefficients, D_t is a vector of deterministic variables and e_t is a vector of n errors with zero mean and constant covariance matrix. One may observe that vector x_t' does not contain some of the variables included in X_t'; in fact, at this point we have deemed it appropriate to exclude from the modelling procedure some variables whose nature is likely to be exogenous and whose inclusion, based on our preliminary estimates, does not significantly modify the results given by the model. Since for the purpose of our analysis it is important to subdivide the sample into two sub-periods, the requirement of maintaining a suitable number of degrees of freedom has been assumed as a priority. The re-parameterization $VECM$ (*Vector Error Correction Model*) of equation (26) is:

$$\begin{aligned}\Delta x_t &= \sum_{i=1}^{k-1}\Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \Psi D_t + e_t \qquad (27)\\ &= \sum_{i=1}^{k-1}\Gamma_i \Delta x_{t-i} + \alpha\beta' x_{t-1} + \Psi D_t + e_t\end{aligned}$$

where Δ is the difference operator, $\Gamma_i = -\Sigma_{j=i+1}^{k}\Pi_j$, $\Pi = -(I_n - \Sigma_{i=1}^{k}\Pi_i) = \alpha\beta'$ is the reduced rank r matrix, α is the $n \times r$ loading matrix of the equilibrium relationships and β is the $n \times r$ matrix of the cointegrating vectors; the latter represent the parametric structure of the steady state equilibrium relations represented in disequilibria form. The reduced form (27) is the starting point to estimate and identify the following structural parameterization $SECM$ (*Structural Error Correction Model*):

$$A\Delta x_t = \sum_{i=1}^{k-1}\Gamma_i^* \Delta\ x_{t-i} + a\beta' x_{t-1} + \Phi D_t + v_t \qquad (28)$$

with $v_t \sim IN(0, \Omega)$ and where: $\Gamma_i^* = A\Gamma_i$, $a = A\alpha$, $v_t = Ae_t$, $\Phi = A\Psi$, $\Omega = A\Lambda A'$.

A simple comparison between (27) and (28) shows that while the long-run coefficients of the reduced form do not differ from the long-run coefficients of the structural form, the short-run parametric structure is different in the two forms.

Therefore, the passage from (27) to (28) requires that a further identification process be produced for the short-run dynamics, whose parametric structure is given by matrixes A , Γ_i^* and a; in particular the matrix A of the parameters describing the simultaneous equations and the matrix of the loading coefficients a are an important objective in the process for the identification of the dynamics of the structural form.

III.C. Identification of the long-run structure and tests of weak exogeneity

In this section we will discuss the results of the estimate of model (26) consisting of five equations pertaining to the vector of variables x_t; in particular, we will illustrate the results of the estimate and factorization of the long-run matrix Π. As pointed out earlier, the analysis was conducted for two separate periods[20]: $1970.1-1979.4$ and $1983.1-1997.4$. Furthermore, univariate DF and ADF tests have induced us to hypothesize - albeit with due caution - that nominal wages and prices might be $I(1)$. For the first period, we performed the OLS estimate of an unrestricted $VAR(2)$ system; the set of deterministic variables includes a constant restricted in the cointegrating vector and the impulse dummies $D73.2$, $D73.3$, and $D74.2$, each of which is included in order to take into account well-known events, such as the devaluation of the Lira and the first oil price shock. For the second period, we have estimated a $VAR(4)$; in addition, we have introduced a dummy ($Unemp$) concerning adjustments required to comply with the European standard introduced in 1993 as regards the criteria for assessment of the unemployment rate, and a deterministic trend has been restricted in the cointegrating space. The choice of a $VAR(2)$ and a $VAR(4)$, for the first and second period respectively, is justified by the fact that these specifications correspond to the properties of congruence required for a satisfactory description of the data (Table 1)[21].

The analysis continues with the determination of the rank of the matrix Π. This is a particularly delicate phase because it will affect future choices as to the identification of long-run structures. If a type I error is incurred, a unit root is introduced in the cointegrating vectors; conversely, if a type II error is made, this will induce an underestimate of the rank and lead to neglecting important cointegrating relations, whose absence will subsequently affect the model dynamics with the consequent wrong specification of the model itself. Under the present set of variables there is the expectation of at least three common trends; therefore - consistently with theoretical expectations - the assumption that the rank equals two will be privileged.

This rank hypothesis was checked against three tests: i) the *Trace* tests; ii) the graphs of the disequilibrium $\beta' x_t$, iii) the standard errors of the α-coefficients. Table 1 shows the eigenvalues together with the results for the *Trace* test, and the

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[20] To support this partition of the period, see the analyses carried out by Marcellino and Mizon (2001), Juselius (2002) and Ghiani (2004).

[21] Table 1 shows tests for the first-order autocorrelation and for the order $k = 3$ and $k = 4$, respectively for the first and second periods (F_{AR1-1} and F_{AR1-k}) and normality tests of residuals in the two VAR systems. Later on, in the framework of more parsimonious systems, heteroskedasticity tests (*vector* x_i^2) in form F, are also shown. For details on the tests shown and for references concerning them see Hendry and Doornik (1997). The empirical analysis has been undertaken using the programme *GiveWin* 1.3 and *PcFiml* 9.3. *P-values* are shown in square brackets.

corresponding significance levels. In the second period there are no uncertainties in the choice of rank, because the *Trace* test statistic does not reject the hypothesis that the cointegrating rank is two; the significance level is 1% for $r = 1$ and 5% for $r = 2$. For the first period the *Trace* test indicates the possibility that the rank could be three; however, inspection of the third graph of the relation $\beta' x_t$, which appears non-stationary, rules out the hypothesis that the rank could be higher than two. Therefore, we can conclude that for both the periods the *Trace* test indicates that $r = 2$ might be appropriate; this choice appears correct when one also considers the non significant values of the t calculated for the coefficients of the column vector α_3 of matrix α in the framework of the hypothesis $r = 3$.

TABLE 1

Misspecification tests and test for cointegrating rank

Period I: 1970.1 – 1979.4			*Multivariate tests*		
Residual autocorrelation: F_{AR1-1}			$F(25,57) = 1.6113$ [0.0695]		
Residual autocorrelation: F_{AR1-3}			$F(75,28) = 1.3733$ [0.1750]		
Normality:			$\chi^2(10) = 7.3369$ [0.6933]		
Rank:	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$
Eigenvalues:	0.60	0.51	0.43	0.33	0.08
Trace test:	101.6	66.8	39.55	18.42	3.36
Prob 95%:	76.1	53.1	34.9	20.0	9.2
Period II: 1983.1 – 1997.4			*Mulivariate tests*		
Residual autocorrelation: F_{AR1-1}			$F(25,105) = 0.8334$ [0.6916]		
Residual autocorrelation: F_{AR1-4}			$F(100,68) = 0.9863$ [0.5302]		
Normality:			$\chi^2(10) = 5.3242$ [0.8685]		
Rank:	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$
Eigenvalues:	0.41	0.39	0.27	0.19	0.12
Trace test	100.51	69	38.88	20.1	7.39
Prob. 95%	87.3	63.0	42.4	25.3	12.3

After determining the rank, we applied Johansen's identification process (1992). Obviously, during this phase we were guided by the theoretical model illustrated above, as the statistical identification process is necessarily supported by the effort to attribute an economic significance to the irreducible cointegrating relations of the matrix β.

TABLE 2

A structural representation of the cointegrating space

Period I:1970.1 – 1979.4					
Eigenvectors β			*Weights* α		
Variables	$\widehat{\beta}_1$	$\widehat{\beta}_2$	*Equations*	$\widehat{\alpha}_1$	$\widehat{\alpha}_2$
w_t	1	1	Δw_t	0	−0.34 (0.06)
p_t	−1	−1	Δp_t	0.28 (0.07)	−0.30 (0.07)
pr_t	−1	−1	Δpr_t	0	0
u_t	−0.055 (0.00)	0	Δu_t	0	0
$(pm-p)_t$	0	−0.26 (0.05)	$\Delta(pm-p)_t$	0	0
const.	0.41 (0.02)	0.31 (0.02)			

LR-test-(restrictions on β*)*: $\chi^2(5) = 6.6012[0.2520]$

LR-test-(restrictions on β *and* α*)*: $\chi^2(12) = 20.982[0.0506]$

TABLE 3

A structural representation of the cointegrating space

Period II:1983.1 – 1997.4					
Eigenvectors β			*Weights* α		
Variables	$\widehat{\beta}_1$	$\widehat{\beta}_2$	*Equations*	$\widehat{\alpha}_1$	$\widehat{\alpha}_2$
w_t	1	1	Δw_t	−0.13 (0.07)	−0.23 (0.05)
p_t	−1	−1	Δp_t	0	−0.05 (0.03)
pr_t	−0.85 (0.00)	−1	Δpr_t	0.18 (0.06)	0
u_t	0.30 (0.02)	0	Δu_t	−0.85 (0.31)	0
$(pm-p)_t$	0	0.10 (0.03)	$\Delta(pm-p)_t$	0	0
trend	0	0.004 (0.0004)			

LR-test-(restrictions on β*)*: $\chi^2(4) = 5.6352[0.2281]$

LR-test-(restrictions on β *and* α*)*: $\chi^2(10) = 10.747[0.3775]$

Table 2 shows the final result of the cointegration analysis concerning the first period. The model includes a constant restricted in the cointegrating space. The restrictions imposed on the coefficients of the matrix β and those concerning weak exogeneity are not rejected[22]. In addition, the matrix of loadings α is also

[22]Over-identifying restrictions were tested using a *LR* (*Likelihood Ratio*) test, whose limit distribution is a $\chi^2(p)$, where p represents the number of independent restrictions tested.

shown. The corresponding standard errors are indicated below the coefficients, in brackets. The two cointegrating vectors show a positive weak relation between the wage share and the unemployment rate and a more marked positive relation between wage share and the real import price. Furthermore, pr_t, u_t and $(pm-p)_t$ are weakly exogenous with respect to the parameters of the two cointegrating relations. Similarly, table 3 shows the final results of the cointegration analysis regarding the second period. The model includes a linear trend restricted in the cointegrating space:

$$\Delta\ x_t = \sum_{i=1}^{4-1}\Gamma_i\Delta\ x_{t-i} + \alpha\beta' x_{t-1} + \alpha\gamma_1 t + \mu + \Psi Unemp_t + e_t$$

where μ measures the linear growth rate. The second period shows an important change in the sign of the relation between the real wage and the unemployment rate, and between the real wage and the price of import of raw materials. However, the latter shows only a weak effect on the wage share in the second cointegrating vector; by contrast, the unemployment rate coefficient seems to be rather high in the first cointegrating relation. In this second period, the only weakly exogenous variable with respect to the long-run parameters of both the equilibrium relationships is $(pm-p)_t$, while pr_t and u_t are weakly exogenous with respect to the papameters of the second cointegrating vector. Variable p_t is weakly exogenous for the parameters of the first long-run relation, even though it shows a very low coefficient (close to significance) of adjustment to the second disequilibrium.

III.D. Identification of a short-run adjustment structure

Before proceeding with the short-run specification, we carried out an investigation on the strong exogeneity of the variables that were shown to be weakly exogenous for the parameters of both cointegrating relations. In the first period, the strong exogeneity was not rejected for productivity and the unemployment rate; the latter, in particular, appears to be a random walk [23], while strong exogeneity was not rejected in the second period for the real import price. The search for a final structure is preceded by an estimate of a parsimonious specification of the variables in space $I(0)$ with respect to which the selected structural model will be evaluated. The 41 over-identifying restrictions of the parsimonious reduced form (given by the difference between the 55 parameters of the initial system and the 14 parameters of the parsimonious system) were tested by the LR test and were not rejected ($\chi^2(41) = 46.8748$ [0.2442]). The final model is reproduced in table 4, where multivariate diagnostic tests and the over-identifying restrictions imposed are also shown. In addition to the parsimonious specification restrictions, these tests include the diagonalization restrictions of the loading ma-

[23] This result is likewise obtained by Marcellino and Mizon (2001).

trix[24] a and the identification of the coefficients (impact multiplier) of the current endogenous and exogenous variables.

TABLE 4

A multivariate structural error correction model

Period I: 1970.1 – 1979.4 (*FIML estimation*)

$$\Delta w_t = -\underset{(0.017)}{0.36}\, ect2_{t-1} + \underset{(0.011)}{0.03}\, D73.2$$

$$\Delta p_t = \underset{(0.060)}{0.29}\, ect1_{t-1} + \underset{(0.042)}{0.17}\, \Delta(p_m - p)_{t-1} + \underset{(0.037)}{0.79}\, \Delta w_t$$

$$\Delta pr_t = \underset{(0.126)}{0.37}\, \Delta pr_{t-1} + \underset{(0.002)}{0.005}$$

$$\Delta u_t = \underset{(0.042)}{0.14}\, D73.2 - \underset{(0.039)}{0.23}\, D73.3 - \underset{(0.039)}{0.10}\, D74.2$$

$$\Delta(p_m - p)_t = \underset{(0.109)}{0.58}\, \Delta(p_m - p)_{t-1} + \underset{(0.311)}{0.61}\, \Delta pr_{t-1} + \underset{(0.022)}{0.06}\, D73.2$$

$$ect1_t = \widehat{\beta}_1'(x_t \ \vdots \ const.)',\ ect2_t = \widehat{\beta}_2'(x_t \ \vdots \ const.)'$$

Multivariate diagnostic tests:	
Residual autocorrelation: F_{AR1-3}:	$F(75, 85) = 0.6738[0.9590]$
Normality test:	$\chi^2(10) = 18.706[0.0442]$
Heteroscedasticity test x_i^2:	$F(255, 82) = 1.311[0.0750]$
Over-identification LR-test:	$\chi^2(42) = 47.0617[0.2730]$

For the second period too, the search for a final structural form is preceded by the estimate of a parsimonious specification of the variables in space $I(0)$ with respect to which the selected model is to be evaluated[25]. The final model is shown in table 5, together with the diagnostic tests concerning the estimate of the final model and the test conducted for the 32 over-identifying restrictions. The diagonalization restrictions of the first (2×2) submatrix of a are not rejected, while the identification of matrix A_0 coefficients leads to not excluding short-run homogeneity ($LR - test : \chi^2(1) = 0.1602$ [0.6890]).

A common characteristic of the estimates of both regimes consists in the excessively parsimonious specification of the short-run dynamics of the structural model. In fact, among the first period parameters that describe the short-run effect of rates of change in the endogenous and exogenous variables, only five parameters (four in the second period) were shown to be significant as compared to the 25 initially estimated in the unrestricted $VECM(1)$. However, we should observe that the marked presence of the error correction terms in all the final model

[24] It is the diagonalization of the first (2×2) partition of the loading matrix.

[25] Starting from a specification consistent with the $VAR(4)$, we have produced an initial $VECM$ re-parameterization, with a maximum lag of three periods; through a simplification process, we have reached the conclusion that the best specification is a parsimonious $VECM$ with a maximum lag of one period.

equations compared to the poverty of the dynamic specification is a common feature to all analyses of this kind[26].

TABLE 5

A multivariate structural error correction model

Period II: 1983.1 – 1997.4 (*FIML estimation*)

$$\Delta w_t = -\underset{(0.04)}{0.08} ect1_{t-1} + \underset{(0.11)}{1.04} \Delta p_t - \underset{(0.017)}{0.03}$$

$$\Delta p_t = \underset{(0.006)}{0.03}\, ect2_{t-1} + \underset{(0.10)}{0.37} \Delta p_{t-1} + \underset{(0.006)}{0.03}$$

$$\Delta pr_t = \underset{(0.04)}{0.11} ect1_{t-1} + \underset{(0.027)}{0.05}\, \Delta(p_m - p)_{t-1} + \underset{(0.02)}{0.05}$$

$$\Delta u_t = -\underset{(0.009)}{0.02}\, ect1_{t-1} - \underset{(0.02)}{0.05} Unemp$$

$$\Delta(p_m - p)_t = \underset{(0.10)}{0.69} \Delta(p_m - p)_{t-1} + \underset{(0.01)}{0.04} Unemp$$

$$ect1_t = \widehat{\beta}_1'(x_t \vdots\, trend)', ect2_t = \widehat{\beta}_2'(x_t \vdots\, trend)'$$

Multivariate diagnostic tests:	
Residual autocorrelation: F_{AR1-4}:	$F(100, 170) = 0.8614[0.7923]$
Normality test:	$\chi^2(10) = 17.342[0.0671]$
Heteroscedasticity test x_i^2:	$F(240, 332) = 1.3844[0.0031]$
Over-identification LR-test:	$\chi^2(32) = 41.9137[0.1128]$

IV. A comment on the results of empirical analysis

The empirical modelling clearly conveys two messages. The first is that the data reject the assumption that the same system of equilibrium relations applies for each one of the two sub-periods that we have defined. In addition, our attempt to obtain a consistent model by unifying the two sub-periods leads to fragile or unacceptable results. The second point is that the picture of endogenous responses to the disequilibrium in prices and wages of the different variables we have considered changes appreciably during the shift from the first to the second period. Taken together, these two results provide a confirmation of the assumption, put forward in the literature based on a historical analysis of macroeconomic events[27], that a change in the macroeconomic system occurred at the beginning of the 1980s. This change did not take the form of a sudden discontinuity: rather, the results of the dynamic predictions show that the 1970s model retained good predictive capability until 1981-1982; therefore the change was closely connected to the progressively greater strictness in the implementation of the exchange rate

[26]See Juselius (2002), Marcellino and Mizon (2001), Bardsen and Fisher (1999), Binotti (1995), Binotti and Ghiani (1999) for the most recent analyses.

[27]For a historical-macroeconomic type of approach, see – for instance - Juselius (2001), Rossi (1998), Signorini and Visco (2002).

policy and to the establishment of a different attitude in industrial relations. An indication pointing toward the same outcome is given by the graphs shown in figures 3 and 4, which represent the trends of the real wage disequilibrium for the 80's and 90's, calculated with the model of the 1970s, and vice versa. In this case too, around the years 1981-1982 a change[28] came about in the steady state features of ect_1 and ect_2.

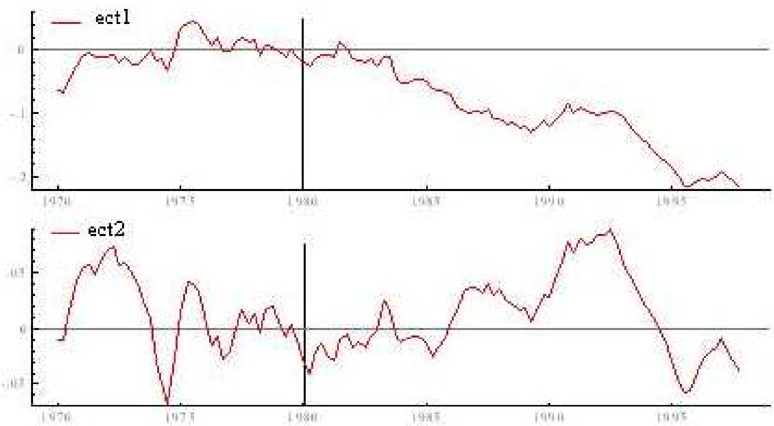


Figure 3: Forward extrapolation of $ect1_t$ and $ect2_t$ of the seventies into the second regime

IV.A. The Seventies

The results for the first period have been obtained with a very direct and secure method. This leads to a different picture from the one frequently indicated for other European countries: thus in this picture there is no role for unemployment as a determinant of the real supply wage, because unemployment plays a role only for the real demand wage, with a value coefficient that is not high and has a positive sign (the mark-up is therefore a growing function of employment). A very significant role is, however, played by the real exchange rate in the supply wage, while productivity presents neutral features (see table 2). Since long-run homogeneity in prices is confirmed in the wage equation, and vice versa for wages in the price equation, and since both prices and wages significantly respond to disequilibrium, two real wage equilibrium relations are obtained which act as a force of attraction for equilibrium itself.

[28] In this regard, we also recall that an attempt made to identify a third sub-period starting from the 1992 devaluation, and coinciding with the return to a phase of relative exchange rate variability, on the one hand, and with the definitive establishment of the '*concertation*' logic in industrial relations, on the other hand, did not give convincing results.

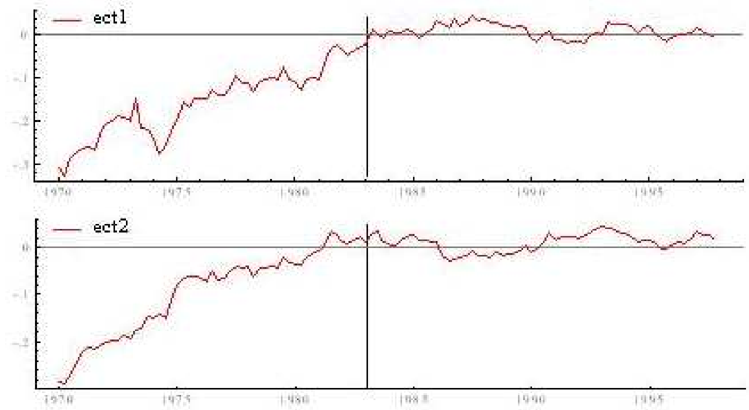


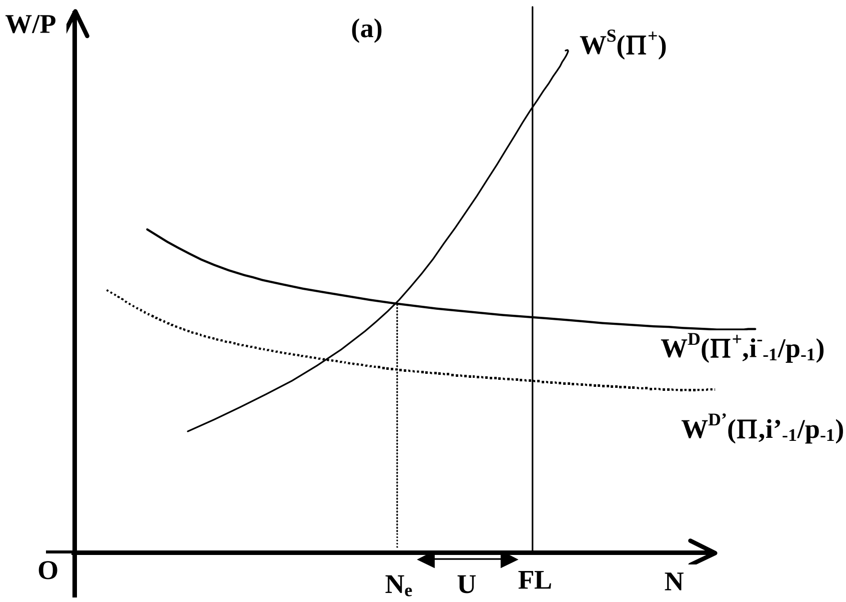
Figure 4: Backward extrapolation of $ect1_t$and $ect2_t$ of the second regime into the seventies

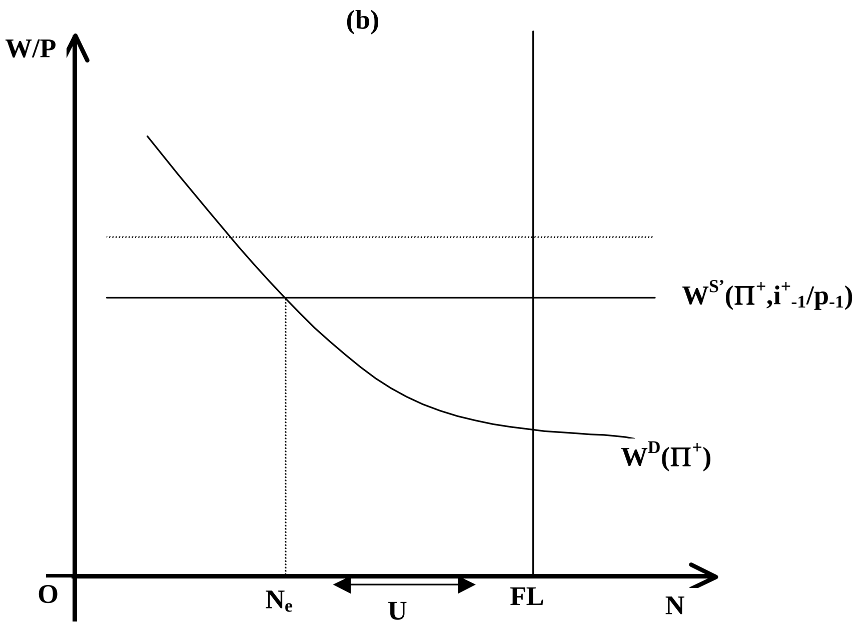
The differences between our results and those obtained by other authors and for different European countries may be illustrated by using figure IV.A.(a). The upper graph shows the real supply wage as a decreasing function (curve W^S) of the unemployment rate and as an increasing function of productivity, and does not respond significantly to the real price of raw materials, while the demand wage is an increasing function (curve W^D) of the unemployment rate and is affected not only by productivity, but also by the real price of raw materials. An important implication of such a picture is that the increase in the real import price determines downward translations of the demand wage curve, and therefore simultaneous reductions in wages and employment, with the effect of reducing the wage share. However, both the latter and real wages, as shown in 2, grew precisely in the 1970s phase during which the Lira was devaluated and the real import price was increasing. This behaviour is apparently non compatible with the picture outlined, but it may be rendered consistent by the presence of strong exogenous shocks on the supply wage connected to trade union action. Nevertheless, the attempts at introducing an indicator of the contractual strength of trade unions in the wage equation leads to scarcely convincing results[29].

In contrast, the situation described by our results is illustrated in figure IV.A.(b). In this case, the increase in the import prices moves the (flat) curve of the supply wage upward, thus leading to wage increases and a fall in employment. Such a result is also fully compatible with the wage share increase.

The picture of the equilibrium relations coincides with that outlined by Modigliani and Padoa Schioppa (1977) for the Seventies. It is characterised by two aspects:

[29]Some attempts have been made (number of strike days per worker, number of persons enrolled in the trade union) which proved inconclusive, as also in other works; see, in this regard, Marcellino and Mizon (2001); Corsini and Guerrazzi (2002).


W/P
(a)
W^S(Π^+)
W^D(Π^+,i^-_-1/p_-1)
W^D'(Π,i'_-1/p_-1)
O
N_e
U
FL
N


(b)
W/P
W^S'(Π^+,i^+_-1/p_-1)
W^D(Π^+)
O
N_e
U
FL
N

rigidity of the real wage and the fact that, given the value of the model's coefficients, resorting to unemployment as a means to settle the distributive conflict would have been scarcely effective. Moreover, unemployment does not respond to the two disequilibria and takes on the features of an exogenous variable that can be modelled (Table 4) as a random walk. Obviously, this outcome is hardly favourable to the assumption that the forces operating in this system were capable of maintaining unemployment close to its equilibrium level. The rigidity picture is completed by the absence of a dynamic response to the disequilibrium by productivity (Table 2). Clearly, in such conditions, a painless solution for the distributive conflict, i.e. a solution that does not involve an exogenous revision of the trade unions' and/or the firms' objectives, does not exist; the alternative is either severe unemployment or strong inflation, or a smaller - but still rather elevated, - degree of both. At the given exchange rate coefficient in the wage equation, changes in the exchange rate might have represented an element of flexibility capable of mitigating the stagflationary pressures deriving from the supply conditions. On the other hand, in 1973-1974, at first, and then dramatically in 1976, a problem of external equilibrium arose and drove the monetary authorities to considerably devaluate the Lira, and this devaluation countered the endogenous revaluation springing from the inflation differential. The exchange rate policy, together with the external inflation trend, thus explains the result shown in table 4, which excludes any endogenous response to the disequilibrium by the real exchange rate. Furthermore, another point to be noted is the existence of long-run homogeneity of wages with respect to prices, and vice versa, while, despite significant coefficients, no homogeneity is seen in the respective inflation rates (Table 4). Finally, the model shows significant and rather high coefficients of loading of the disequilibrium in prices and wages, which are compatible with the stability of the equilibrium and with the assumption that an important response of wages and prices to the disequilibrium came into play.

The picture emerging for the years considered outlines a country characterised by a high degree of indexation of nominal magnitudes and by a phenomenon of marked rigidity not only of real wages, but also of productivity, unemployment and the real exchange rate itself.

IV.B. The Eighties and Nineties

During the 1980s, important changes took place as compared to the picture described above. As for equilibrium relations (see table 3), we may observe that: a) an appreciable role of the unemployment rate can be identified in the supply wage equation: the conditions of the labour market, with a significant and quantitatively non-negligible coefficient, once more become an important factor in the determination of the real wage; therefore, the latter became more flexible; b) the exchange rate is no longer an important factor in the determination of wages; it appears, instead, in the price equation though with a very low coefficient, and this leads us to maintain that the rebalancing role of the exchange rate in the system is essentially downsized in this period; c) the assumption that there is no neutrality in productivity is accepted; more precisely, while the coefficient preserves a unit value in the price equation, it is lower than one in the wage equation, thus confirming the consideration that, over these years, by virtue of an incomplete adjustment of wages to changes in productivity, a slow but significant wage countershock may have been produced; d) the price equation also includes a trend component that can be linked, in our model, to the trends of factors - distinct from the unemployment rate - which determine the mark-up[30]; this element acts by reducing the demand wage and, consequently, exacerbating the distributive conflict and worsening supply conditions.

As regards endogeneity, we may observe (Tables 3 and 5) that: a) there is a response of productivity to disequilibrium. This confirms the assumption[31] that adopting a stable nominal exchange rates policy and the presence of a new framework of industrial relations drove firms to recover competitiveness by using technological innovation and expelling the labour force in excess, thus introducing a virtuous element in the system's response to disequilibrium; b) the unemployment rate loses its status of exogenous variable and responds to the disequilibrium; if we assess this finding together with the exchange rate policy (which introduces a rigidity element) and with the greater sensitivity of wages to unemployment, it may be interpreted as the result of a greater implementation of demand policies in response to the inflationary tensions determined by the distributive disequilibrium; c) the exchange rate maintains its exogenous nature. This may appear as a weak result of the analysis, referring to a period of relatively stable nominal exchange rates (at least until 1992). However, one should keep in mind 1) that the exchange rate coefficient in the equilibrium relation became very low in this second period, 2) that we should expect a certain degree of substitution among the reactions by the different variables to disequilibrium[32], 3) that the period considered includes a long phase (after September 1992) of once again fluctuating exchange rates; 4) that nominal devaluations frequently, even though partially, offset the endogenous revaluation of the exchange rate in the period prior to 1992; 5) and that during the 1980s, some important exogenous changes took place in external inflation (in dollars); d) the last point concerns the loadings of disequilibrium by wages and prices, and it is a delicate point for us, since the effectiveness of the model adopted crucially depends on these. In all the alternative versions of the model we have tried out, these coefficients show a considerable value reduction compared to the Seventies, a systematic incapacity to be statistically significant and to provide a consistent set of values. This leads us to assume that the mechanism of response of prices and wages to the disequilibrium had changed and produced a new long-run Phillips curve in the

[30] Consider the role of m_0 in equation (3).

[31] See, for instance, Rossi (1998), Signorini and Visco (2002).

[32] For a discussion on this point, see Ghiani (2004), page 73 and the following.

Eighties and Nineties. Such an aspect deserves a special attention and will be reconsidered in the following section.

The results of our empirical analysis suggest some comments on the role of the supply counter-shock - connected with the reduction in the prices of raw materials and wage moderation - during the eighties and nineties. We may observe that the weight of the exchange rate in the equilibrium relations is high and significant in the negative phase of supply shocks, while, as we have seen, it is considerably reduced in the positive phase: the effects of oil counter-shocks on inflation and unemployment therefore appear to be reduced in size compared to the effects of oil shocks. In such circumstances, the de-indexation of wages from external inflation was probably counterproductive, as it came into play when the sign of the changes in the prices of raw materials had already changed. As a matter of fact, while in the seventies there was an evident positive correlation between the real exchange rate and the real wage, this was not so in the eighties.

The non-neutrality of productivity operated by improving supply conditions. However, in this case too the virtuous effect of the increase in productivity was, at least partially, offset by the tendency of firms to privilege transfer of a part of the consequent unit cost reduction into mark-up increases, rather than into (relative) price reductions. Thus firms appear to have responded to trade union moderation by a certain distributive aggressiveness, a fact which, in our opinion, would be expected to attenuate the positive evaluations concerning the role played by the changes in the climate of industrial relations. The net effects on employment and inflation may have been smaller than generally stated.

As a result of the attenuated importance of the role of the exchange rate in the equilibrium relations, the system was deprived of the stabilising mechanism that used to be capable of settling the distributive conflict; *ceteris paribus*, this made the system's re-balancing more dependent on changes in unemployment. This finding must be assessed together with the greater flexibility of the real wage (the u_t coefficient in the equilibrium relation is remarkably higher), which had the effect of making recourse to an increase in unemployment in the presence of inflationary tensions more effective. Finally, the findings on the loadings of disequilibrium by prices and wages raises the possibility that in the second period the system was characterised by lower nominal flexibility (and greater real flexibility), and that a Phillips curve negatively sloping in the long-run was once again in operation. This, combined with the rigidity of nominal exchange rates, suggests that the only mechanisms available for a rebalancing of the system were linked to changes in productivity and unemployment.

The picture of static relations we have outlined for the 80's and 90's leads to the expectation that an increase in real wages associated with a reduction in unemployment should have been produced in those years due to the effects of the oil counter-shock. On the contrary, wages are known to have undergone only a very moderate increase (and they remained at the same levels for a long period), while the wage share was reduced and unemployment increased appreciably. Our results offer an explanation of these facts, at least in part. The moderate nature of the wage increase was due to: a) the relatively low coefficient of the real price of raw materials; b) the fact that supply wages did not fully incorporate productivity increases; c) the fact that mark-up increases balance the positive effects on the demand wage. As far as unemployment is concerned, we may put forward two hypotheses; the first is that the appearance of an endogenous response of this variable to disequilibrium provides evidence that the political authorities had promptly responded to the inflationary pressure (see the events of 1985, 1990 or 1995) or to the pressure of exchange rates by enacting restrictive policies. Such policies, as Modigliani (1995) maintained, for example, seem to be the main cause of the increase in the unemployment rate in those years. Such an assumption is also supported by the fact that the sustainability of inflationary disequilibrium situations was reduced during this period by the attenuation of the role of the exchange rate as settler of the distributive conflict and also by the stricter monetary regulations implemented following membership in the European Monetary System. The second assumption is that, as suggested by Rowthorn (1999), the strong increase in the labour force in the second half of the 1980s was accompanied by an accumulation of capital that was not sufficient to ensure the constancy or reduction of the unemployment rate. However, this latter assumption is not demonstrated by our model.

V. An alternative model for the Eighties and Nineties

As we observed in the previous section, the coefficients of reaction to the disequilibrium of prices and wages for the years considered (80's and 90's) show a considerably reduced value compared to the previous decade; they are on the borderline of statistical significance and sometimes provide a set of values that is not consistent with theoretical expectations[33]. These weaknesses in previous results have led us to take into consideration the hypothesis that after 1983 the inflation rate might have been a near $I(1)$ or $I(1)$ variable, and that consequently both price levels and the level of wages incorporate a stochastic trend described by twice accumulated shocks. Note that this hypothesis cannot be excluded in the light of the results obtained with the univariate analysis, whose tests have been reported and commented in Appendix A.

The empirical model derived from these considerations differs from the one considered earlier in that, on the one side, it includes the inflation rate in the set

[33] We may say that the response of wages and prices to the disequilibrium probably depends on the inflation rate level (see Modigliani and Padoa Schioppa (1977), page 401); average inflation was reduced, in the second period considered, to slightly less than a half of the value of the first period, and this can explain the lower sensitivity to disequilibrium. A second remark is that this response is probably related to the intensity and to the nature of indexation mechanisms. Based on this, it is natural to expect an attenuation in the endogenous response of wages and prices in a period when the power of such mechanisms is reduced.

of variables among which to search for cointegrating relations, and on the other hand, it excludes the level of prices and wages from the inflation rate. The reason for this is that according to the assumptions presented, we would be dealing with $I(2)$ variables, whose rate of change could not be explained only on the basis of a reaction to a steady state disequilibrium. So, we actually lose the information regarding the reaction of wages and prices to the disequilibrium; however, we are able to test the assumption that inflation does cointegrate with unemployment and any further variables. Since there is long-run homogeneity between prices and wages, we will also be able to study the features of the dynamic behaviour of the real wage, and therefore to investigate the possible presence of an ECM in the short-run Phillips curve.

Thus, the vector of the relevant variables of the model becomes:

$$x_t' = [(w-p)_t, pr_t, \Delta p_t, u_t, (pm-p)_t].$$

Therefore a $VECM$ restricted to the identified disequilibrium will present the equation of the rate of change of the real wage which - using the symbols introduced in section III.B - we can write as follows:

$$\Delta(w-p)_t = \sum_{j=1}^{k-1}\sum_{i=1}^{n}\gamma_{1i,j}\Delta x_{i,t-j} + \sum_{s=1}^{r}\alpha_{1,s}\beta_s' x_{t-1} + \psi_1 D_t + e_{1t} \tag{29}$$

where k indicates the number of lags, n the number of variables in vector x_t and index 1 indicates the first line (the one referring to $(w-p)$) of the matrixes of the corresponding system. In our analysis, we will consider (29) as the empirical correspondent of the theoretically derived equation (20). The process that leads to the estimate of (29) will allow us to ascertain if it is possible to configure a map of short-run Phillips curves presenting an error correction mechanism. At the same time, through cointegration analysis, we will enquire whether there exists a long-run relation between inflation and unemployment, which should be included in the theoretical structure of equation (23). In detail, we may observe that in the empirical analysis the estimate of a $VAR(4)$ produced satisfying results in terms of congruence. The tests are shown in table 6 together with the results of the cointegration analysis. Within the framework of the analysis carried out with real variables, the expectation is that there are at least two common trends. The *Trace* statistics, in contrast with our theoretical expectation, gives a rank of two; however, examination of the graph of the third disequilibrium induces us to consider as correct the assumption according to which the rank is three (see figure 5). Furthermore, when we impose $r = 2$, we obtain very different results for the long-run matrix Π as compared to those of the unrestricted model; vice versa, when we impose $r = 3$, we obtain similar results.

TABLE 7

A structural representation of the cointegrating space

Period II: 1983.1 − 1997.4							
	Eigenvectors β				*Weights* α		
Variables	$\widehat{\beta}_1$	$\widehat{\beta}_2$	$\widehat{\beta}_3$	*Equations*	$\widehat{\alpha}_1$	$\widehat{\alpha}_2$	$\widehat{\alpha}_3$
$(w-p)_t$	1	1	0	$\Delta(w-p)_t$	0	−0.28 (0.06)	−0.46 (0.14)
pr_t	−0.75 (0.038)	−1	0	Δpr_t	0.31 (0.09)	0	0
Δp_t	0	0	1	$\Delta^2 p_t$	0.12 (0.07)	0	0
u_t	0.21 (0.026)	0	0.07 (0.014)	Δu_t	0.99 (0.43)	0	−1.77 (0.61)
$(pm-p)_t$	0	0.08 (0.021)	0	$\Delta(pm-p)_t$	0	0	0
trend	0	0.0034 (0.0003)	0				
LR-test-(restrictions on β and α): $\chi^2(13) = 20.00[0.0952]$							

TABLE 6

Misspecification tests and test for cointegrating rank

Period II: 1983.1 − 1997.4	*Multivariate tests*				
Residual autocorrelation: F_{AR1-1}	$F(25,105) = 0.7806$ [0.7576]				
Residual autocorrelation: F_{AR1-4}	$F(100,68) = 1.2199$ [0.1919]				
Normality:	$\chi^2(10) = 4.1202$ [0.9418]				
Rank:	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$	$r \leq 4$
Eigenvalues:	0.43	0.39	0.25	0.19	0.10
Trace test:	98.99	65.74	36.56	18.97	6.25
Prob 95%	87.3	63.0	42.4	25.3	12.3

Table 7 contains all the final results of the cointegration analysis under the hypothesis $r = 3$. The first two cointegrating relations essentially coincide with those obtained within the framework of the nominal model. In addition, it was possible to identify a third equilibrium relation corresponding to a long-run Phillips curve. As far as *loadings* are concerned, the real exchange rate is confirmed as a variable that is weakly exogenous with respect to the long-run parameters, as in the previous analysis. Real wages and the unemployment rate are adjusted to the relation between Δp_t and u_t.

The search for a final structural form is preceded by the estimate of a parsimonious specification of the variables in space $I(0)$. After estimating a system $VECM(3)$, a $VECM(2)$ is selected (with $F(25,135) = 1.0530[0.4057]$). Table 8 shows the results of the structural model together with the results of diagnostic

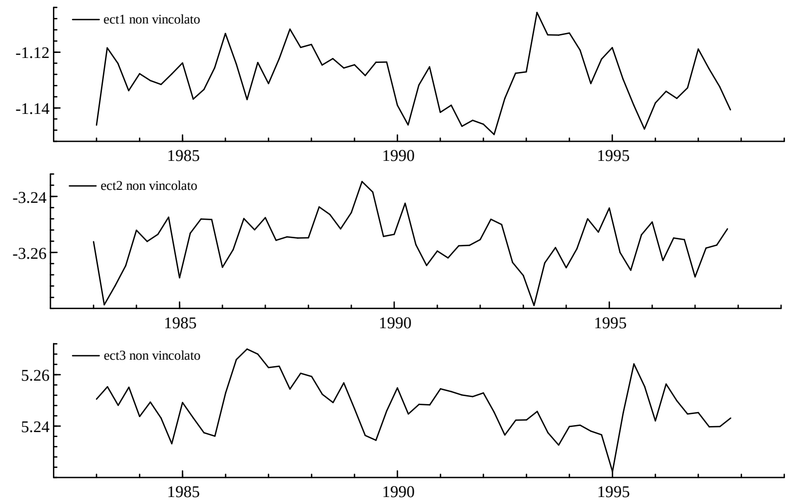


Figure 5: The graphs of the three equilibrium error correction mechanisms

TABLE 8

A multivariate structural error correction model

Period II: 1983.1 − 1997.4 (*FIML estimation*)

$$\Delta(w-p)_t = -\underset{(0.04)}{0.16}ect2_{t-1} - \underset{(0.10)}{0.27}ect3_{t-1} - \underset{(0.09)}{0.25}\Delta pr_{t-2} - \underset{(0.02)}{0.05}\Delta u_{t-2} + \underset{(0.0007)}{0.004}$$

$$\Delta pr_t = \underset{(0.06)}{0.23}ect1_{t-1} - \underset{(0.11)}{0.25}\Delta pr_{t-2} + \underset{(0.11)}{0.31}\Delta^2 p_{t-2} + \underset{(0.02)}{0.05}\Delta(p_m-p)_{t-1} + \underset{(0.0009)}{0.007}$$

$$\Delta^2 p_t = \underset{(0.05)}{0.15}ect1_{t-1} + \underset{(0.03)}{0.07}\Delta(p_m-p)_t - \underset{(0.10)}{0.38}\Delta^2 p_{t-1} - \underset{(0.10)}{0.24}\Delta^2 p_{t-2} - \underset{(0.02)}{0.05}\Delta u_{t-1}$$

$$\Delta u_t = -\underset{(0.30)}{0.48}ect1_{t-1} - \underset{(0.49)}{1.51}ect3_{t-1} - \underset{(1.09)}{2.18}\Delta(w-p)_t + \underset{(0.49)}{2.01}\Delta pr_{t-1} - \underset{(0.02)}{0.05}Unemp$$

$$\Delta(p_m-p)_t = \underset{(0.10)}{0.66}\Delta(p_m-p)_{t-1} + \underset{(0.01)}{0.04}Unemp$$

$$ect1_t = \beta_1'(x_t \vdots trend)',\ ect2_t = \beta_2'(x_t \vdots trend)',\ ect3_t = \beta_3'(x_t \vdots trend)'$$

Multivariate diagnostic tests:

Residual autocorrelation: F_{AR1-4}: $F(100,160) = 0.77282[0.9188]$

Normality test: $\chi^2(10) = 12.9100[0.2288]$

Heteroscedacity test x_i^2: $F(420,228) = 1.0583[0.3177]$

Over-identification LR-test: $\chi^2(53) = 45.0603[0.7727]$

multivariate tests. We may observe that the real model produces a richer dynamic specification compared to the nominal model.

V.A. The reappearance of the Phillips curve

The inclusion of the inflation rate in the set of variables to be searched for cointegrating relations allows us to compare the existence and characteristics of the Phillips curves in the two periods considered. As a matter of fact, in our empirical analysis, the search for a negatively-sloping long-run Phillips curve translates into recognition of the existence of a cointegrating relation between wage (or price) inflation and unemployment rate[34]. For the Seventies, the analysis of the degree of integration in the time series of the wage and price inflation rate suggests that these are $I(0)$ variables, which leads to excluding that a cointegrating relation may be configured with the unemployment rate (which is $I(1)$)). On the other hand, the fact that no inverse empirical relation can be configured between inflation and unemployment for the 1970s in Italy has already been extensively highlighted in the literature[35]. If we exclude the inflationary effects of the oil shock, inflation shows a steady state profile throughout the whole decade, which leads us to exclude a connection with the accentuated growing trend in the unemployment rate. A flat Phillips curve thus seems to be outlined for these years, according to a theoretical hypothesis extensively described in the literature[36].

As far as the Eighties are concerned, the most interesting part of the results presented in the previous section consists in the two following equations:

$$\Delta(w-p)_t = -0.16ect2_{t-1} - 0.29ect3_{t-1} + DB \qquad (30)$$

$$\Delta p_t = -0.07u_t \qquad (31)$$

where (30) is the first equation of the parsimonious $VECM$[37]; (31) is the cointegrating relation between inflation and unemployment; expressions for $ect2_{t-1}$ and $ect3_{t-1}$ are those reproduced in table 8 and $DB = 0.004 - 0.20\Delta pr_{t-2} - 0.05\Delta u_{t-2}$ represents the remaining short-run dynamics. Then (30) can be written as follows:

$$\Delta w_t = \Delta p_t - 0.16ect2_{t-1} - 0.02u_t + DB^* \qquad (32)$$

where $DB^* = DB - 0.29\Delta p_{t-1} + 0.02\Delta u_t$. (32) describes the map of short-run Phillips curves with ECM, where the real wage tends to converge to an equilibrium value represented, in this case, by the demand wage. Note also that by imposing the steady state equilibrium condition $\Delta(w-p)_t = \Delta u_t = 0$, $\Delta p_t = \Delta p_{t-1}$ in

[34] For a similar approach on Italian data, see Golinelli (1998).

[35] See, for example, Reichlin (1986) and the literature quoted therein.

[36] See Carlin and Soskice (1990), Ghiani (2004).

[37] As is well-known, the parsimonious $VECM$ (which we did not reproduce for lack of space) precedes the estimate and identification of the dynamics of the final structural model.

(32) and therefore $DB^* = 0$, it is easy to obtain, as a solution, the cointegrating relation represented by equation (31), which describes the long-run Phillips curve indicated in the theoretical model of equation (23).

Our empirical analysis has therefore led us to identify both the long-run equilibrium relation between inflation and unemployment, and the response mechanism of real wages to the disequilibrium[38]. The analysis induces a rejection of the assumption of a vertical long-run Phillips curve and, in addition, it indicates the presence of error correction mechanisms aligning our results to those obtained for the main European Countries[39]. Since the negative slope of the curve is not linked, in our model, to the shaping of inflationary expectations, we must conclude, consistently with the theoretical model - that it is likely to be connected to the institutional features of the process of formation of prices and wages [40].

The transition from a flat Phillips curve in the course of the Seventies to a negatively - sloping curve, characterised by the presence of an ECM during the subsequent two decades, is the expression of a further important change in the dynamic regime of the Italian labour market during the period, a change that enriches the picture previously outlined. It is the indicator of a progressive, even though still incomplete [41], flexibilization of real wages.

VI. Conclusions

In this work, we have presented a small aggregate econometric model of the dynamics of money wages and prices for Italy, characterised by 'distributive conflict' and imperfect competition and directly derived from the work of Modigliani and Padoa Schioppa (1977). The objective of the analysis was to verify whether, over the span of time considered, there was an important change in Italy in the aggregate supply conditions, and to examine what were the features of such a

[38]We may observe that the cointegrating relation expressed by equation (31) does not include the real exchange rate, as could have been expected on the basis of the theoretical analysis. This result may be explained by the extremely low coefficient of the real exchange rate in the static equation of the real demand wage. Here we find a further confirmation of the assumption that, during the transition from the 70's to the 80's and 90's, the Italian labour market became in a sense somewhat isolated from external shocks and this translated into a negligible role of the real exchange rate in the process of formation of wages and prices, and consequently in the Phillips curve.

[39]See Bean (1994).

[40]There is an element in the results achieved by our study that does not seem to be in line with the experiences of other European Countries: the steady state equilibrium real wage of the model is not that of a wage curve, but rather that of the equilibrium wage, on the labour demand side. This implies that the inflationary mechanism seems to be more connected to the reaction of firms to the wage disequilibrium realised with respect to the objective, in the pricing process, rather than to the effects of the divergence between achieved wages and bargaining objectives on money wage dynamics.

[41]The full flexibility of real wages exists in the presence of a vertical long-run Phillips curve. For a more detailed investigation on this subject, see Binotti and Ghiani (2004).

change. The analysis has been developed within the class of cointegrated VAR models. In particular, after introducing the unrestricted VAR representation of the labour market model, the long-term relations of the demand and supply wage have been identified through cointegration analysis. Finally, by applying a 'general to specific' strategy, we have achieved the specification of a final simultaneous model capable of describing the short-run dynamics of prices, wages and the other weakly exogenous variables, incorporating the information regarding long-run relations. The results of the empirical model find an immediate economic interpretation in the theoretical model used.

Our analysis provides a confirmation of the assumption, put forward in the literature, that a prominent change took place in the Italian macroeconomic system at the beginning of the Eighties, one that expressed itself with particularly strong evidence in the conditions that characterised the ways how the labour market operated. The data reject the assumption that the same set of static relations applied for each of the two sub-periods studied. Furthermore, the picture of the endogenous responses to the disequilibrium of the different variables changes dramatically during the early 1980s.

Our analysis leads to a reading of the macroeconomic events of the period considered that differs noticeably from the more consolidated analysis we find in the literature. For the Seventies, the literature underlines on the one hand the role of trade union shocks, as an element that affected the supply wage, and the effects of oil shocks on the demand wage, on the other hand. Since real wages underwent remarkable increases over that period, we should conclude that the effect of trade union-induced shocks definitely prevailed over oil shocks. However, in our study, we were not able to highlight a role for trade union variables, with the consequence that the effects of the oil shocks on the demand wage would appear to have produced a reduction in real wages and an increase in the unemployment rate, a trend that is clearly incompatible (as regards the first aspect) with the historical experience. The results illustrated in the previous pages do not show this contradiction as a consequence of the role played by real import prices in the supply wage (*wage resistance*): the latter appears to have been remarkably increased due to the oil shocks, while the effects on the demand wage seem to have been negligible. Evidently this result seems to be more consistent with the behaviour of real wages and of the wage share of the Seventies.

The picture of the static relations presented in this work for the first period coincides surprisingly with the one outlined by Modigliani and Padoa Schioppa (1977). It is characterised by the rigidity of real wages and by the absence of an endogenous response of unemployment to the distributive disequilibrium. In fact, unemployment takes on the features of an exogenous variable that can be modelled as a random walk. Obviously, such a result is rather unfavourable to the assumption that there were forces operating in the system that were capable of maintaining unemployment close to its equilibrium level. The rigidity scenario is also completed by the absence of a dynamic response of productivity to the disequilibrium.

For the Eighties and Nineties, the picture of static relations shows a return to the traditional picture, while the dynamic analysis shows the activation of endogenous responses of productivity and of the unemployment rate that were not present in the previous years. In particular, the labour market conditions (through the unemployment rate) once again became an important factor in the determination of real wages; the influence of the exchange rate on the labour market was considerably attenuated (due to the effect of de-indexation); and finally, the assumption of the neutrality of productivity is rejected (thus confirming the supposition that a slow but significant wage countershock may have arisen during the years in question).

One interesting feature of these results is that the weight of the exchange rate in equilibrium relations seems to be high and significant in the negative phase of supply shocks, while it is much less important in the positive phase. Therefore, the effects of oil countershocks on inflation and unemployment were attenuated compared to the effects of the shocks. In such circumstances, the de-indexation of wages from external inflation would appear to have had counterproductive effects, as it occurred when the sign of the changes in the prices of raw materials had already changed. And in fact, while in the Seventies there was a clear positive correlation between real exchange rate and real wage, in the Eighties this was not the case.

The analysis of the endogenous responses of unemployment and productivity suggests that, in the course of the last two decades of the century, important macroeconomic flexibilization symptoms became manifest in the labour market. Signs indicating similar trends are drawn from the analysis of the Phillips curve, as the empirical results presented in our paper suggest that a cointegrating relation between inflation and unemployment (long-run Phillips curve) may have reappeared in Italy over the Eighties and Nineties, associated with a map of short-run Phillips curves characterised by the presence of an ECM.

Finally, with regard to the changes that occurred in the degree of permissiveness of supply conditions and the resulting effect on demand policies, the transition (which took place in the course of the 80's) to a regime where the response of nominal magnitudes to disequilibrium was attenuated had the effect of extending the margins for an expansive role of monetary policies, because it reduced the inflationary cost of each given disequilibrium. The appearance of an endogenous response of productivity operated in the same direction. By contrast, the lower elasticity of wages to the exchange rate operated in exactly the opposite direction. On the other hand, the greater elasticity of wages to unemployment accentuated the extent of the disequilibrium determined by a given increase in employment and therefore discouraged the use of expansive demand policies. For the same reasons, it was also an incentive to their use for deflationary purposes.

A Appendix - Univariate time series analysis: testing for the order of integration

If the nominal variables of wages and prices are integrated of order one $\{w_t, p_t\} \sim I(1)$, it follows that their growth rate is stationary. If, on the contrary, one empirically discovers that $\{w_t, p_t\} \sim I(2)$, then it follows that $\{\Delta w_t, \Delta p_t\} \sim I(1)$ and furthermore it is possible that $\{(w-p)_t\} \sim I(1)$. Empirical verification of the order of integration of nominal variables in the two sub-periods identified for the analysis is important not only from an econometric point of view, but also for its implications as regards the choice of the variables to be used to develop the VAR and, ultimately, for purposes of model specification.

In this section we will show the results of DF and ADF tests regarding the presence of unit roots in the time series of interest here. The test is grounded on three specifications, which we will call i) if the model has no constant and deterministic trend, ii) if only the constant appears, and iii) if, in addition to the latter, there is also a deterministic trend. The low power of unit root tests is well known when the value of the autoregressive parameter is close to one and, in the empirical analysis of the second period, the tests indicate this possibility. In fact, while there are no uncertainty margins on the order of integration of the nominal variables of the first period (see table $A1$), this uncertainty is clearly evident in the second period.

Table A1 - *DF-test and ADF-test* (*First-period*: 1970.1 – 1979.4)

Variables	*t-ADF*	*lags*	*Mod.*	*Residual autocorrelation tests*
pr_t	-3.206	1	*iii)*	$F(1,33) = 0.0905[0.7655]$
u_t	-3.157	3	*iii)*	$F(1,29) = 1.0841[0.3064]$
$(pm-p)_t$	-1.818	1	*i)*	$F(1,34) = 0.0525[0.8202]$
w_t	-2.803	1	*iii)*	$F(1,32) = 0.2492[0.6211]$
p_t	-2.705	1	*iii)*	$F(1,32) = 0.1054[0.7475]$
Δpr_t	-4.274^{**}	0	*ii)*	$F(1,33) = 0.1533[0.6980]$
Δu_t	-3.201^{**}	1	*i)*	$F(1,30) = 0.9611[0.3347]$
$\Delta(pm-p)_t$	-2.614^{*}	1	*i)*	$F(1,34) = 4.0971[0.0509]$
Δw_t	-4.04^{**}	0	*ii)*	$F(1,35) = 0.3276[0.5707]$
	-3.44^{*}	1	*ii)*	$F(1,33) = 0.5905[0.4477]$
Δp_t	-3.63^{**}	0	*i)*	$F(1,34) = 0.3132[0.5794]$
	-2.96^{*}	2	*ii)*	$F(1,28) = 0.0146[0.9046]$

Table $A2$ clearly shows the nature $I(1)$ of variables pr_t, u_t and $(pm-p)_t$, whereas, as far as nominal variables w_t and p_t are concerned, the results are affected by the length of the lags. The test DF marks the steady state condition, while $ADF(1)$ once again marks a unit root, which suggests the nature $I(2)$ of nominal variables[42]. For the reasons illustrated, the multivariate analysis was also carried out within the framework of a VAR system with variables expressed in real terms.

Table A2 - *DF-test and ADF-test* (*Second-period*: 1983.1 – 1997.4)

Variables	*t-ADF*	*lags*	*Mod.*	*Residual autocorrelation tests*
pr_t	-2.60	0	*iii)*	$F(4,52) = 0.3786[0.8229]$
u_u	-1.33	1	*ii)*	$F(4,51) = 1.8501[0.1336]$
$(pm-p)_t$	-1.85	1	*i)*	$F(4,52) = 0.7614[0.5552]$
w_t	0.012	1	*iii)*	$F(4,50) = 0.5679[0.6871]$
p_t	-1.31	1	*iii)*	$F(4,50) = 0.5395[0.7074]$
$(w-p)_t$	-0.82	0	*ii)*	$F(4,52) = 1.1394[0.3484]$
	-0.84	1	*ii)*	$F(4,51) = 0.9102[0.4651]$
Δpr_t	-8.55^{**}	0	*ii)*	$F(4,53) = 1.2405[0.3050]$
Δu_u	-4.22^{**}	1	*i)*	$F(4,52) = 1.4296[0.2373]$
$\Delta(pm-p)_t$	-3.96^{**}	1	*i)*	$F(4,52) = 0.6737[0.6133]$
Δw_t	-3.91^{**}	0	*ii)*	$F(4,52) = 1.5341[0.2060]$
	-2.84	1	*ii)*	$F(4,51) = 0.7259[0.5784]$
Δp_t	-3.45^{*}	0	*ii)*	$F(4,52) = 1.6610[0.1731]$
	-2.51	2	*ii)*	$F(4,50) = 1.1389[0.3490]$
$\Delta(w-p)_t$	-6.14^{**}	0	*i)*	$F(4,53) = 1.6997[0.1638]$
	-5.45^{**}	1	*i)*	$F(4,51) = 2.3752[0.0642]$

B Appendix - Data definition

$w = \ln(W/UL)$, where W is the compensation of employees and UL are the 'standard labour units' (Source: ISTAT, *Quarterly National Economic Accounts*);

p is the logarithm of the GDP (*Gross Domestic Product*) deflator (Source: ISTAT, *Quarterly National Economic Accounts*);

pr is the logarithm of the ratio between the real gross domestic product and the 'total standard labour units' (Source: ISTAT, *Quarterly National Economic Accounts*);

u is the logarithm of the unemployment rate (Source: ISTAT, *Labour Statistics*);

pm is the logarithm of the import deflator (Source: ISTAT, *Quarterly National Economic Accounts*).

All the data are seasonally adjusted.

[42]The multivariate analysis shows the same uncertainty. However, this problem does not produce effects on the estimate of the two cointegrating relations, while it affects the specification of the short-run dynamics. In this regard, compare the results obtained in Binotti (2003), where the model was estimated in real terms for the same period.

C Appendix - Model parameters

Expressions of text equation parameters:

$\Omega_0 = D\left[\beta_1\left(\gamma\alpha_2 + \phi_w\delta_w + \delta_p\right) - \beta_2\eta\phi_w\right], \Pi_0 = -D\left[\eta\beta_2 + \beta_1\left(\gamma\phi_p\alpha_1 +^{\phi_p} \delta_w\delta_p\right)\right],$

$\Omega_1 = D\left[\beta_1\left(1-\sigma\right)\left(1-\alpha_0\right)\gamma + \eta\phi_w\left(\beta_3+\beta_0\right)\right], \Omega_2 = \beta_1 D\left(\eta\phi_w - \gamma\right),$

$\Pi_1 = D\left[\left(\beta_3+\beta_0\right)\eta + \beta_1\left[\gamma\phi_p\left(1-\sigma\right)\left(1-\alpha_0\right)\right]\right], \Pi_2 = \beta_1 D\left(\eta - \gamma\phi_p\right)$

$D = \beta_1\left(1-\phi_w\phi_p\right)^{-1}, \quad \Psi_w = Z_w^{\beta_1 D\gamma\alpha_2}\pi_L\pi_M^{-D\beta_0\eta\phi_w},$

$\Psi_P = Z_p Z_w^{\frac{\gamma\phi_p\alpha_2}{1-\phi_w\phi_p}}, Z_p = \pi_L\left(\frac{1}{\pi_M}\right)^{\frac{\beta_0\eta\phi_w}{\beta_1(1-\phi_w\phi_p)}}$

$\Phi_0 = D\left\{\beta_1\left[\left(\gamma\alpha_2 + \phi_w\delta_w + \delta_p\right) + \phi_p\left(\gamma\alpha_1 + \delta_w\delta_p\right)\right] + \beta_2\eta\left(1-\phi_w\right)\right\}$

$\Phi_1 = D\left[\beta_1\left(1-\sigma\right)\left(1-\alpha_0\right)\gamma\left(1-\phi_p\right) - \left(\beta_3+\beta_0\right)\eta(1-\phi_w)\right]$

$\Phi_2 = 1 - \left[\beta_1 D\left[\eta(1-\phi_w) + \gamma(1-\phi_p)\right]\right]$

$\Gamma_0 = D\left[\eta\beta_2 + \beta_1\left(\gamma\phi_p\alpha_1 + \phi_p\delta_w\delta_p\right)\right]$

$\Gamma_1 = 1 - D\left[\left(\beta_3+\beta_0\right)\eta + \beta_1\left[\gamma\phi_p\left(1-\sigma\right)\left(1-\alpha_0\right)\right]\right]$

$\Gamma_2 = \beta_1 D\left(\gamma\phi_p - \eta\right)$

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