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Wage Setting and Hysteresis in Unemployment *

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I. Introduction

Why is unemployment so high in most industrialized countries? And why does unemployment remain so high even when growth rates are at a satisfactory level? These are the main puzzles in today's macroeconomics. Several answers have been proposed for these questions.[1]

Classical economists prefer the view that the natural rate of unemployment (in the sense of a labor market equilibrium rate) has increased. One reason for this could be too high and rising unemployment benefits. But because the replacement ratio (unemployment benefits as a percentage of average earnings) has hardly changed in the last two decades this explanation is not very convincing. Another reason for a rising natural rate could be a higher degree of mismatch resulting from changes in the structure of demand or technology. Moreover, in most countries there has been a substantial outward shift of the UV Curve,[2] which renders this hypotheses even more plausible.

Other explanations rely in one sense or another on the failure of the target real wage to adjust downwards in the face of an adverse economic environment. For example, if there is a slowdown in the rate of growth of labor productivity, there will be a slowdown in the feasible growth of real wages at any given level of unemployment. If wage aspirations do not take this into account, the result will be higher unemployment. A very similar argument refers to changes in import prices and in the tax wedge.

Perhaps the most interesting theories deal with the persistence phenomenon. Thereby attention shifts away from the original source of increased unemployment toward the more important question of how the effects of shocks are propagated over time. This leads to an equilibrium rate of unemployment (in the sense of

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a position of rest, not in the sense of a labor market equilibrium) that depends not only on the current values of the relevant forces, but also on the history of unemployment.

Several sources have discussed such persistence or hysteresis effects. The most important seem to be insider-outsider relationships. This strand of the literature develops the idea that the level of wages is largely determined by those who are currently employed (insiders) and that insiders do not care about the welfare of outsiders, i.e. of the unemployed. A key feature is thus the assumption that currently employed workers cannot easily be replaced by new (unemployed) workers because of high turnover cost (e.g. redundancy payments or firm-specific human capital) or because of legal protection against dismissal.

A similar branch of the persistence literature focuses on outsiders themselves. The first argument states that a long duration of unemployment decreases skills. Entrepreneurs are then led to take the duration of unemployment as screening device, i.e. firms may prefer to hire those who have been unemployed only for a short period. Therefore, the long-term unemployed cannot have a strong influence on the wage bargaining process. Secondly, prolonged lack of success in finding a job leads the unemployed to give up searching (as this seems to be a fruitless exercise), while at the same time they adjust to living on unemployment benefits.

Upon consideration of these hypothesis, one may observe that all of them are plausible and may play an actual role. So, the problem is basically an empirical one.[3] In our paper we try to investigate this issue.

In particular, we investigate wage setting behavior in Austria and concentrate on the following questions.

1. Are there any significant hysteresis or persistence effects in the sense that exogenous shocks lead to permanent effects on unemployment?
2. Are there any changes in the wage setting behavior during the period of investigation (1956 to 1994)?
3. Is the evidence consistent with the Blanchard-Summers variant of the insider-outsider hypotheses?
4. Is there any significant effect of the duration of unemployment on wage setting?
5. Is the slowdown of productivity growth of any importance for wage setting?
6. Is there evidence of a substantial change in the natural (equilibrium) rate of unemployment?
7. Has there ever been a Phillips Curve in Austria?

In Section II we discuss in detail some of the methodological problems involved. In Section III we develop a simple wage bargaining model which serves as a theoretical framework for our investigation and in Section IV we study its implication for the hysteresis problem. In Section V our empirical results are presented. Section VI summarizes our main points and draws some final conclusions.

II. Methodology

There are several approaches to investigating hysteresis phenomena. The simplest is to check whether the unemployment rate contains a unit root. As it is now well known, unemployment data for most European countries exhibit this feature (for Austrian data see Table I in Section V). But this fact says nothing about the source of this unit root (hysteresis effects or simply non-stationary structural factors governing the natural rate) nor does it give any indication of the economic importance of permanent shocks to unemployment.[4]

By far the most common approach to investigating hysteresis effects is based on a Phillips Curve

$$\Delta w_t = \Delta p_t^e - b(u_t - u_t^{nat}) + cx_t + \varepsilon_t. \tag{1}$$

According to this equation, the wage inflation is equal to the expected price inflation[5] corrected by the difference between the actual and the natural rate of unemployment and other variables x_t (for example expected productivity growth). The natural rate is assumed to be determined by

$$u_t^{nat} = \alpha u_{t-1} + \beta Z_t, \tag{2}$$

whereby the vector Z_t contains variables explaining shifts in the natural rate due to structural factors. Inserting (2) into (1) gives

$$\Delta w_t = \Delta p_t^e - bu_t + b\alpha u_{t-1} + b\beta Z_t + cx_t + \varepsilon_t. \tag{3}$$

If $\alpha = 1$, then the natural rate is basically equal to the unemployment rate of the previous period. This represents the hysteresis phenomenon. In this case the wage growth depends only on changes in unemployment and not on the level. A simple test for hysteresis is therefore to check whether the level of unemployment is important for the determination of the wage growth rate. Such or similar tests have been carried out for instance by Blanchard-Summers (1986), Coe (1988,1990), Gordon (1989), and Franz-Gordon (1993). The results of these studies point toward a support of the hysteresis phenomenon or at least to a high degree of persistence for most European countries.

However, this procedure suffers from several problems. First, as Manning (1993) pointed out, an identification problem arises because wage Equation (3) typically contains all the variables which are also relevant for labor demand and price setting. For this reason, Manning argues that a productivity variable is especially problematic.

A second, and in our opinion more important difficulty has already been mentioned by Jaeger-Pakinson (1990). They argue that the hypothesis $\alpha = 1$ in Equation (3) will be accepted by default if u_t is non-stationary and the variables in Z_t are not correctly specified as would be always the case in practice. This can be seen by rewriting Equation (3):

$$\Delta w_t = \Delta p_t^e - b\Delta u_t + b(\alpha - 1)u_{t-1} + cx_t + v_t \tag{4}$$

with

$$v_t = b\beta Z_t + \varepsilon_t.$$

If the growth rate of expected real wages as well as x_t are stationary, the coefficient of the non-stationary variable u_{t-1} will converge to zero, leading to the conclusion that $\alpha = 1$. The key problem in running regression of Equation (4) lies in the fact that v_t, and thus the structural factors governing the natural rate, are implicitly assumed to be stationary. In the case of a non-stationary unemployment rate, one cannot determine whether the observed unit root in the unemployment rate is due to a non-stationary natural rate (represented by Z_t) or hysteresis effects. It is this difficulty which renders nearly all empirical literature on tests for hysteresis effects questionable. In the next sections we shall address this problem by using time-varying parameter models to explicitly allow for a non-stationery v_t.

A third qualification of the Phillips curve approach refers to the rate-of-change specification. This implies that a *transitory* shock in real wage growth (for instance due to unanticipated inflation) leads to a *permanent* effect on the real wage level if unemployment remains at its natural level.[6] From an empirical point of view this problem can be easily remedied by estimating an error correction model like the one below:

$$\begin{aligned}\Delta w_t &= \Delta p_t^e - b\Delta u_t + b(\alpha - 1)u_{t-1} + cx_t \\ &\quad + dERC(w_{t-1}, p_{t-1}, \text{prod}_{t-1}) + v_t \end{aligned} \tag{5}$$

In this model, a long run relationship between the levels of real wages, productivity and perhaps unemployment (or employment) is postulated and Equation (4) is simply augmented by the corresponding error correction term. As long as unemployment is not included in this long term relationship, nothing changes for the hysteresis test; if the coefficient of u_{t-1} is approximately zero in Equation (5), the level of unemployment plays no role in determining wage growth and we have hysteresis effects. But even if the coefficient of u_{t-1} is significantly different from zero, the conclusion that hysteresis effects are not present in this case would be premature.[7] A significant coefficient of in (5) simply imply a long-run relationship between the levels of real wages $(w - p)$ *and* unemployment $(u - u^{nat})$, and therefore a relationship between the growth rate of real wages and the change of unemployment. But generally, as we shall see below, this also implies hysteresis effects.[8]

A fourth objection against the Phillips curve approach has more to do with the interpretation of the results. Suppose we are running a regression of Equation (4) to test for the relevance of insider-outsider relationships and we get a zero coefficient of u_{t-1}. This result is generally interpreted as favoring that theory. But there are some subtleties involved in deriving Equation (4) which are often overlooked. Following Blanchard-Summers (1986) we start by positing a dynamic labor demand schedule. With the exception of the unemployment rate u, all lower case letters represent logs:

$$\begin{aligned} n_t \;=\; & \delta n_{t-1} - (1-\delta)\delta_0(w_t + (1+\tilde{t}) - p_t - \text{prod}_t) \\ & +(1-\delta)e_t, \quad 0 \leq \delta < 1. \end{aligned} \tag{6}$$

In this equation, w represents the logarithm of gross wages. The relevant wage for firms is W times $(1+\tilde{T})$, where $\tilde{T}$ represents the 'employer's tax rate' (employer's contribution to social insurance), and $(1+\tilde{t})$ is defined as $\ln(1+\tilde{T})$. n represents employment, p product prices, *prod* a productivity index and e_t an error term, for instance an aggregate demand shock which is not reflected by a change in prices (e.g. in the presence of nominal price rigidities and monopolistic competition in the goods market). Wages are then fixed so as to set expected employment at a target value, which, according to the insider-outsider approach, equals n_{t-1}. This implies:

$$w_t = p_t^e + \text{prod}_t^e - (1+\tilde{t}_t^e) - \frac{1}{\delta_0} n_{t-1} + \frac{1}{\delta_0} e_t^e. \tag{7}$$

We observe that the coefficient of n_{t-1} is negative. This is a main feature of all insider-outsider theories. If we use a formulation with unemployment u instead of employment n ($u_t \equiv l_t - n_t$, where l represents labor force) we get a positive coefficient of u. As we shall see in Section V, this is counterfactual. Generally, Equation (7) is not directly estimated in levels, but rather in "differences". Lagging (6) and subtracting from (7) we get:[9]

$$\Delta w_t = \Delta p_t^e + \Delta\text{prod}_t^e - \Delta(1+\tilde{t}_t^e) + \frac{\delta}{(1-\delta)\delta_0}\Delta n_{t-1} + \frac{1}{\delta_0}\Delta e_t^e. \tag{8}$$

This formulation yields the "correct" sign of Δn_{t-1} respectively Δu_{t-1}, but we observe that the appearance of these variables depends on the parameter δ. So, if we take the Blanchard-Summers version of the insider-outsider approach seriously, we reach the somewhat unpleasant observation that the growth rate of real wages depends on changes in unemployment (employment) only if there is a delay in labor demand.

III. A Wage Bargaining Model

To avoid some of the difficulties discussed in the previous section, we prefer to start with a simple wage bargaining model. We assume that, in each period, labor market decisions are made in two stages. First, unions and firms bargain for the next period's wage w_{t+1}. Second, given this wage, the employment decision is made unilaterally by the firm, which maximizes its profits (right-to-manage-model).

Let us turn to the first stage of decision making. Because of the problem of aggregating individual preferences, the question of the appropriate form of a union's utility function is an open one. There are several approaches to tackling this problem, for instance the median voter principle (which often serves as a theoretical basis for insider-outsider theories) or the assumption of a representative worker. Here we will adopt a very simple functional form which is quite popular in the existing literature.[10] We suppose that unions want to maximize a quadratic utility function. Note: Except for the unemployment rate u, lower case letters represent logs:

$$U_{t+1} = -(\Delta w_{t+1} - \Delta w^*_{t+1})^2 - \alpha(u^e_{t+1} - u^*_{t+1})^2, \tag{9}$$

with

$$\begin{aligned}\Delta w^*_{t+1} \;=\; & \Delta p^e_{t+1} + \Delta \text{prod}^e_{t+1} - \eta\Delta(1 - t^e_{t+1}) \\ & -\zeta(w_t - p_t - \text{prod}_t + \eta(1 - t_t) - s).\end{aligned}$$

Here one sees that next period's expected utility depends on the deviations of wages and (sector specific) unemployment from their respective target values.[11] The parameter α represents the relative weight given to the unemployment target.[12] The target for gross wages is formulated as an error correction mechanism: $\Delta w^*_{t+1} = \Delta p^e_{t+1} + \Delta \text{prod}^e_{t+1} - \eta\Delta(1 - t^e_{t+1}) - \zeta(w_t - p_t - \text{prod}_t + \eta(1 - t_t) - s)$, where the scale parameter s depends on the desired income distribution and $0 \leq \eta \leq 1$ (a higher employee's tax rate t puts additional pressure on the long term wage target).[13] If ζ is zero, we have the case that the union's wage target is formulated only in differences. Target wage growth is then equal to the expected inflation rate plus expected productivity growth plus a factor depending on expected changes in tax rates. Considering the famous "*Benya*-rule", such a formulation in growth rates seems to be plausible for Austria on a-priori grounds. If ζ is one, the union's wage aspirations are formulated only in levels. If ζ is between one and zero, we arrive at a general case in which unions look at both when formulating their wage target. This behavior guarantees a constant income distribution in the long term. Depending on the value of ζ, the wage target can substantially deviate from the long-run target $(p + \text{prod} - \eta(1 - t) + s)$ in the short term.[14]

The firm's objective in wage bargaining is to maximize profits

$$\Pi_{t+1} = \Pi(w_{t+1}, \ldots). \tag{10}$$

We assume that the negotiated wage is the solution of the following Nash bargaining problem:

$$\begin{aligned}\max_{w_{t+1}} : \; [\; - \; & (\Delta w_{t+1} - \Delta p^e_{t+1} - \Delta \text{prod}^e_{t+1} + \eta\Delta(1 - t^e_{t+1}) \\ & +\zeta(w_t - p_t - \text{prod}_t + \eta(1 - t_t)))^2 \\ & -\alpha(u^e_{t+1} - u^*_{t+1})^2 - d_u]^\lambda \times [\Pi_{t+1}(w_{t+1}, \ldots) - d_f]^{1-\lambda},\end{aligned}$$

subject to the labor demand:

$$\begin{cases} n_t = \delta n_{t-1} - (1-\delta)\delta_0(w_t + (1+\tilde{t}_t) - p_t - \text{prod}_t) \\ \qquad + (1-\delta)e_t, \quad 0 \le \delta < 1, \\ u_t \equiv l_t - n_t, \end{cases} \tag{11}$$

where (d_U, d_F) represents the disagreement point, which is assumed to be exogenous, and λ defines the relative bargaining power of the union. Solving the first order condition for w_{t+1} we get:

$$\begin{aligned} \Delta w_{t+1} \ = \ & \Delta p^e_{t+1} + \Delta \text{prod}^e_{t+1} - \eta\Delta(1 - t^e_{t+1}) - \alpha(1-\delta)\delta_0(u^e_{t+1} - u^*_{t+1}) \\ & -\zeta(w_t - p_t - \text{prod}_t + \eta(1 - t_t)) + \frac{1}{2}K, \end{aligned} \tag{12}$$

with K equal to

$$\frac{1-\lambda}{\lambda}\frac{d\Pi_{t+1}}{d\log(W_{t+1})}\frac{(U_{t+1} - d_U)}{\Pi_{t+1} - d_F)}. \tag{13}$$

Here, we implicitly assume that price expectations are predetermined, i.e. unions do not take into account that their wage setting may affect the general price level. This hypothesis can be justified by presuming sectoral unions, which treat the general price level as given.

Expression (13) depends on the relative bargaining power λ, on the relative position of the union in the case of disagreement and on the elasticity of profits on wages, $\varepsilon_{\Pi,W}$.[15] We assume K to be approximately constant. If $\lambda = 1$ (monopoly union) K vanishes.

By taking the first difference of Equation (6) and applying the expectation operator, we are able to derive an expression for the rationally expected unemployment rate u^e_{t+1},

$$\begin{aligned} u^e_{t+1} \ = \ & u_t + \delta\Delta u_t + (1-\delta)\delta_0(\Delta w_{t+1} + \Delta(1 + \tilde{t}^e_{t+1}) - \Delta p^e_{t+1} - \Delta \text{proc}^e_{t+1}) \\ & + \Delta l^e_{t+1} - \delta\Delta l_t - (1-\delta)\Delta e^e_{t+1}. \end{aligned} \tag{14}$$

Inserting this into (12) and rearranging we get:

$$\begin{aligned} \Delta w_{t+1} \ = \ & \Delta p^e_{t+1} + \Delta \text{prod}^e_{t+1} - \frac{\eta\Delta(1 - t^e_{t+1}) + \alpha((1-\delta)\delta_0)^2\Delta(1 + \tilde{t}^2_{t+1})}{1 + \alpha((1-\delta)\delta_0)^2} \\ & - \frac{\alpha(1-\delta)\delta_0}{1 + \alpha((1-\delta)\delta_0)^2}(u_t + \delta\Delta u_t - u^*_{t+1}) \\ & + \frac{1}{2(1 + \alpha((1-\delta)\delta_0)^2)}K - \left(\frac{\zeta}{1 + \alpha((1-\delta)\delta_0)^2}\right) \\ & \times(w_t - p_t - \text{prod}_t + \eta(1 - t_t)) + k, \end{aligned} \tag{15}$$

with

$$k = \frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}((1-\delta)\Delta e^e_{t+1} - \Delta l^e_{t+1} + \delta\Delta l_t).$$

Now we have to make an assumption about the union's target unemployment rate u^*_{t+1}. We suppose that unions in part pay attention to the labor market equilibrium unemployment rate u^{nat}_t – the natural rate of unemployment (which is not observable to the econometrican and might be non-stationary) – and in part adjust their target level according to a weighted sum of previous unemployment rates.

$$u^*_{t+1} = \mu u^{nat}_t + (1-\mu)\sum_{i=0}^{k}\gamma_i u_{t-i}, \quad \text{with} \quad \sum_{i=0}^{k}\gamma_i = 1, \;\; 0 \le \mu \le 1. \quad (16)$$

So, if unemployment remains high for some time, it is assumed that unions (and the public) will to some extent become accustomed to higher rates of unemployment.

Inserting the target unemployment rate (16) into (15) we get

$$\begin{aligned}\Delta w_{t+1} \;=\;& \Delta p^e_{t+1} + \Delta \text{prod}^e_{t+1} \\ & - \frac{\eta\Delta(1-t^e_{t+1}) + \alpha((1-\delta)\delta_0)^2\Delta(1+\tilde{t}^e_{t+1})}{1+\alpha((1-\delta)\delta_0)^2} \\ & - \frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}\left(\sum_{i=0}^{k} g_i u_{t-i} - \mu u^{nat}_t\right) \\ & + \frac{1}{1+\alpha((1-\delta)\delta_0)^2}\frac{1}{2}K - \left(\frac{\zeta}{1+\alpha((1-\delta)\delta_0)^2}\right) \\ & \times(w_t - p_t - \text{prod}_t + \eta(1-t_t)) + k, \end{aligned} \quad (17)$$

with

$$\sum_{i=0}^{k} g_i = \mu.$$

Note that for $\mu = 0$ the coefficient of the u_t's sum to zero, which now, in contrast to the insider-outsider approach, does not require δ, the delay parameter in (6), to be greater than zero.

Combining (17) with the labor demand equation (6) and setting $\Delta u = 0$, $p^e = p$, prod^e = prod, $t^e = t$, $\tilde{t}^e = \tilde{t}$ we get the (long run) steady state solution for u_t (assuming μ and $\zeta > 0$):

$$\begin{aligned}\mu(u_t - u^{nat}_t) \;=\;& -\frac{\zeta}{\alpha(1-\delta)\delta_0}(w_t - p_t - \text{prod}_t + \eta(1-t_t)) \\ & + \left(\frac{1}{\alpha(1-\delta)\delta_0}\left(\frac{1}{2}K + \Delta(1+\tilde{t}_{t+1}) - \eta\Delta(1-\tilde{t}^e_{t+1})\right)\right. \\ & \left. + \frac{1}{\alpha((1-\delta)\delta_0)^2}(\Delta l_{t+1} - \delta\Delta l_t - (1-\delta)\Delta e_{t+1})\right). \end{aligned} \quad (18)$$

Equation (18) suggests a particular cointegration relationship between u_t and $(w_t - p_t - \text{prod}_t + \eta(1 - t_t))$ whenever u_t^{nat} and the bracket term are stationary. If $\mu = 0$, we only have a cointegration relation between w_t, p_t, prod_t and $(1 - t_t)$. Note that (18) places no restrictions on the NAIRU.[16] The steady state unemployment rate depends on the particular real wage and is therefore in principle compatible with any level of unemployment and inflation. Only for $\zeta = 0$ and $\mu > 0$ do we get the steady sate:

$$u_t = u_t^{nat}.$$

To examine whether only short term unemployment plays a significant role in wage bargaining, i.e. there is less wage pressure by long term unemployed, we modify Equation (17) somewhat. A natural way to do so is to augment the employment target by the ratio of long-term unemployed to total unemployed (*Ratio*). This leads to:

$$u_{t+1}^{*} = \mu(u_t^{nat} + \beta \text{Ratio}) + (1 - \mu) \sum_{i=0}^{k} \gamma_i u_{t-i} + \varepsilon_t,$$

$$= \text{with} \quad \sum_{i=0}^{k} \gamma_i = 1, \quad 0 \leq \mu \leq 1. \tag{16'}$$

This formulation allows for a distinction in the source of the hysteresis effects. If $\mu = 0$, only past unemployment matters for target unemployment, regardless of whether short or long term. If $\mu > 0$ and $\beta > 0$, the distinction between long and short-term unemployment matters. A rising share of long-term unemployed implies more wage pressure as the difference between actual and target unemployment decreases. Therefore, hysteresis or at least persistence can arise through outsider characteristics effects in this case, if the portion of long-term unemployment compared to total unemployment is an increasing function of unemployment.

To arrive to an empirically assessable equation, we finally need a hypothesis about the unobservable natural rate of unemployment u_t^{nat}. As stressed by Friedman 1968, the natural rate is not constant but is a function of structural characteristics of the labor and commodity markets. Attempts to estimate the natural rate as function of these structural factors have not been particularly successful.[17] This is not surprising, given that we know very little about the properties of a complex general equilibrium system which incorporate all the market imperfections noted by Friedman. To deal with this problem we choose another approach. We presume that the natural rate follows a random walk:

$$u_{t+1}^{nat} = u_t^{nat} + \xi_{t+1}, \quad \sigma_\xi^2 \geq 0. \tag{19}$$

This assumption enables the natural rate to move in any direction. A very broad class of structural shifts can be handled in this way.[18]

Combining (19) and (17) we arrive at

$$\begin{aligned}\Delta w_{t+1} \;=\;& a\Delta p^e_{t+1} + b\Delta \text{prod}^e_{t+1} + \frac{\eta\Delta t^e_{t+1}}{1+\alpha((1-\delta)\delta_0)^2}\\ &-\frac{\alpha((1-\delta)\delta_0)^2\Delta\tilde{t}^e_{t+1}}{1+\alpha((1-\delta)\delta_0)^2} - \frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}\Delta u_t\\ &-\frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}\mu u_{t-1} - \left(\frac{\zeta}{1+\alpha((1-\delta)\delta_0)^2}\right)\\ &\times(w_t - p_t - \text{prod}_t - \eta t_t) + v_t(\mu u^{nat}_t, \text{constant}) + \varepsilon_t, \qquad (20)\end{aligned}$$

which is the basis of our empirical estimations.[19] Note that the sum of the coefficients of the u_t's equals to μ as Equation (17) suggests. Note further that the intercept v of Equation (20) depends on u^{nat}_t and therefore is non-stationary if $\sigma^2_\xi > 0$. The natural rate is treated as an 'unobserved component' here; it is identified if the innovations in (19) are uncorrelated with the error term ε_T in (20).[20]

The variant corresponding to (16′) equals to

$$\begin{aligned}\Delta w_{t+1} \;=\;& a\Delta p^e_{t+1} + b\Delta \text{prod}^e_{t+1} + \frac{\eta\Delta t^e_{t+1}}{1+\alpha((1-\delta)\delta_0)^2} - \frac{\alpha((1-\delta)\delta_0)^2\Delta\tilde{t}^e_{t+1}}{1+\alpha((1-\delta)\delta_0)^2}\\ &-\frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}(1-\mu)\Delta u_t - \frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}\mu u_{t-1}\\ &+\frac{\alpha(1-\delta)\delta_0}{1+\alpha((1-\delta)\delta_0)^2}\mu\beta\text{Ratio}_t\\ &-\left(\frac{\zeta}{1+\alpha((1-\delta)\delta_0)^2}\right)(w_t - p_t - \text{prod}_t - \eta t_t)\\ &+v_t(\mu u^{nat}_t, \text{constant}) + \varepsilon_t. \qquad (20')\end{aligned}$$

In the Section V we shall estimate these equations (and some other variants) by means of time-varying parameter models.

In deriving Equation (20) we avoid most of the methodological problems mentioned at the beginning of Section II. First, identification is no issue here, as all right hand side variables in (20) are predetermined. Further, we are able to interpret (20) as a structural wage setting equation. We also avoid the "sign-problem" of the insider-outsider approach regarding n_{t-1} and we do not accept the hypothesis of full hysteresis ($\mu = 0$) by default, as we are dealing with the possibly non-stationary natural rate in a proper way.

IV. Long Run Solution

In this section we will examine whether our bargaining model implies hysteresis effects, and if so, how strong they are. To do so, we calculate the "particular" solution of the dynamic system defined by the wage setting Equation (17) and the labor demand (6). We assume that the expected values are equal to their actual values and that p, prod, e, l, $(1-t)$, $(1-\tilde{t})$ and u^{nat} are exogenous. The "particular" solution of this dynamic system is:

$$\begin{bmatrix} 1 & 1 & \frac{(1-\delta)\alpha\delta_0\mu}{\Xi} & \frac{-(1-\delta)\alpha\delta_0\mu}{\Xi} & \frac{-\eta\zeta}{\Xi} & \frac{-(1-\delta)\alpha\delta_0\mu}{\Xi} & \frac{(1-\delta)\alpha\delta_0\mu}{\Xi} \\ 0 & 0 & \frac{-\zeta}{\Xi} & \frac{\zeta}{\Xi} & \frac{-\eta\zeta\delta_0}{\Xi} & \frac{\zeta\delta_0}{\Xi} & \frac{(1-\delta)\alpha\delta_0^2\mu}{\Xi} \end{bmatrix}, \tag{21}$$

with $\Xi = \zeta + \alpha\delta_0^2\mu - \alpha\delta_0^2\delta\mu$.

The first row represents the long run solution for the real wage, and the second row the long run solution for the unemployment rate, which equals to the NAIRU. The columns correspond to the exogenous variables p, prod, e, l, $(1-t)$, $(1-\tilde{t})$ and u^{nat}. As the second row of (21) indicates, shocks in the growth rates in e, l or t lead to permanent effects in u and in the NAIRU, whenever $\zeta > 0$. So we come to the conclusion that this error correction model, which we obtained by assuming that the union's long-run wage target is formulated in levels rather then in differences (unions strive for a certain long run income distribution), leads to hysteresis effects regardless the value of the "unemployment-target" parameter μ (although a lower value of μ strengthens the hysteresis effects).

Let us now calculate the long run solution for the non-cointegration case (the union's wage target is solely formulated in differences rather then in levels, $\zeta = 0$, "*Benya*-rule"):

$$\begin{bmatrix} 1 & 1 & \frac{1}{\delta_0} & \frac{-1}{\delta_0} & 0 & -1 & \frac{1}{\delta_0} \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}. \tag{22}$$

As we see, there are no hysteresis effects in this case (although long-lasting persistence effects are possible even here, depending on the value of μ).

Additionally, setting $\mu = 0$, we get the long-run solution:[21]

$$\begin{bmatrix} 1 & 1 & \frac{(1-\delta)\alpha\delta_0(2-\delta)}{\Gamma} & \frac{-(1-\delta)\alpha\delta_0(2-\delta)}{\Gamma} & \frac{-\eta}{\Gamma} & \frac{-(1-\delta)\alpha\delta_0^2\delta}{\Gamma} & 0 \\ 0 & 0 & \frac{-1}{\Gamma} & \frac{1}{\Gamma} & \frac{-\eta\delta_0}{\Gamma} & \frac{(1+2\alpha\delta_0^2+2\alpha\delta_0^2\delta^2-4\alpha\delta_0^2\delta)\delta_0}{\Gamma} & 0 \end{bmatrix} \tag{23}$$

with $\Gamma = 1 + \alpha\delta_0^2\delta^2 - 3\alpha\delta_0^2\delta + 2\alpha\delta_0^2$.

As we can see, this variant also implies hysteresis effects. So we come to the conclusion that hysteresis effects seem to be the rule rather than the exception for our bargaining model. Only if $\zeta = 0$ (the *level* of real wages plays no role in wage bargaining and therefore income distribution is not fixed in the long run) and $\mu > 0$ (the unemployment target is at least partially determined by the natural rate) are there no hysteresis effects, although persistence effects can occur even in this case.

V. Empirical Results

In this section we first investigate the time series properties of the variables under consideration. We then estimate Equation (20) along with some other variants by OLS. After that, time-varying parameter methods are employed to investigate empirically the seven questions posed in the introduction.

We used the following variables for our study (all variables, except unemployment rates, are in logs, source: WIFO database):

w	...	monthly average gross earnings in the industrial sector
wh	...	hourly average gross earnings in the industrial sector
p	...	consumer price index
wp	...	$w - p$
whp	...	$wh - p$
prod	...	hourly productivity in the industrial sector (ratio of industrial production and hours worked in industrial sector)
u	...	unemployment rate
u_s	...	short-term unemployment rate (less than six months)
u_l	...	long-term unemployment rate (more than six months)[22]
Ratio	...	ratio of long-term unemployment to total unemployment: u_l/u
n	...	employment in the industrial sector
t	...	employee's tax rate, containing direct taxes and social contributions.

The wage variable is clearly the most controversial one. We used the monthly and hourly average gross earnings in the industrial sector because these are the longest time series available. Tariff wages are generally available only since 1967. As time-varying parameter models require a lot of observations (surely more than 30) to provide useful results, we did not use tariff wages.

For estimation purposes we also need proxies for the expected inflation rate and expected productivity growth. We defined the expected value of a variable as an average of the value of the previous period and the true value of the next period, i.e. $E(y_t|I_{t-1}) = \frac{1}{2}(y_{t-1} + y_t)$. This way, we hoped to get better results than through purely extrapolative expectations and reduce the "errors in the variables" bias of

Table I. Unit root tests – (Augmented Dickey-Fuller Test[23])

	Level	1st Difference	2nd Difference
w	-0.88_+	-2.08	-4.83***
wh	-0.91_+	-2.01	-4.93***
p	-1.86_+	-1.95	-4.90***
wp	-0.19_+	-3.33_+*	–
whp	-1.07_+	-3.16_+*	–
prod	-2.13_+	-5.02_+***	–
u	-1.88_+	-4.98_+***	–
u_l	-0.66_+	-4.51_+***	–
u_s	-1.86_+	-4.20_+***	–
Ratio	-1.09_+	-4.52_+***	
n	-1.82_+	-4.15***	–
t	-0.99_+	-4.66_+***	–

Estimation period: 1958–1994, (1967–1994 for wt and wtp).
* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.
$_+$ Time trend included.

true rational expectations. Indeed, by using this proxy for the expected variables, the fit of our regressions was always better compared to extrapolative expectations. However, no result of this paper is seriously affected if we use extrapolative expectations instead.

Table I reports the unit root tests. The results are (with one exception) not very surprising. As we can see, the hypotheses that the variables are non-stationary are not rejected for any variable. With the exception of w, wh and p all variables seem to be integrated of order one. For w, wh and p an I(2) property is possible but note that real wages wp and whp are likely to be I(1). There is one feature in the results of Table I which deserves some attention: The short-term unemployment rate is probably also non-stationary. This is a surprising first indication that outsider characteristics effects do not seem to be the prime source of the hysteresis phenomenon in Austria.

As we know from Section II, the existence of cointegration vectors among our variables is important for both specifying the “correct” empirical form and for assessing the importance of hysteresis effects. Here, however, some methodological issues arise. For our problem at hand, it is not sufficient to know whether a cointegration relationship among the variables exists, as such a relation could stem from another context, for instance from a labor demand schedule. Instead

Table II. Estimation of the error correction term

	Engle-Granger cointegration regression		Stock's NLS procedure	
Dep. variable	w	wh	w	wh
Coefficient of p	1.11	1.34	0.7	0.95
Coefficient of prod	0.54	0.64	0.7	0.75
Coefficient of u	−3.68	−5.61	−2.65	−2.95
Coefficient of t	0.037	0.04	0.2	0.21
t-value of error correction term in Equation (20)	−1.29	−1.30	−4.21	−2.31

we are looking for a stationary error correction term for our wage Equations (17) and (20). Stock's NLS-method is very well suited for this purpose. According to this procedure, a single equation is estimated in its error correction form and the parameters of the cointegration vector are then recovered form this equation. Stock (1987) shows that this procedure is consistent, generally less biased and more efficient than the common Engle-Granger method. It is also probably less prone to specification errors than Johansen's maximum likelihood procedure, which only yields an estimate of the cointegration space. But its main advantage for our purpose is that it directly supplies an estimate of the particular cointegration vector we are looking for. However, it must be mentioned that by using this method, we were not able to reject the hypothesis of non-stationarity for these "cointegration vectors" (the Augmented Dickey-Fuller test statistics were never less than −2.1),[24] but the corresponding error correction terms were highly significant in our wage equations, as we will see in Table II and later in Table III.

Table II shows the estimated parameters for some variants of this error correction term. For comparison, the corresponding estimates from the Engle-Granger procedure are also displayed. As we can see, only the parameters for the wedge variable t differ noticeably: according to Stock's NLS-method the wedge term has a very pronounced effect on long run-wage setting, whereas this variable plays no role according to the Engle-Granger procedure. In the last row of Table III the t-values of these error correction terms from equation (20) are displayed. This clearly justifies our preference for the NLS estimates.

Now, let us turn to the estimation of the wage-bargaining curve, Equation (20). First, we estimate (20) using the hypothesis of constant coefficients (ordinary least squares). Next, we use a variable intercept. Finally, we allow all coefficients to evolve over time.[25] We are especially interested in the coefficients of Δu_{t-1} and u_{t-2} as the ratio of these parameters is an estimate of μ, the "unemployment-target" parameter of (16), and the coefficient of the error correction term. According to our theoretical discussion in Sections III and IV, both are necessary for identification of hysteresis. We are further interested in the time path of the intercept, which should reflect changes in u_t^{nat}. We shall also pay attention to the time paths of the coefficients of u_{t-2}, ERC and of Δprod, as these can be helpful in deciding whether possible hysteresis effects have developed only recently or whether wage aspirations have risen in the light of falling productivity growth.

Table III shows the estimation results for some variants of Equation (20). In presenting these results we mainly concentrate on the variants with monthly gross earnings as dependent variables, but the results for hourly gross earnings are generally similar. Panel a displays the OLS estimates. The first five variants are estimated without error correction terms (Phillips Curve approach), whereas variants six to nine contain an error correction term (without u_{t-2} as this is included in (20) as a separate variable).

It is interesting to note that the coefficient of u_{t-2} was statistically significant only in three of the nine versions whereas the coefficient of Δu_{t-1} was always significant at least at a 1% level. Taking the ratio of the coefficients of Δu_{t-1} and u_{t-2}, we get an estimate for the "target" parameter μ ranging between 0.03 and 0.23. The variants without the error correction term generally yield somewhat lower values for μ than the other variants. A similar result was obtained for version 4. In version 4, employment n was used instead of the unemployment rate u (insider-outsider approach, see Equation (8)). In Version 3 and 7, the ratio of long term unemployed to total unemployed (Ratio) was included as additional variable (according to Equation (20′)). But this does not alter our results; this variable was never significant and it exhibits the wrong sign. Further, the highly significant Q-statistics leads to the conclusion that these formulations are misspecified.

In sum, the OLS regressions suggest that hysteresis effects are present in Austrian wage data. In every variant without error correction-terms the estimated value for μ was practically zero, whereas the other variants generally show somewhat higher values for μ. Whenever an error correction term was included, it was highly significant; moreover the distinction between short and long-term unemployment seems to be of no importance for the explanation of wage growth. However, as we know from Section II, all these results are uninformative if the natural rate is non-stationary.

Panel b of Table III shows the results if the intercept is allowed to vary. According to Equation (20), this reflects a possible non-stationary natural rate of unemployment. By comparing the findings of panel a with panel b, we see that practically nothing changes. Variants 6 to 9 remain completely unaltered. For versions 1, 2, 3 and 5, as before, it is only the rate of change in unemployment which is important for explaining wage growth. The *level* of unemployment plays no role. Also, the distinction between short and long-term unemployment remains unimportant.

To examine the estimated time paths of the intercept along with the 90% confidence intervals for versions 1, 2 and 5, look at the first row of Figure 1. There are obviously no dramatic movements in the intercept over time and the detected

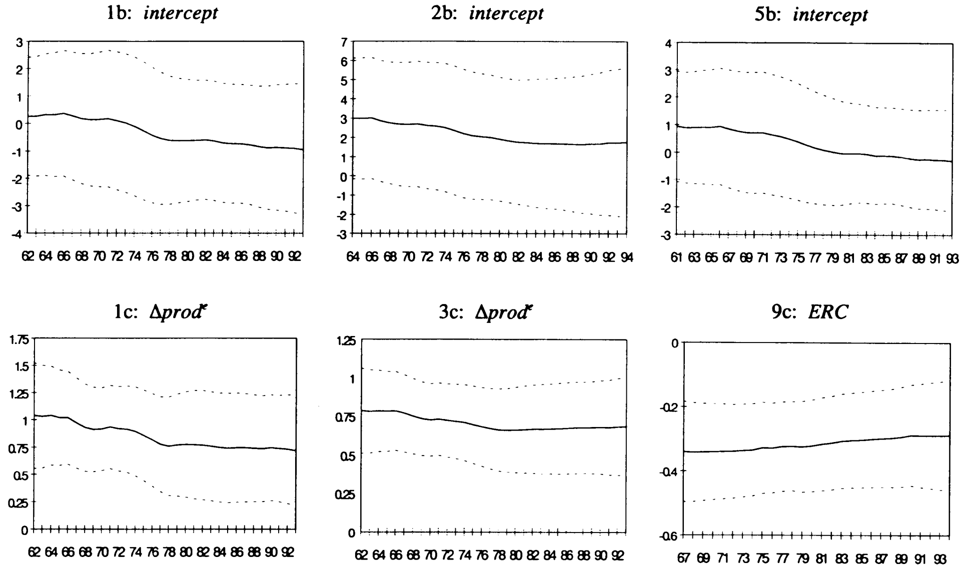

Figure 1. Time paths of several parameters (version No. correspond to table III, panel a to c).

shifts are not in accordance with a-priori beliefs about the possible movements of the natural rate. Moreover, as the likelihood-ratio tests in panel b show, these weak movements are not statistically significant. So, even if we allow the intercept (and the natural rate of unemployment) to evolve over time, our results points toward significant hysteresis effects in Austrian wage data.

Finally, in panel c of Table III we present the estimates when all coefficient are allowed to vary. Before commenting on these results it should be noted that letting all coefficients vary with only 37 observations probably demands too much. However, the results are quite plausible and we never encountered convergence problems. Regarding the four variants without the error correction term, we observe that only the coefficients of Δp and Δprod seem to have evolved during the estimation period. The other coefficients, including the intercept (with one exception) are all constant. In the second row of Figure 1 the estimated time paths of the coefficients of Δprod_t^e for versions 1 and 3 are listed (the estimated time path for version 5 is practically identical). We observe that the estimated shifts in this parameter are not very pronounced and are not statistically significant. If any change has occurred in the influence of productivity growth on wage growth, it has been a reduction. This is in conflict with the thesis that wage aspirations fail to adjust downwards in the face of the productivity slowdown. If this had been the case, we would have observed an increase in the coefficient of Δprod_t^e over the period of estimation. Our results regarding the relative importance of Δu_{t-1}, u_{t-2} and the distinction between short and long-term unemployment remain valid for panel c as well.

Table III. Panel a. Regressions with constant coefficients

Version	1a	2a	3a	4a	5a	6a	7a	8a	9a
Dep. variable	Δw	Δw	Δw	Δw	Δwh	Δw	Δw	Δw	Δwh
Intercept v	0.009	0.0032	−0.0025	−0.42	−0.29	−0.06	−0.004	−0.006	0.0
Δp_t^e	0.90***	0.72***	1.08***	0.86***	1.33***	1.29***	1.37***	1.0***	1.44
Δprod_t^e	0.64***	0.57***	0.71***	0.72***	0.69**	0.55***	0.56***	0.46**	0.88***
Δu_{t-1}	−2.71***	−3.01***	−2.36***	–	−3.91***	−1.80***	−1.67***	−2.1***	−2.54***
u_{t-2}	−0.21	−0.41*	0.19	–	−0.098	−0.078	0.13	−0.49**	−0.59*
Ratio_{t-1}	–	–	−0.09	–	–	–	−0.05	–	–
Δn_{t-1}	–	–	–	0.599***	–	–	–	–	–
n_{t-2}	–	–	–	0.066	–	–	–	–	–
Δt_t	–	0.2*	–	–	–	–	–	0.17*	–
$\Delta \tilde{t}_t$	–	−0.61***	–	–	–	–	–	−0.53***	–
Δl_{t-1}	–	–	–	–	–	–	–	−1.64***	
ERC_{t-1}	–	–	–	–	–	−0.21***	−0.21***	−0.19***	−0.26***
μ	0.08	0.13	−0.08	–	0.03	0.05	−0.08	0.23	0.23
R_D^2:[a]	0.34	0.51	0.28	0.57	0.36	0.56	0.50	0.64	0.69
σ:[b]	1.71	1.52	1.75	1.40	2.73	1.42	1.49	1.32	1.93
Q:[c]	7.68	7.2*	23.4***	7.03	15.1***	8.8*	9.44***	5.9*	13.72***
η_η:[d]	1.46	1.21	1.48	1.24	2.31	1.19	1.25	1.0	1.62

[a] R_D^2 is a measure of the fit suited for non-stationary time series. According to this measure, the residual sum of squares of the estimated equations is compared to the residual sum of squares obtained by a pure random walk model with drift. A value of 0.2 therefore means that the model's fit is 20% better than the fit of a pure random walk model.
[b] Estimated standard deviation of the one-step prediction errors.
[c] Ljung-Box Q-statisic of the one-step prediction errors.
[d] Estimated standard deviation of the white noise error term η.
Significant at 10% level.
* Significant at 5% level.
** Significant at 1% level.

Table III. Panel b. Regressions with time-varying intercepts

Version	1b	2b	3b	5b	6b	7b	8b	9b
Dep. variable	Δw	Δw	Δw	Δwh	Δw	Δw	Δw	Δwh
intercept v	varying	varying	varying	varying	−0.06	−0.004	−0.006	0.0
Δp_t^e	1.03***	0.86***	1.06**	1.33***	1.29***	1.37***	1.0***	1.44
Δprod_t^e	0.53***	0.49**	0.46*	0.32*	0.55***	0.56***	0.46**	0.88***
Δu_{t-1}	−2.15**	−2.4**	−1.69**	−3.28***	−1.80***	−1.67***	−2.1***	−2.54***
u_{t-2}	0.003	−0.19	0.50	−0.096	−0.078	0.13	−0.49**	−0.59*
Ratio_{t-1}	–	–	−0.17	–	–	−0.05	–	–
Δt_t	–	0.23*	–	–	–	–	0.17*	–
$\Delta \tilde{t}_t$	–	−0.66***	–	–	–	–	−0.53***	–
Δl_{t-1}	–	–	–	–	–	–	–	1.64***
ERC_{t-1}	–	–	–	–	−0.21***	−0.21***	−0.19***	−0.26***
μ	−0.001	0.08	−0.29	0.03	0.05	−0.08	0.23	0.23
$\chi^2(1)$[a]	1.27	2.8*	0.97	0.56	0.0	0.0	0.0	0.0
R_D^2:	0.37	0.56	0.26	0.34	0.56	0.50	0.64	0.69
σ:	1.67	1.43	1.77	2.76	1.42	1.49	1.32	1.93
Q:	9.08	9.42**	25.45***	11.48***	8.8*	9.44***	5.9*	13.72***
σ_η:	1.32	1.09	1.15	2.02	1.19	1.25	1.0	1.62
σ_v:[b]	0.36	0.25	0.83	0.87	0.0	0.0	0.0	0.0

[a] $-2[L^* - L(0)]$-Test statistic for the usual likelihood-ratio test with $L(0)$ equal to the likelihood under the assumption that all parameters are constant. In this case the test statistic is approximately χ^2-distributed with one degree of freedom (see Garbade 1977 pp. 55–56).

[b] Estimated standard deviation of the random walk innovation ξ for the process v.

Table III. Panel c. Regressions with all coefficients varying

Version	1c	2c	3c	5c	6c	7c	8c	9c
Dep. variable	Δw	Δw	Δw	Δwh	Δw	Δw	Δw	Δwh
Intercept v	0.31	varying	0.012	0.011	−0.06	0.04	−0.006	0.05
Δp_t^e	varying	varying	varying	varying	1.29***	varying	varying	varying
$\Delta \mathrm{prod}_t^e$	varying.0	41**. varying	varying	0	55***.−0	22.0	47**.0	12.
Δu_{t-1}	−1.921*	−2.2**	−1.55**	−2.69***	−1.80***	−1.48**	−1.89***	−2.48***
u_{t-2}	0.06	−0.19	0.57	−0.43	−0.088	0.001	−0.44*	−0.75**
Ratio_{t-2}	–	–	−0.18	–	–	−0.12	–	–
Δt_t	–	0.24*	–	–	–	–	0.19*	–
$\Delta \tilde{t}_t$	–	−0.63***	–	–	–	–	varying	–
Δl_{t-1}	–	–	–	–	–	–	–	1.43***
ERC_{t-1}	–	–	–	–	−0.21***	varying	−0.20***	varying
μ	−0.03	0.09	−0.36	0.16	0.05	0.00	0.23	0.3
R_D^2:	0.41	0.59	0.37	0.55	0.56	0.58	0.66	0.78
σ:	1.62	1.40	1.64	2.28	1.42	1.36	1.28	1.63
Q:	9.04	8.13**	20.35***	12.27**	8.8*	7.89**	5.6	3.4
σ_η:	1.21	1.05	1.22	0.05	1.19	0.78	0.93	0.56
σ_v:	0.0	0.08	0.0	0.0	0.0	0.0	0.0	0.0

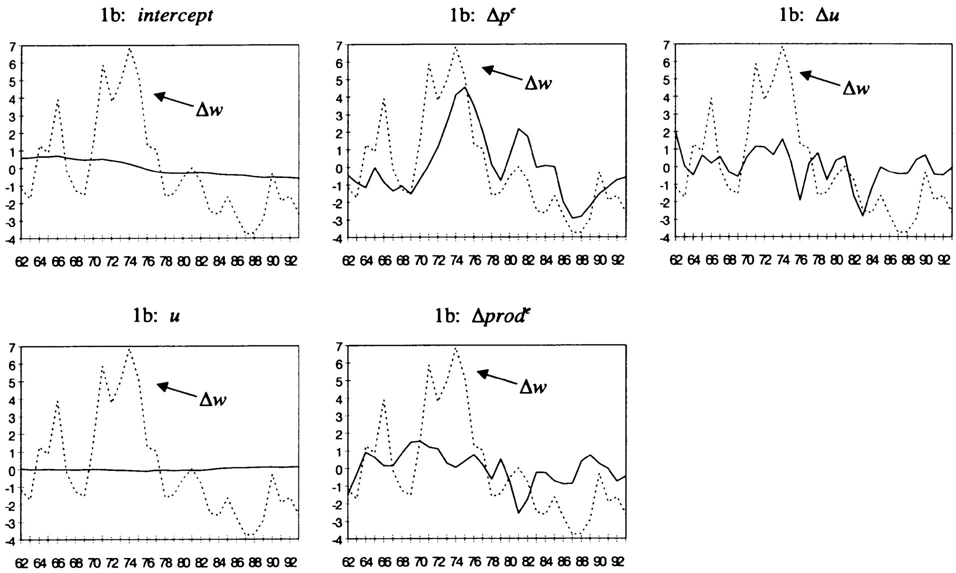

Figure 2. Contribution of the explanatory variables to variations in the dependent variable: Version 1b.

We now turn to the variants with the error correction term. We observe that in addition to a shift in the coefficient of Δp, in some variants the coefficient of the error correction term also shifted. This could be quite interesting in answering the question whether the hysteresis phenomenon in Austria has only recently emerged. The last picture in the second row of Figure 1 shows the estimated time path of the coefficient of the error correction term for version 9, which is also typical for the other variant. As we can see, if anything, there was a slight increase in this parameter, so the influence of the error correction term decreases. Maybe this reflects the fact that unions are now slightly more willing to accept deviations of wages from their long-run target.

Figures 2 and 3 show the effects of each explanatory variable in explaining the variations of the dependent variable for the versions 1b and 6c, which are quite typical. We observe that variations in ERC and Δu_{t-1} substantially contribute to the variation in wage growth, whereas the *level* of unemployment is of only minor importance for explaining wage growth.

Finally, we want to compute the long-run effects of shocks in the growth rate of the exogenous variables p, prod, e, l, $(1-t)$, $(1+\tilde{t})$ and u^{nat} on wages and unemployment. To do so, we use the formulas derived in Section IV. Formula (21) is relevant for the error correction version. Using the estimated coefficients of variant 8a, we can recover the structural parameters α, ζ and μ. Parameter η is taken from Table II multiplied by $(1-T)/T$ (see Note 19). So we use the following parameter values, $\delta = 0.56$, $\delta_0 = 0.5$,[26] $\alpha = 17$, $\mu = 0.23$, $\eta = 0.5$ and $\zeta = 0.35$,

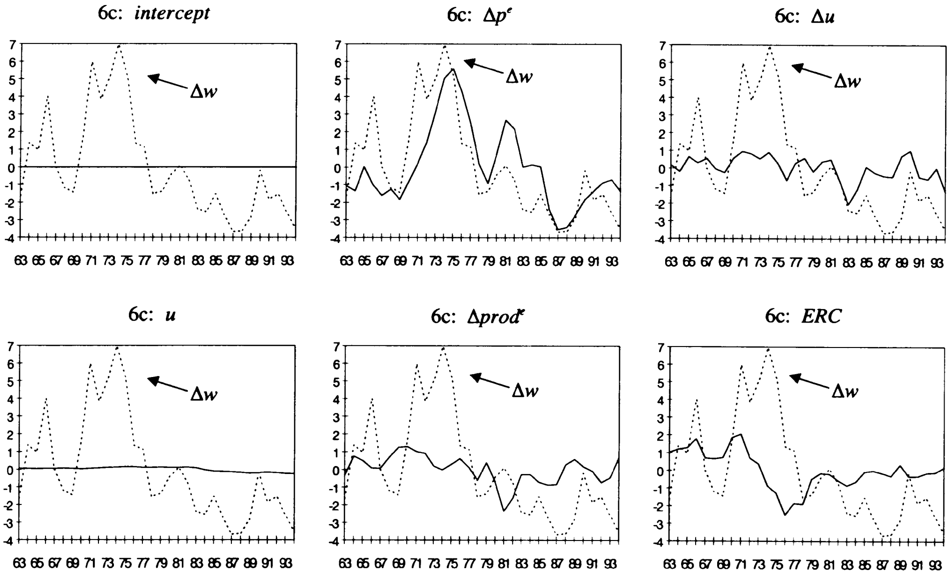

Figure 3. Contribution of the explanatory variables to variations in the dependent variable: Version 6c.

which are inserted in (21). By doing so we arrive at the following numerical long run solution:

$$\begin{bmatrix} 1 & 1 & 1.1 & -1.1 & -0.16 & -0.55 & 1.1 \\ 0 & 0 & -0.45 & 0.45 & -0.11 & 0.22 & 0.55 \end{bmatrix}. \qquad (24)$$

The first row shows the effects of shocks in the growth rate of the exogenous variables on wages, the second row on the unemployment rate. According to these results, a one percent shock for example in the growth rate of the labor force l (fourth column) leads to a long-run increase of the unemployment rate of about 0.45 percentage points. Between 1989 and 1991, the labor force in Austria has risen more than 10%. According to our model, this would imply an increase of the unemployment rate of about 4.5 percentage points if this rise in l has not been partially compensated by other forces, for instance by the exceptionally high aggregate demand growth during this period. In this respect it is interesting to note that positive shocks in productivity growth (second column) – even if they are not expected – are not able to compensate for negative shocks in the labor force or in aggregate demand (indirect effects of productivity via prices and real balance effects cannot be investigated within this partial model).

Another interesting question involves the effects of an increase in tax rates. A 1% rise in $(1 - T)$ implies a long-run decrease of the unemployment rate of about

0.11 percentage point (fifth column). If we calculate the effect of a rise in T of one *percentage point*, we get (for an employee's tax rate of 0.3):

$$\frac{du}{d\ln(1-t)} \times \frac{d\ln(1-T)}{d\ln(T)} \times \frac{d\ln(T)}{dT} = -0.11 \times -0.43 \times 3.34 = 0.15.$$

As similar calculation leads to the effect of a one percentage point rise in employer's tax rate (sixth column) on unemployment rate of 0.18. If both tax rates rise (as it is typically the case) a one percentage point rise in tax rates increases long-run unemployment rate of about 0.33 percentage points. These are very strong effects!

Next, we compute the long-run effects for the version without the error correction term (Phillips Curve approach). Here, we used variant 1b to recover the structural parameters leading to $\mu = 0$, $\alpha = 16$ and $\eta = 0.5$. Inserting this into formula (23) implies the following numerical long-run solution:

$$\begin{bmatrix} 1 & 1 & 1.43 & -1.43 & -0.1 & -0.71 & 0 \\ 0 & 0 & -0.28 & 0.28 & -0.07 & 0.14 & 0 \end{bmatrix} \qquad (25)$$

Now compare (24) with (25). It is a striking fact that the version with error correction term, $\zeta > 0$, leads to even stronger hysteresis effects than the version without error correction term ($\zeta = 0$, and $\mu = 0$). To summarize: Regardless of the chosen variant, we have found strong hysteresis effects in Austrian data. As we know from our theoretical model of Sections III an IV, only if $\zeta = 0$ (the *level* of real wages plays no role in wage bargaining and therefore income distribution is not fixed in the long run) and $\mu > 0$ (the unemployment target is at least partially determined by the natural rate) there are no hysteresis effects. Our empirical analysis shows that it is highly improbable that both requirements are fulfilled at the same time. If we estimate without the error correction term ($\zeta = 0$), μ is practically zero, if we estimate with the error correction term, ζ is highly statistically significant and $\mu > 0$ but still very small. Our estimates further show that the implied hysteresis effects are numerically quite important for both variants.

VI. Summary and Conclusions

In the introduction we posed seven questions and we shall now try to answer these using the empirical analysis of the previous section. The first question was:

(1) Are there any significant hysteresis or persistence effects in the sense that exogenous shocks lead to permanent effects on unemployment.

The answer is a clear yes. Basically, we tried two specifications: without the error correction term (Phillips Curve approach) and with the error correction term. These two variants emphasize distinct sources of the hysteresis phenomenon. Let's consider the Phillips Curve variant first.

In all specifications tried - fixed coefficients, a varying intercept to allow for a non-stationary natural rate, varying coefficients, different sets of variables, etc.

– we found that the *level* of unemployment never noticeable affected real wage growth. So we think this result is quite robust. The implied value of the unemployment-target parameter μ (Equation (16)) was very close to zero in every variant. We interpret this result to mean that unions and the public become accustomed to higher unemployment rates when unemployment remains high for some time. This is a remarkable result as Austrian unions are highly centralized and it is often believed that they follow a policy of preserving full employment and international competitiveness (see for example Christl, 1992, p. 116).

Now let us turn to the variant with the error correction term. If this term is significant, the source of the hysteresis phenomenon is due to the fact that unions strive for a long-run real wage target (a certain income distribution). If unemployment rises, unions are of course willing to accept a deviation from their wage target (depending on the parameter α in their utility function), but as long as $\alpha < \infty$, not to a sufficient extent. Therefore, unemployment does not return to its previous (natural) level.

Our results show that both effects are probably important for Austria because in the variants with the error correction mechanism, this term is highly statistically significant and *additionally*, the estimated values for the target parameter μ remain very low (around 0.2 in most cases).

Another often-quoted source of the hysteresis phenomenon, the duration of unemployment, seems to play no important role in Austria according to our results (see issue 4 below).

The second question we posed was:

(2) Are there any changes in the wage-setting behavior during the period of investigation (1956 to 1994)?

The answer is no with some qualifications. According to our estimates, the wage-setting behavior seems to be very stable over the period of estimation. We did not find significant variation in the estimated parameters, and the shifts we did find were mainly the coefficient of productivity growth, which showed a weak tendency to decline. So, wage setting behavior seems to be very stable during the estimation period.

Now to the third problem:

(3) Is the evidence consistent with the Blanchard-Summers variant of the insider-outsider hypotheses?

We conclude that the insider-outsider theory in its simple (and usual) form does not seem to be a proper description of Austrian data. As we know from Equation (7) that hypothesis predicts a negative coefficient of employment (or a positive coefficient of unemployment) in a regression of real wages on employment (unemployment). Looking at the first and second columns of Table II, we see that this is obviously counterfactual. Expressing Equation (7) as differences, the insider-outsider theory no longer requires the false sign for Δn_{t-1} (Equation (8)), but we learned that that coefficient strongly depends on the parameter δ, the delay parameter in the labor demand schedule. We can use the study of Bean, Layard and Nickell (1986), who estimated (among other things) a labor demand schedule for Austria, to check for the plausibility of the insider-outsider theory compared to our approach. They found a value of 0.56 for the delay parameter δ and a value of 0.5 for the long run elasticity of labor demand on real wages, δ_0.[27] Using these estimates, we would expect a value of 2.55 for the coefficient of Δn_{t-1} in Equation (8). But we get a value of approximately 0.6, (see Table III, panel a, version 4). Therefore, according to the usual insider-outsider theory, variations in employment should have four times the effect on wages than actually observed. This is totally inconsistent. On the other hand, basing on equation (20), we obtained values for the coefficient ofΔu_{t-1} ranging between -3.1 and -1.8 with a most plausible value of approximately -2. This implies a value for α of about 16, which is, in our opinion, quite plausible. That means that a one *percentage point* deviation in the actual unemployment rate from target unemployment rate (which corresponds to an increase in unemployment of 25% if the target unemployment rate is at 4%) is as bad for unions as a 4% decrease in wages.

We next consider the question:

(4) Is there any significant effect of the duration of unemployment on wage setting?

We have not found any indication that the distinction between short and long-term unemployment is important for real wage determination (see Equation (20′) and the estimates in Table III, panels a–c, versions 3 and 7). Whenever another source of the hysteresis phenomenon was admitted, the duration effect turned out to be insignificant. Further, if a larger share of long-term unemployed reduces the pressure on wages, we should observe a significant reduction of the influence of unemployment on real wage growth in recent times, as this share is now considerably larger than a few years ago. But neither the influence of Δu_{t-1} nor that of u_{t-2} has changed. This does not mean that outsider characteristics are not an important factor for the probability of reemployment of a particular individual, nor does it rule out that, through selection mechanisms, the share of long-term unemployed rises in times of high unemployment. But specific effects of long-term unemployment on real wages were not detectable and hence we reach to the conclusion that the duration of unemployment is not the prime cause of the hysteresis phenomenon in Austria.

The fifth problem is:

(5) Is the slowdown of productivity growth of any importance for wage setting?

A popular explanation for the rise in unemployment is the hypothesis that wage aspirations fail to adjust downwards in the face of productivity slowdown. If the rate of productivity growth falls, this implies a slowdown in the feasible growth of real wages at any given level of unemployment. If wage aspirations do not take account of this, the result will be higher unemployment. But we did not find any evidence supporting this view. On the contrary, if there was any change in the influence of productivity growth on real wage growth, it was a reduction (see Figure 1, second row).

Next, we examine the issue:

(6) Is there evidence of a substantial change in the natural (equilibrium) rate of unemployment?

One main aspect of our empirical approach was that we explicitly allow for a non-stationary natural rate of unemployment using time-varying parameter techniques. This procedure both allows for a test of a possible shift and further enables us to estimate the time path of the natural rate as an unobserved component. Summing up, we found no evidence for a substantial change in the natural (equilibrium) rate of unemployment. Looking at Table III, panel b we see that (with one exception) the likelihood-ratio test statistics do not reject H_0; $\sigma_\xi^2 = 0$, i.e. that the innovation variance of the non-stationary intercept in Equation (20) is zero. The first row of Figure 1 displays some estimated time paths of the intercept found in Equation (20). Here we observe only slight shifts over the period of investigation, which in addition are not in accordance with a priori beliefs about the possible movements of the natural rate. However, it may well be the case that other factors in (20) – for instance the relative bargaining power λ, the relative position in the case of disagreement, the elasticity of profits on wages or the relative weight given to the unemployment target in the union's utility function – also changed during the last years, so that the shifts in the natural rate are obscured by these other factors. But there are no striking reasons to believe that these factors changed substantially in the last years. So we nevertheless presume that a *significant* increase in the natural rate probably would have dominated the movements of these other factors. This view is also strongly supported by the fact that the calculation of so-called "mismatch indicators" gives no evidence for a substantial increase in structural unemployment during the last decades.[28]

Finally we investigate the interesting question:

(7) Has there ever been a Phillips Curve in Austria?

]In the mid-eighties there was a discussion about the stability of the Austrian Phillips Curve. According to Breuss (1989) and Wörgötter (1983) the Austrian Phillips Curve was exceptional stable at that time. Stiassny (1985) showed that this stability breaks down if the natural rate (in our present terms, the target level of unemployment) is allowed to evolve over time. In the light of our present results we can assess these arguments once again. The main result of our paper is that unions' target level of unemployment changes over time (it depends on previous levels of unemployment) and hence real wage growth mainly depends on the rate of change in unemployment and not on the level of unemployment. In this respect, Stiassny (1985) was certainly right. But strictly speaking, if it is true that solely the rate of change in unemployment influences real wage growth, a Phillips Curve in

Austria never existed, nor in the short or long run. But how can it be that a graphical representation of a Phillips Curve of that time looks so stable. The answer is quite simple. Our model implies for $\mu = 0$ and $\zeta = 0$:

$$\Delta p_t = \Delta p_t^e - a(L)\Delta u_t + (\Delta \text{prod}_t^e - \Delta \text{prod}_t)$$
$$- b(\Delta e_t - \Delta l_t) + c(\Delta e_t^e - \Delta l_t^e), \quad -b + c < 0, \;\; a(1) > 0.$$

If we set $\Delta p_t^e = \Delta p_{t-1}$ it follows:

$$\Delta p_t = -a(L)u_t + \sum(\Delta \text{prod}_t^e - \Delta \text{prod}_t)$$
$$- b\sum(\Delta e_t - \Delta l_t) + c\sum(\Delta e_t^e - \Delta l_t^e).$$

So we have an "ordinary" Phillips Curve with one exception: the "error term" now consists of the entire history of shocks in (unexpected) productivity growth, demand growth and growth in labor force. If these shocks are accidentally symmetrically distributed around zero, the "Phillips Curve" is stable, i.e. does not shift. However, if there are several shocks in the same direction, we would observe permanent shifts. In the light of this, it is not surprising that Breuss and Wörgötter found an apparent stable inflation unemployment trade-off for the period before 1980, although such a stable trade-off never existed. But, on the other hand, they were right in maintaining that expansionary policy could reduce unemployment without an accelerating inflation rate because, according to Equations (21) or (23), unexpected as well as anticipated shocks do have some permanent impact on the unemployment rate if $\mu = 0$ (or $\zeta > 0$), and the NAIRU is compatible with any level of unemployment or inflation.

Notes

1. For an exhaustive survey on this topic see *Bean* 1994.
2. See *Christl* 1992 for an Austrian investigation of this matter.
3. In this paper we will not discuss the theoretical foundations of all these theories as this already has been done elsewhere exhaustively (e.g. *Bean* 1994).
4. See *Campell – Mankiw* 1987.
5. For convenience we write: Δp_t^e instead of $p_{t/t-1}^e - p_{t-1}$.
6. For this line of argument see *Blanchard-Fisher* (1989) p. 544 ff.
7. See *Coe* 1993, page 756 criticizing *Franz-Gordon* 1993 in this respect.
8. It should be noted, that Equation (5) leads to a very similar estimation problem as before. If the natural rate is non-stationary and the variables in Z_t are not correctly specified, the coefficients of the non-stationary variables u_{t-1} and $ERC(w_{t-1}, p_{t-1}, \text{prod}_{t-1})$ converge to zero if the other variables are all stationary.
9. Equation (8) is not simply the first difference of (7) as the expected inflation rate is defined as $p_{t/t-1}^e - p_{t-1}$, and not as $p_{t/t-1}^e - p_{t-1/t-2}^e$, which is simply the change of price expectations.

10. See for instance Alogoskoufis-Manning 1988. A different type is used for instance in Manning 1993.
11. The quadratic formulation of this utility function might at first seem strange as a higher wage and a lower unemployment rate is always better for unions. But for our problem this does not matter as unions here are constrained to choose a point on the labor demand function. Which point is chosen on the this curve depends on the shape of the indifference curves. So, the only role for the utility function is to provide the *relative* weights, which are given respectively to the unemployment and wage target. The parameter α is crucial in this respect.
12. This formulation is more general than simply maximizing wage revenues, which is consistent with maximization of household's utility if there is equal rationing for all workers, or, in the case of all-or-nothing rationing, if selection of workers is purely randomly and workers are risk neutral (see Dixon-Rankin, 1995, Footnote 5).
13. Once again, $(1-t)$ means $\ln(1-T)$, where T represents employee's tax rate.
14. In the following analysis the scale parameter s is ignored.
15. The expression

$$\frac{d\Pi_{t+1}}{d\log(W_{t+1})}\frac{1}{(\Pi_{t+1}-d_F)}$$

is equal to

$$\frac{d\Pi_{t+1}}{dW_{t+1}}\frac{W_{t+1}}{(\Pi_{t+1}-d_F)},$$

which represents the elasticity of profits on wages, $\varepsilon_{\Pi,W}$, if d_F is zero. One can show that for a broad class of production functions this elasticity is constant. See for instance Layard-Nickell-Jackman (1991) p. 540.
16. If the inflation rate contains a unit root, $p_t^e = p_t$ implies: $\Delta^2 p_t = 0$, i.e. a constant inflation rate.
17. See Coe 1988, p. 286ff.
18. By means of Monte-Carlo methods, Garbade 1977 investigates the bias which arises if the structural shifts can not be described properly by a random walk. He concludes that the random walk model yields useful results even in the extreme case of singular structural breaks. Only just before and after a structural break does a noticeable bias arise.
19. The parameter a should be equal one. The coefficient of prod_t^e, b, might be less than one if unions smooth productivity fluctuations and are guided to some extent by long term average productivity growth, which is then reflected by the constant term. We further approximated $\ln(1 \pm T)$ by $\pm \ln(T)$ + const, which obviously is not exactly the same but the fit of the equations improved considerably through this introduced nonlinearity. The estimated parameters must then be corrected by

$$\frac{\partial \ln(T)}{\partial \ln(1\pm T)} = \frac{(1\pm T)}{T}.$$

20. For a very similar approach see Gordon (1997).
21. Note, that μ and ζ must be set to zero *before* solving for u and w. After canceling several terms containing $(1-L)$, we set $L=1$ and calculate (23).
22. I am grateful to *Gudrun Piffl* for providing me with the data of long and short-term unemployment.
23. For all variables, one lag was sufficient to eliminate the correlation between residuals.
24. Even if one uses the Engle-Granger method or Johansen's procedure, the evidence for a cointegration relationship is still not overwhelming (see Stiassny 1996, p. 12 ff.).

25. To do this, we used time-varying parameter models. The difference to an ordinary regression model lies in the fact that the regression coefficients β_t now depend on time, i.e. β can evolve over time. To estimate these changes, we must specify a model in which β is allowed to evolve. In the most simple case a random walk model is postulated for β_t. By making this assumption, one is able to transform the model to the so-called state space form, which can be handled very conveniently by the Kalman filter. As a by-product of the Kalman filter, the series of prediction errors can be used to define the likelihood function of the model (prediction error decomposition), which allows one to estimate the system parameters by maximum likelihood methods. Applying a smoothing algorithm, which makes use of all available information contained within the observations, we get an optimal estimate for the time paths of the state variables β_t along with their confidence bands. For details see Harvey (1989) or Stiassny (1993). Actual estimation was carried out with the computer program TVP, which has been developed by the author for such models. For more information about that program, especially about the somewhat serious estimation problems involved and how they are handled by TVP, see Stiassny (1993).
26. The labor demand parameters are taken from Bean, Layard and Nickell (1986), page S9, Table 3.
27. Bean, Layard and Nickell (1986), page S9, Table 3.
28. See for instance Jackman-Roper (1987) or Christl (1992).

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