The equilibrium rate of unemployment : a theoretical discussion and an empirical evaluation for six OECD countries

Odile Chagny, Frédéric Reynès, Henri Sterdyniak

The equilibrium rate of unemployment: a theoretical discussion and an empirical evaluation for six OECD countries

Odile Chagny, Frédéric Reynès, and Henri Sterdyniak*

N° 2002-04

April 2002

* Odile Chagny and Henri Sterdyniak are economists at the OFCE and Frédéric Reynès is preparing a Doctorate in economics at the OFCE; Observatoire Français des Conjonctures Economiques, Fondation Nationale des Sciences Politiques, 69 Quai d'Orsay, 75340 Paris Cedex 07, France, tel +33 (0)1 44 18 54 00; fax: +33 (0)1 44 18 54 64. E.mail: ochagny@ofce.sciences-po.fr; frederic.reynes@ofce.sciences-po.fr; sterdyniak@ofce.sciences-po.fr.

Abstract

This paper examines theoretically and empirically the controversial notion of "equilibrium rate of unemployment" (ERU) which opposes proponents of the Phillips curve to those of the WS/PS models. Theoretically, this paper shows that the specification of the wage equation has a significant influence on the ERU. It also shows that an "asymmetric" wage-price setting using a Phillips curve and a price equation in level allows a clear distinction between the medium run ERU and the long run ERU that can be seen as a reconciliation between WS/PS models and the Phillips curve.

Moreover, this paper calculates ERU for 6 OECD countries (the United States, Germany, France, the United Kingdom, Spain and the Netherlands) for the period 1970-late 1990's by using a structural approach. As there are little studies that test directly the impact of institutional variables in a Phillips curve, the first empirical objective is to test this effect. The results in this matter are not really conclusive.

The second objective is to calculate medium run and long run ERU. The evolutions of the medium run ERU explain relatively well those of the actual unemployment rate until the late eighties. Its determinants are the slowdown of productivity growth, the 2 oil shocks, the increase of employer's social contribution and the change in the inflation target of the monetary authorities. In the nineties, the actual unemployment lies clearly above its equilibrium level suggesting that a big part of the European unemployment is due to an excess supply.

***Keywords*: labor market, equilibrium unemployment, Phillips curve, WS/PS model, Three Stage Least Squares estimation, OECD.**

JEL Classification: C13, C32, E24, E31

Introduction

The notion of "equilibrium rate of unemployment"[1] is the center of numerous economic policy debates. Did this rate decrease in the United States due to a new economy effect? Did it stay high in continental Europe? Could it be a factor explaining why the period of strong growth in continental Europe from 1997 to 2000 came to an end? Can we place this concept at the core of the economic policy debates in Europe, as recently proposed by Pisani-Ferry (2000)? Is it possible to decrease the equilibrium rate of unemployment through reforms strengthening the flexibility of the labor market, a decrease of the tax burden over labor factor, lower interest rates or even via a lower unemployment rate?

The evaluation of the equilibrium rate of unemployment (ERU) is theoretically and empirically controversial. Its determinants differ according to the specification of the model. In particular, this notion opposes the proponents of the wage curve in level and those of the Phillips curve (see Sterdyniak *et al.* (1997)).

In the first part, we will see that the debate can not be simply reduced to an alternative between Wage-Setting Price-Setting (WS/PS) models and the Phillips curve; we will also see the importance of the distinction between the medium run ERU and the long run ERU, that can be seen as a way of reconciliation between WS/PS model and the Phillips curve.

A lot of empirical and theoretical studies (Bean (1994); Blanchard and Wolfers (2000); Belot and Van Ours (2001); Burda and Weder (2001); Den Haan *et al.* (2001)) suggest that differences in OECD unemployment performances can be explained by institutional differences in the labor market. Two questions then arise: (1) Can we explain empirically unemployment differences by institutional differences? (2) To what extend have institutional changes in some countries led to a modification of the equilibrium rate of unemployment[2]? Among the empirical studies that focus on the link between the institutional characteristics and unemployment, mainly two approaches can be distinguished: structural approaches of the WS/PS type, popularized by Layard, Nickell and Jackman (1991) and reduced approaches that establish a direct link between the unemployment and the institutional characteristics. Some studies have recently focused on the complexity of the link between the institutional characteristics and the real rigidity of nominal wages measured by a Phillips curve (Passet and

1. We will prefer this relatively neutral expression to the natural rate of unemployment and to the NAIRU.
2. This point is discussed in Fitoussi and Passet (2000).

Jestaz (1998); Cadiou, Guichard and Maurel (1999)). However few empirical studies have directly tested the role of the institutional characteristics in a model where the wage setting relies upon the traditional Phillips curve, where the growth rate of wages is a function of the level of unemployment and the past inflation. We use this approach for six OECD countries (the United States, Germany, France, the United Kingdom, Spain and the Netherlands) for the period 1970-late 1990s. It allows us to estimate for these countries medium run and long run ERU based on a clear theoretical and empirical definition and to test the interaction between shocks and labor market institutions on the equilibrium rate of unemployment.

Part 1. Some considerations about the equilibrium rate of unemployment (ERU)

Several definitions of the ERU are proposed in the economic literature (Blanchard and Katz (1997), Sterdyniak *et al.* (1997), Mellis and Webb (1997), Richardson *et al.* (2000)). Some specifications consider that the ERU depends solely on the growth rate of labor productivity. Other specifications put the emphasis on the role played by the trade unions, the impact of the level of unemployment benefits, the tax burden and the level of the interest rates (Bean (1994)). The debate cannot be summarized by a simple alternative between the structural wage-price setting model developed by Layard, Nickell and Jackman (1991) and the Phillips curve[3]; each branch of this alternative may be decomposed into several models and definitions.

We will show that it is necessary to distinguish between a long run ERU and a medium run ERU. Indeed, this distinction leads to some reconciliation of the WS/PS and the Phillips curve models. For a given specification, we define the long run ERU as the rate of unemployment prevailing in the long run equilibrium of the model and characterized by inflation and labor share stability. In some specifications, the long run ERU depends only on structural or institutional parameters of the economy and is therefore unique and relatively stable. In some others, it can be influenced by the economic policy choices (such as the level of public expenses, the desired price inflation); in such cases, the long run ERU (ERU_{LR}) may vary and

3. The structural Phillips curve we are using must be distinguished from the "triangle model" of Gordon (1997) where the Phillips curve relates directly the price inflation rate (and not the wage inflation) to inertia (measured by the past price inflation), excess demand (measured by the gap between the unemployment rate and the NAIRU) and supply shocks (import price, etc.).

will be influenced by some pertinent parameters. In addition, given a certain initial state of the economy, it may be impossible to have an unemployment rate permanently equal to the long run ERU. We will see that this is the case in presence of hysteresis, when the inflation rate remains above the desired inflation rate, and when the real wage is too high. In this case, the path of the unemployment rate is influenced by a medium run constraint that can be defined as the medium run ERU (ERU_{MR}). The definition of the equilibrium rate of unemployment will be clarified in the following presentation of wage-price setting systems alternatives.

1.1. The simple model

Starting with a simple model, the production technology is a Leontief technology (no factor substitution). Wages are determined by an "augmented" Phillips curve. The model is described by the following equations[4]:

Labor demand equation:

(1.1) $$l_t = y_t - \pi t$$

where y is the output, l is the employment and π the labor productivity growth.

Price setting equation:

(1.2) $$\Delta p_t = \mu(k + w_t + t_{cr} - \pi t - p_{t-1})$$ [5]

where t_{cr} is the employer's social contribution rate, k is the firm's mark-up ratio, w is the gross nominal wage.

Wage setting equation:

(1.3) $$\Delta w_t = c + \Delta p^e - bU_t$$

where Δp^e is the expected inflation, assumed here to be equal to past inflation Δp_{t-1}, c is a constant representative of wage push factors, U_t is the unemployment rate.

4. In the rest of the paper, the lower-case variables are in logarithm, Δ is the change in the variable and all coefficients are positive. Time t as suffix will be omitted in the rest of the paper.

5. This specification is equivalent to a constrained error correction model.

Rearranging equations (1.1) to (1.3) gives the unemployment rate consistent with a constant inflation:

(1.4) $$U_{ELR} = (c - \pi)/b$$

The ERU depends positively on the constant of the wage setting equation and negatively on the growth rate of labor productivity.

This model does not precisely formalize the wage setting process. Nominal wages can be fixed by collective bargaining or by individual agreements involving each firm and each employee. Social partners agree to index the wages on the prices. The unemployment rate represents here either the bargaining power of workers and the firms or the pressures on the labor market. On one hand, the labor market leads to a real wage growth being a decreasing function of the rate of unemployment, on the other hand the equilibrium growth of the real wage is equal to the growth rate of the labor productivity. Thus, only one level of the unemployment rate allows the effective growth rate of wages to be equal to the medium run equilibrium growth rate of real wages.

This elementary model assumes that the parameter *c* is constant. It is an intrinsic characteristic of the labor market in a given country, for a given period. But this hypothesis has poor foundations and leads to three possible research fields. The first is to find empirical factors that can explain the variations of the parameter *c* – as for instance the bargaining strength of unions, the degree of mismatch, the reforms on the labor market. The second consists in studying econometrically changes in *c*, but without relating explicitly these changes to institutional or structural changes as in Gordon (1997). The third is to study the microeconomic foundations of the wage setting process (as in Cahuc and Zylberberg (1996)).

Equation (1.3) postulates that nominal wages adjust fully to prices. This is often explained by the absence of nominal illusion of workers and firms. However, this may not be the case at least for two reasons. First, in periods of sustained inflation, the bargaining power of workers is weakened because they attempt to maintain their purchasing power. Second, in some countries, they may agree not to fully adjust wages to inflation in order to contribute to a lower inflation rate when trade unions internalize the effect of their bargaining posture on macro-economic performance (Calmfors and Driffill (1988) and Soskice (1990)) or fear the reaction of the central bank. Assuming the wage equation is:

(1.3 bis) $\Delta w = c + a\Delta p^e - bU$,

the ERU is given by:

(1.4 bis) $U_{ELR} = (c - \pi - (1-a)\Delta p^o)/b$

This is a decreasing function of the inflation target of the monetary authorities (Δp^o); the well known inflation-unemployment trade-off model developed by Samuelson and Solow (1960). The main problem is the stability of equation (1.3 bis) when the price inflation remains durably on a relatively high level. In such a case, there is a strong incentive to adopt automatic indexation rules ($a = 1$), i.e. the inflation-unemployment trade-off disappears.

1.2. Hysteresis

Hysteresis occurs when part of the unemployed workers exert no influence on the wage setting. Proposed theoretical explanations include deterioration of human capital of long term unemployed workers, the reluctance of firms to hire long term unemployed workers as they are not able to evaluate their human skills or the fact that incumbent workers (insiders) afford to maintain their position in the wage negotiations (Blanchard and Summers (1986), Lindbeck (1993)). In this case, as the growth of wages depends also on the gap between the actual unemployment rate and its past trend, the Phillips curve equation can be rewritten:

(1.3 ter) $\Delta w = c + \Delta p^e - b_1 U - b_2 (U - U_l)$ with $U_l = \sum_{i=1}^{\infty} \lambda_{-i} U_{-i}$ and $\sum_{i=1}^{\infty} \lambda_{-i} = 1$

Independently of the hysteresis phenomena, this equation can also refer to models where the wage setting is affected both by the level and the rate of change of employment. Recovering periods, where firms hire a relatively high proportion of workers, may induce wage acceleration notwithstanding the high level of unemployment. The opposite situation, in periods of low unemployment rate but where firms begin to fire workers, is inauspicious to high wage increases (as in Lipsey (1960)). Two cases can be distinguished:

In case of full hysteresis ($b_1 = 0$), the model has no stable long run. Indeed, for any constant unemployment rate level, the real wage growth is *c*, which is not equal to π , except by chance. The specification of the model is therefore not correct.

In case of partial hysteresis ($b_1 > 0$), the long run equilibrium rate of unemployment is defined by:

(1.4 ter) $$U_{ELR} = (c - \pi) / b_1$$

Nevertheless, if at the initial situation the unemployment rate is not equal to the long run ERU, speed limit effects will affect the convergence of the unemployment rate towards its equilibrium level. The path (the medium run ERU) allowing the growth rate of wages to be consistent with the growth rate of productivity is the following:

(1.5) $$U_{EMR} = \frac{b_1 U_{ELR} + b_2 U_{l,t}}{b_1 + b_2}$$

where $U_{l,t}$ is the past trend unemployment rate.

Let us assume, for instance, that $b_1 = b_2$. The long run ERU is equal to 8%; the past trend unemployment rate (average of the last four years) is equal to 12%. In such a case, the evolution of the unemployment rate will be: 10%, 9.75%, 9.35%, 9.14%, 8.77%.

The greater b_2 is relatively to b_1, the longer the adjustment path of the unemployment rate level and the higher the gap between the medium run ERU and the long run ERU will be.

1.3. Price setting

In addition to an adequate growth rate of real wages, the macroeconomic equilibrium requires also an appropriate level of the real wages. When the wage equation is a Phillips curve, the wage and price settings are assumed to be asymmetric (Debonneuil and Sterdyniak (1984)) and the consistency of the *level* of the real wages depends only on the price equation. Firms set their desired prices as a mark up over labor costs. However, workers don't have any objective of real wage independent from the evolution of wages. This is a fundamental difference with WS/PS model and the main reason why we call the wage-price setting described here an asymmetric setting.

In our simple model, the transformation of the equation (1.2) gives a specific level of real wages, the ***available real wage***. It corresponds to the real wage firms are ready to offer to their employees considering their price setting.

(1.6) $$\omega^d = \pi t - t_{cr} - k + \Delta p(1-\mu)/\mu$$

where ω is the real wage.

If we assume that at a given time period, the real wage lies above the available real wage level, firms will increase their prices. This reaction will induce a stagflation process, until the real wage level equals to the available real wage. Rearranging equation (1.3) gives:

(1.7) $$\Delta\omega = -b.(U - U_{ELR})$$

Hence, if the effective real wage lies above the available real wage, and assuming that the convergence to the long run ERU will be obtained arbitrarily by an increase of the unemployment rate during T periods, the level of the equilibrium rate of unemployment at each of these T periods will be:

(1.5 bis) $$U_{EMR} = U_{ELR} + \Delta\varpi / bT$$

where $\Delta\varpi$ is the gap between the actual real wage and the available real wage.

Temporary shocks affecting wages or long lasting shocks affecting the level of desired prices will therefore temporarily alter the ERU. In our simple model, such a shock can only be an increase of the employer's social contribution rate but the model can easily be extended to other shocks.

Next we turn to the consequences of the precise specification of the price setting.

a) Super-neutrality

The price setting specification of equation (1.2) is such that in the long run, the actual mark up of the firms is a decreasing function of the inflation rate. The model is hence not super-neutral. Such a result can be avoided under the assumption that firms incorporate a trend inflation rate in their price setting, as follows:

(1.2 bis) $$\Delta p = \mu(k + w + t_{cr} - \pi t - p_{-1}) + \nu\Delta p_l$$

in this case, super-neutrality is guaranteed if $\nu = 1 - \mu$.

The presence (or the absence) of super-neutrality has no impact on the long run ERU. It however modifies the medium run ERU when the trend inflation rate changes. Rearranging equations (1.6) and (1.5 bis), we can see that a lower inflation leads to a higher medium run ERU:

(1.5 ter) $$U_{EMR} = U_{ELR} + (\Delta p_I - \Delta p_F)(1-\mu)/(\mu bT)$$

where Δp_I and Δp_F are respectively the initial and the final trend inflation rate with $\Delta p_I > \Delta p_F$.

b) The case of an open economy

Under the assumption that all imports are used as intermediate inputs by the firms, the equilibrium price level is:

(1.2 ter) $$p = n(p^* + s) + (1-n)(w + t_{cr} + k - \pi t)\,,$$

where *n* is the ratio of imports to the output, supposed to be equal in both countries, *s* is the exchange rate and p^* is the external price level.

The external balance is:

(1.8) $$b_e = ny^* - ny + n\ \varphi\ (p^* + s - p) + b_0\ ,$$

where φ is the price elasticity of the external balance, b_0 is an exogenous shock on the external balance, *y* and *y** are respectively the output level in the national country and abroad.

The equilibrium exchange rate that equilibrates the external balance is:

(1.9) $$\phi = p - p^* - s = \ (n(y^* - y) + \ b_0)/(n\varphi)$$

The available real wage level is therefore:

(1.6 bis) $$\omega^d = \pi t - t_{cr} - k + n\phi/(1-n)$$

A decrease of the real exchange rate induced by a shock on the external balance requires a decrease of the real wage and therefore a temporary increase of the unemployment rate.

Assuming for instance that $n = 0.3$ and $\varphi = 1.5$; a negative external balance of 1 percentage point of the GDP induces a decrease of 2.2% of the real exchange rate and hence a decrease of 0.95% of the real wage. If $b = 0.5$, it involves a period of two years where the unemployment remains 0.95 point above the ERU.

c) The case of capital financing

Now assume that firms want to achieve a given ratio γ_0 between their indebtedness and

their capital level. In the initial period, the ratio is γ. The desired price is:

(1.2 quater) $$p = (wL + ((g+\delta)(1-\gamma_0) + (r-g-\Delta p)\gamma - \lambda(\gamma_0 - \gamma))pK)/Y$$

where L is the employment level, δ is the depreciation rate of the capital, r is the nominal interest rate, g is the growth rate of the economy, Y is the level of real output and λ the speed at which firms want to achieve their desired indebtedness ratio.

The available real wage is therefore a decreasing function of the real interest rate. An increase of the real interest rate induces a transitory period of higher unemployment.

A numerical example: assume that $b = 0.5$. In the initial period, the following hypothesis are made: the nominal interest rate has a value of 6%, the inflation is equal to 3%, the growth rate is equal to 3%. The production level is 100; the wages level is 70; the investment level is 30; the capital stock level is 200; the indebtedness level is 100 and the ratio of desired indebtedness is 0.5. Let us assume an increase of one percentage point of the interest rate level (7%) and a decrease of 0.05 percentage point of the ratio of desired indebtedness (0.45). The long run ERU is not affected, but the available real wage is affected by a double effect. On one hand, it declines from 0.7 to 0.691 (a decrease of 1.3%). On the other hand, as the desired indebtedness of the firms is now 90, it requires a decrease of the real wage of 14.3%. There are many unemployment rate paths consistent with these results. The most abrupt way is to have one year where the unemployment rate remains 31.2 points above the initial value, followed by a year where it will be below its initial value by 28,6 points. The third year, the unemployment rate will return to its initial value. If the objective is to spread the shock over ten years, it will require a five-year period where the unemployment rate remains 1.87 point above the long run ERU, followed by a five-years period where the unemployment rate remains 1.35 point below the long run ERU.

In this respect, any supply shock induces a gap between the long run ERU and the medium run ERU. But the concept of medium run ERU is ambiguous as it relies on specific hypotheses about the duration and the type of convergence towards the long run equilibrium.

1.4. Capital-labor substitution

Now let's assume that the technology is a CES function with labor-saving technical progress:

Price setting:

(1.2 quinto) $p = \alpha c_K + (1-\alpha)(w + t_{cr} - \pi t)$

where α is the capital share.

Capital cost:

(1.10) $c_K = p + r + \delta$

where r is the real interest rate, δ the depreciation rate of capital.

Employment demand:

(1.11) $l = y - \alpha\sigma(w + t_{cr} - \pi t - c_K) - \pi t$

where σ is the elasticity of substitution.

Capital demand:

(1.12) $k = y - (1-\alpha)\sigma(w + t_{cr} - \pi t - c_K)$

with a constant real interest rate, the real available wage is:

(1.6 ter) $\omega^d = \pi t - \frac{\alpha}{1-\alpha}(r + \delta - t_{cr})$

and the employment is:

(1.13) $l = y + \frac{\alpha\sigma}{1-\alpha} r - \pi t$

Here again an increase of the interest rate requires a transitory period of higher unemployment rate in order to achieve the decrease of the real wage. It induces a durably lower level of production once the unemployment rate level has returned to its long run equilibrium value. The labor productivity considered here for the evaluation of the ERU is the trend labor productivity and not the effective labor productivity which depends on the evolution of the relative price of factors.

In all Phillips curve based models, the real wage in the long run is equal to the available real wage, but the convergence of the real wage to this available real wage should not be incorporated into the wage equation, as it is not a behavior. The convergence is achieved by the interactions of all components of the model.

1.5. Wage setting

The Phillips curve has been criticized by the proponents of the structural WS/PS model, who consider that the wages are bargained in level and not in variation. The bargaining models (Cahuc and Zylberberg (1996)) imply that wages are fixed as a "mark up" over a reservation wage, which represents the income opportunities of employees outside the firm. As this mark up is a positive function of the trade union membership density and a decreasing function of the unemployment rate, the wage setting equation is:

(1.3 quater) $\omega = c + fT_s - bU + \theta + \omega^r$

where T_s is the trade union density, ω^r is the reservation wage and θ are the mandatory levies on wages which are not compensated by benefits proportional to the contributions (in France, family and sickness contribution for instance).

However, the main problem is the determination of the reservation wage. To address this problem, four proposals have been exposed in the literature.

In a first specification, following Sargan (1964) specification, the reservation wage incorporates a positive trend: $\omega^r = \omega_0 + \tau t$ (for instance, L'Horty and Sobczak (1996), Cotis *et al.* (1996), L'Horty and Sobczak (1997) and L'Horty and Rault (1999, 2001)). In such a case, combining the wage equation with equations (1.2 quinto) and (1.10), the ERU is[6]

(1.4 quater) $U_{ELR} = \dfrac{\omega_0 + c + fT_s + \theta + \alpha(r+\delta)/(1-\alpha) + (\tau - \pi)t}{b}$

According to its proponents, this specification has the advantage to provide numerous candidate variables to explain the evolution of the ERU, as for instance the power of the unions, the social contributions, the interest rate, the labor productivity. Unfortunately, in most cases $\tau \neq \pi$, which induces a trended ERU that is not realistic in the long run. The slowdown of productivity growth in Europe from 1973 to 2000 would in that case have induced a permanent increase of the unemployment rate.

6. In order to simplify, we consider here that wage and price setting equations are super-neutral.

In a second specification, the reservation wage is equal to the unemployment benefits. Assuming that the unemployment benefits are institutionally set as a percentage of the gross wages ($\omega^r = \omega + t_r$), the ERU becomes:

(1.4 quinto) $$U_{ELR} = \frac{c + fT_s + \theta + t_r}{b}$$

where t_r is the net replacement ratio.

The ERU depends only on the labor market features and on the unemployment benefits. An increase of the labor productivity induces an increase of the real wage, but as it is integrated in the unemployment benefits, it does not affect the ERU. An increase of the social contribution rate affects the ERU only when it alters the net replacement ratio (see for instance Layard *et al.* (1991), p.107; L'Horty and Sobczak (1996)). In this model, the increase of the unemployment rate is explained either by the power of the trade unions or by an increase of the replacement ratio, an explanation which is hardly pertinent for the European countries.

In a third specification, the reservation wage is the labor productivity (Layard, Nickell and Jackman (1991); Blanchard and Katz (1999)). The basic idea is that workers can choose between dependent employment and domestic work, and that the productivity of domestic work increases at the same growth rate as the dependent work. The latter hypothesis does not seem very realistic. For other authors, unemployment benefits vary like the labor productivity (independently from wages). In both cases, the ERU is:

(1.4 sexto) $$U_{ELR} = \frac{\omega_0 + c + fT_s + \theta + \alpha(r + \delta)/(1 - \alpha)}{b}$$

This specification is "perfect": the ERU is a function of the desired variables. Unfortunately, the theoretical underpinnings are not obvious, as they rely on arbitrary hypotheses relative to the productivity of the domestic work, or on false hypotheses about the evolution of unemployment benefits. The increases of the ERU are explained by increases in interest rates, unions power or social contributions. As the social contributions increase along with the unemployment rate in order to balance the social budgets, the long run econometric relation may hold.

In a fourth specification (Manning (1993); Blanchard and Katz (1999)), the reservation

wage is the lagged real wage, so that equation (1.3 quater) can be transformed into a Phillips curve.

A few words can be said about the theoretical underpinnings of those specifications. They do not study how actual wages are fixed. The idea that workers can choose between dependent employment and unemployment (or domestic work) is somehow unrealistic. For instance, let us consider a recently graduated student. He will take a job or not according to his idea about the normal level of wages and the level of unemployment. He will not base his decision on the level of productivity of domestic work. On the other hand, the firm will offer a wage that depends on the wages already prevailing in the firm and on the wages of the other firms and on the unemployment level. Such considerations lead to a Phillips curve specification, where the reservation wage is the current wage. Wage bargaining will depend on inflation, wages of other firms and the situation of the labor market. The trade off between dependent employment and the unemployment benefits or domestic work does not intervene. In that sense, the Phillips curve theoretical underpinnings are as valid as those of the WS setting.

1.6. An attempt of synthesis

Let's assume that the general form of the wage equation is the following:

(1.14) $$\Delta w = c + a\Delta p_c - b_1 U - b_2 (U - U_{-1}) + d\pi - f\Delta t_{cr}$$

Wages may be totally or partially indexed on prices; there may be or not hysteresis; wage setting may or may not integrate productivity growth or hikes of employer's social contribution.

The consumer price setting equation is the following:

(1.15) $$p_c = n(p^* + s) + (1-n)p$$

and the value added price equation is:

(1.16) $$\Delta p = \mu(k + w + t_{cr} + \alpha(r+\delta)/(1-\alpha) - \pi t - p_{-1}) + \nu(\Delta p^o)$$

Let's assume that the real exchange rate:

(1.17) $\phi = p - p^* - s$ has no trend and that monetary authorities have an inflation target they impose in the medium term: Δp^o.

The long run ERU is:

(1.18) $$U_{ELR} = (c - (1-d)\pi - (1-a)\Delta p^o) / b_1$$

As in the Phillips curve tradition, the ERU has few determinants. However, coefficient *c* can depend on specific characteristics of the labor market.

The available real wage is:

(1.19) $$\omega^d = \pi t - k - t_{cr} - \alpha(r+\delta)/(1-\alpha) - n\phi + (1-\mu-\nu)\Delta p^o / \mu$$

The medium run ERU differs from le long run ERU when a shock widens the gap between the real wage and the available real wage affects:

(1.20) $$U_{EMR} = U_{ELR} + (\omega - \omega^d)/(b_1 T)$$

The same happens, in the presence of hysteresis, for any shock that widens the gap between the unemployment rate and the long run ERU.

So that:

(1.21) $$U_{EMR} = U_{ELR} + b_2(U_0 - U_{ELR})/(b_1 + b_2)/T$$

$$+(\omega - \pi t + k + t_{cr} + \alpha(r+\delta)/(1-\alpha) + n\phi - (1-\mu-\nu)\Delta p^o / \mu)/(b_1 + b_2)/T$$

The equilibrium rate of unemployment has more determinants in the medium run than in the long run, as they include all supply shocks. Empirically, the differences between the Phillips curve model and the WS/PS model are narrowed, as the determinants of the medium run ERU in the Phillips curve model are the same as those of the long run in the WS/PS model. The difference between the two models lies in the determination of the long run.

A numeric example:

Let's assume that *b* is equal to 0.5 on a yearly basis and *T* is equal to 2 years. Let's assume that the employer's social contribution rate is raised by 1 point at the beginning of the first year.

When there is no hysteresis, the impact on the medium run ERU can be estimated in two ways. The first way is to consider that the medium run ERU has raised by 1 point over the 2 years. This method has the advantage and drawback to be determined *ex ante*: it is independent on the economic policy actually implemented by the authorities. The authorities

are implicitly assumed to correct a gap after a shock in 8 trimesters. We use this method in our empirical part. In the second method, the difference between the medium and the long run equilibrium rate of unemployment is measured each quarter by the difference between the actual real wage and the equilibrium real wage divided by $b_1 T$ (1 in the example). In this case, authorities are implicitly assumed to correct one eighth of the gap each quarters.

After a shock of employer's social contributions (a 1 percentage point increase), the unemployment rate must rise by 2 points in 2 years to meet the equilibrium (table 1). Inflation and the gap between the real wage (including social contributions) and the available real wage are progressively reduced.

1. Impact of an increase of the employer's social contribution of 1 percentage point

	T1	T2	T3	T4	T5	T6	T7	T8	T9
U	1	1	1	1	1	1	1	1	0
Δp	0.584	0.5	0.417	0.334	0.251	0.168	0.083	0.0	0.0
Δw	0.167	0.417	0.334	0.251	0.168	0.083	0	-0.083	0.0
Gap	0.583	0.5	0.417	0.334	0.251	0.168	0.083	0.0	0.0

$$\Delta w = 0.5\Delta p + 0.5\Delta p_{-1} - 0.125U$$
$$\Delta p = 0.5(\Delta w + \Delta t_{cr}) + 0.5(w + t_{cr} - p)_{-1}$$

Hysteresis doesn't significantly alter the results (table 2). Inflation is lower. The real wage gap is less wide during the adjustment process, but it is compensated at the end of the adjustment.

2. Impact of an increase of the employer's social contribution of 1 point with hysteresis

	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10
U	1	1	1	1	1	1	1	1	0	0
Δp	0.500	0.4170	0.334	0.250	0.167	0.083	0.0	-0.083	0.0	0.0
Δw	0.000	0.334	0.250	0.167	0.083	0.0	-0.083	-0.167	0.083	0.0
Gap	0.5	0.417	0.334	0.250	0.167	0.083	0.0	-0.083	0.0	0.0

$$\Delta w = 0.5\Delta p + 0.5\Delta p_{-1} - 0.125U - 0.125\Delta U$$
$$\Delta p = 0.5(\Delta w + \Delta t_{cr}) + 0.5(w + t_{cr} - p)_{-1}$$

In this specification, the mark-up comes back to its initial value after 2 years. However, firms don't recover the profit losses during the period. This would be the case if the price setting incorporated a target of indebtedness.

Part 2. Testing the impact of institutional variables in an asymmetric wage-price setting

2.1. Presentation of the estimated wage-price setting

The wage-price setting model we have estimated is made of three equations. Results are presented in the annex for six countries (the United States, Germany, France, the United Kingdom, Spain and the Netherlands).

The wage-price setting is assumed asymmetric as in the model previously developed. The wage equation is defined as a traditional Phillips curve (see below for the description of the variables):

$$(2.1) \qquad \Delta w = c_1 + a(L)\Delta p_c - b_1 U - b_2(U - U_l) + d(L)\Delta\pi + e(L)\Delta(p_V - p_c) - f(L)\Delta t_{cr} + \sum_{w=1}^{n} \alpha_w Zk_w$$

The consumer price equation is a linear function of the value added price and of the import price:

$$(2.2) \qquad \Delta p_c = n_1(L)\Delta p_V + n_2(L)\Delta p_I$$

The value added price setting results from a profit maximization in an imperfect competitive market. Firms have a desired price level determined as a mark up over labor and capital costs[7] (Debonneuil and Sterdyniak (1984)):

$$(2.3) \qquad P_d = \left(\beta_1 . \frac{W.(1+T_{\text{cr}})}{\Pi} + \beta_2 . \frac{UCC}{Y} + \beta_3 . T_{INV} \right)$$

and the adjustment process of prices follows a constrained Error Correction Model (ECM):

$$(2.4) \qquad \Delta p_V = \beta(L)\Delta p_d - \mu(p_{V_{-1}} - p_{d_{-1}}),$$

the equation (2.4) being estimated by replacing p_d by its specification in (2.3).

7. In our empirical model, we test the impact of the interest rates only via the price equation. However, because of capital-labor substitution, this effect could transit via the labor demand equation (equation (1.11) in our theoretical model). Moreover, we did not test the influence on prices of the firm indebtedness ratio as suggested in equation (1.2 quater). These are two possible extensions of our empirical work.

where:

Π: business sector (hourly or per capita) labor productivity

L: lag operator

P_c: consumer price level

P_d: firm's desired price level

P_I: import price level

P_V: value added price level

T_{cr}: employer's social security rate.

T_{INV}: ratio between the investment in the business sector (excluding housing) and the volume of value added in the business sector.

U: unemployment rate

U_l: trend unemployment rate

UCC: net financial costs in the business sector

W: business sector nominal (hourly or per capita) wage,

Zk_w: potential other variables influencing the wage setting process (union power, replacement ratio, mismatch, employee social contribution, etc...)

In order to eliminate the simultaneity bias, equations (2.1), (2.2) et (2.4) have been estimated with Non Linear Three Stage Least Squares method. Equation (2.3) is incorporated in equation (2.4). In the case of the European countries, we use the data before the revisions of the National Accounts except in the case of the United-Kingdom. The estimation period is as far as this is possible 1970 - late 1990's. The data for Germany refer to West Germany.

First, we estimate the wage-price setting using the standard Phillips curve used in most French macroeconomic model (Economie et Prévision (1998)) (table A-1). In a second step, we estimate the wage-price setting using alternative specifications for the wage setting, in order to test the influence of institutional variables. The institutional characteristics we have tested are often mentioned in the literature (OECD (1994, 1997); Layard *et al.* (1991)): the average unemployment benefit replacement ratio, the trade union membership density, the number of days lost because of strikes and when existing the minimum wage. The existence of hysteresis phenomena has been tested through the effect of the long term unemployment on the wage setting process. Finally, we tested non linearities of the Phillips curve[8].

8. We also tested the impact of unemployment rates by sex, age, qualification and region in order to test insider or mismatch phenomena. We did not find any robust results.

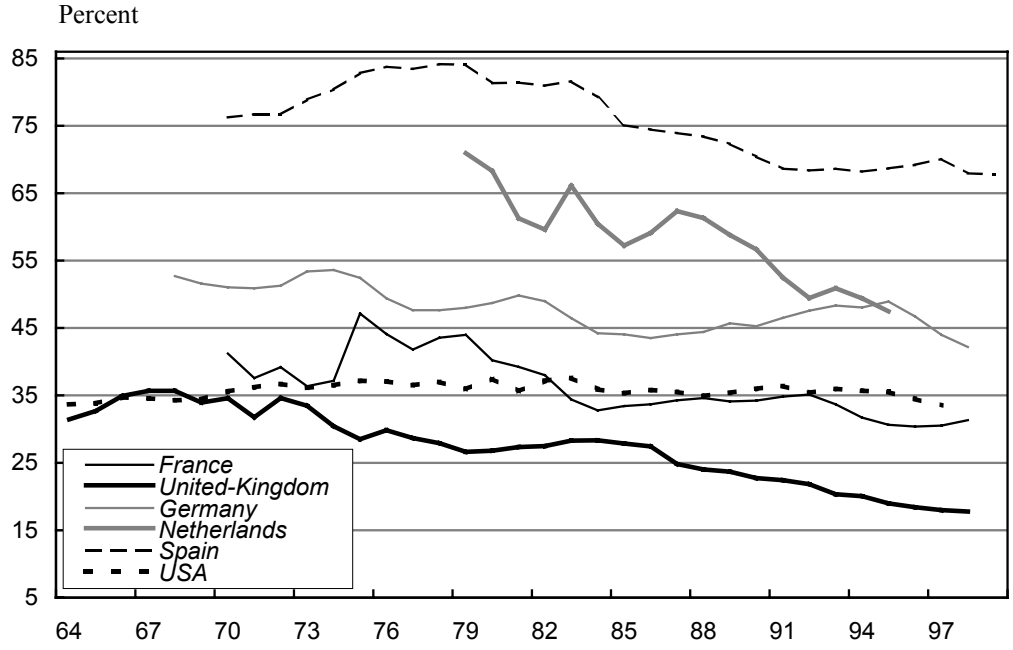
2.2. The evolution of some institutional variables

Some of the institutional variables, we tested here, have been varying significantly over the last thirty years. So, if they play a significant role over the wage-setting, we can expect econometric significant results.

The ***replacement ratios*** are estimated as the ratio of the unemployment benefits (assistance and insurance) to the average per head wage in the business sector. These do not include minimum income benefits or other social benefits that are not related to a former work, as our approach refers more to macro-economic bargaining models than to micro-economic labor supply models. As a consequence, our replacement ratio calculations differ from those of the OECD (1994) that conclude to an increase of the French replacement ratio until the middle of the 1980's.

In most countries, the replacement ratio has decreased since the mid seventies (see graph 2.1). The American replacement ratio is the most stable but also the lowest at the beginning of the period. In France, between 1979 and 1995, it has decreased of about 30%. A similar decrease was observed in Spain and in the United Kingdom. At the end of the 1990's, the French unemployment benefit system would be less generous than in the United States.

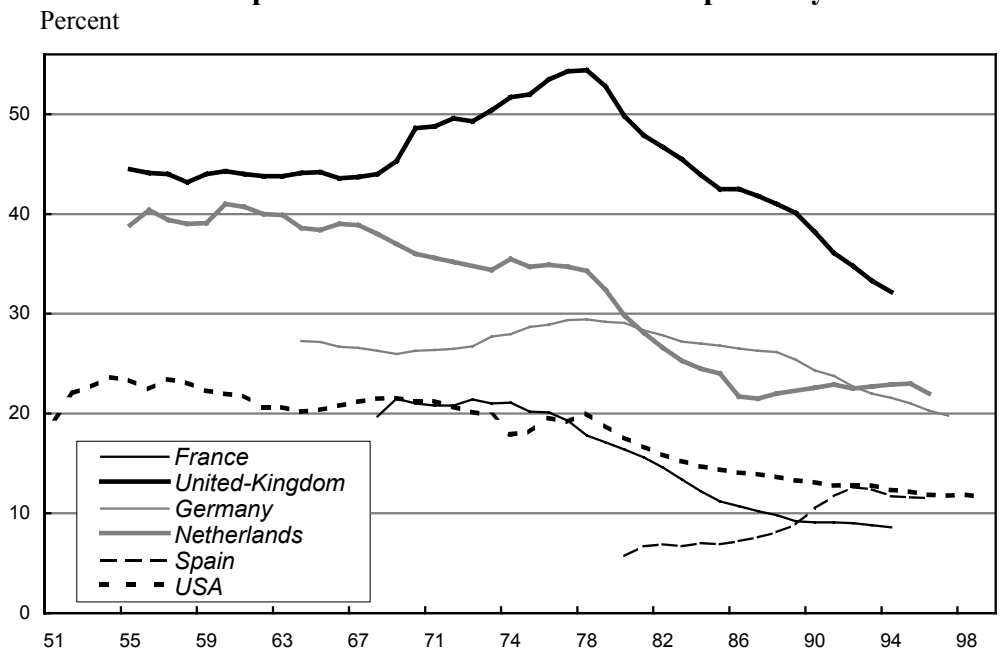
Graph 2.1 – Replacement ratios



Sources: National statistical offices, calculation of the authors.

In most countries, the **trade union membership density** has sharply declined since the mid-seventies (see graph 2.2), except in Spain where the end of the Franco period has led to an increase of the membership density until 1993.

Graph 2.2 – Trade Union membership density



Sources: Ebbinghaus and Visser(2000).

2.3. MAIN EMPIRICAL RESULTS

2.3.1. Hysteresis (table A-2)

The presence of hysteresis has been tested under two specifications. The first one consists of testing directly the influence of the short term unemployment rate versus the long term unemployment rate where the unemployment duration is respectively inferior and superior to one year. In the second one, the impact of a polynomial structure of the unemployment rate on the wage setting is tested in addition to the current unemployment rate. In this case, we test the respective significance of U and of $CD1 = U - \sum_{i=1}^{n} \lambda_{-i} U_{-i}$, with $\sum_{i=1}^{n} \lambda_{-i} = 1$.

In presence of hysteresis, in the first test, we expect that the long term unemployment has no effect on the wage setting and that the coefficient of the short term unemployment is high and significant. In the second test, in case of partial hysteresis, we expect that both coefficients (U and $CD1$) are negative and significant. In presence of full hysteresis, we expect that the coefficient of U is not significant. As in other empirical studies, the results of the tests are not very conclusive (Elmeskov and Mac Farlan (1993)). Germany is the only country where the direct test of the impact of the short term unemployment rate provides conclusive results. No hysteresis is detected in France, Netherlands, the United-States and in Spain. In the United-Kingdom, a full hysteresis is detected.

2.3.2. Non linearity (table A-21)

A log linear specification of the wage setting implies that the Phillips curve is convex. The main implications of the convexity of the wage equation are that economic policies inducing a high volatility of the business cycle are costly in terms of unemployment. This rate can lie above the ERU, as the cost of reducing inflation is higher than the benefits of a lower unemployment rate (Clark and Laxton, 1997).

A non linear Phillips curve specification is accepted in three countries (Germany, France and Netherlands). But the results for France are weak and lead to no improvements of the equations in Germany. The Netherlands is the only country where a non linear specification improves the equation.

2.3.3 Employer's social contribution rate and minimum wages (table A-3)

According to our estimations, in some countries, employers manage to obtain a wage moderation after an increase of the employer's social contribution (Germany, Spain, France and the United-Kingdom). So employees pay a part of this increase by a decrease of their real wage. This effect has an influence on the ERU, as the decrease of the available real wage induced by an increase of the social contribution rate is partly directly paid in terms of lower wage increases. This wage moderation would be rather modest in Germany and France compared to Spain and the United-Kingdom. The integration of employer's social contribution rate improves the results in two cases: the United-Kingdom and Spain.

No impact of the employee's social contribution rate or of the income tax rate were found. They are therefore entirely paid by employees. This result of non homogeneity of the impact of the tax wedge on gross wages is in opposition to the WS/PS models[9].

Among the countries under review, France, Spain, the Netherlands, the United-States and the United-Kingdom have a minimum wage. In the United-Kingdom, its creation is too recent to be tested. We tested the influence of the variation of the purchasing power of the minimum wage. It is only significant in France and in the Netherlands and the effects are of the same magnitude: one percentage point increase of the minimum wage leads to an increase of 0.1 point of the nominal wages. This result is standard in the case of France. In the case of the Netherlands, the presence of the minimum wage alters the significance of other variables.

2.3.4. Wage bargaining variables (table A-4)

The United-Kingdom is the only country where an effect of either the *level* of the replacement ratio or the *level*[10] of the trade union membership density can be observed.

9. WS/PS models often test the impact on wages of the "wedge" defined as the difference between the real labor cost paid by employers and the after-tax real consumption wage received by employees. In most studies, a restriction of homogeneity of the impact of the tax wedge components on the real wage is imposed (for instance, Layard et al. (1991), L'Horty and Sobczak (1997) or L'Horty and Rault (1999, 2001)). As far as we know, only Tyrväinen (1995) tests this restriction.

10. In WS/PS model, wage bargaining variables are specified in level. As far as we know, Fabiani *et al.* (1997) is the only study, with ours, that directly tests institutional variables in a Phillips curve. These authors specify the replacement ratio and strikes in variation which, to a certain extend, respect the WS/PS framework. We tested both specifications. Institutional variables in level in a Phillips curve may explain structural evolutions in the wage bargaining system. The higher the trade union membership density and the replacement ratio are, the higher the bargaining power of workers is: the trade union membership density reflects the level of organization of workers and a worker can refuse a job offer more easily if the replacement ratio is high. On the other hand, the replacement ratio in variation in a Phillips curve reflects that the replacement income growth is taken as a wage growth target by employees, whereas the interpretation of the trade union membership density or strikes in variation is not very logical.

However, because of multicollinearity problems, it is not possible to have simultaneously both variables in the wage equation. The integration of the trade union membership density leads to better results. The Netherlands is the only country where the *variation* of the replacement ratio has an impact on wages as in Broer *et al.* (1999). It is also a country where the replacement ratio, very high at the beginning of the period, has been significantly reduced.

2.3.5. Synthesis of the results

As in other empirical studies, our results show that it is difficult to proof the effect of *temporal changes* of institutional variables on wages (Blanchard and Wolfers (2000)). Recent empirical studies concluding in favor of the role of institutional variables (Fitoussi and Passet (2000), Fitoussi *et al.* (2000), Cadiou, Guichard and Maurel (1999)) use pooled country data and are hence not very useful for providing estimations of the impact of institutional variables on wages and hence on the ERU (Richardson, Boone *et al.* (2000)). However, they underline the complex link between institutional features and unemployment that cannot be captured by a simple integration of variables, such as the trade union membership density or the number of days lost because of strikes. For example, the trade union density membership gives no information about the level of co-ordination of the trade unions, which according to some empirical studies, may have a negative influence on the unemployment level, but a positive one on the persistence of the unemployment (Fitoussi and Passet (2000)).

Taking a closer look at the bargaining systems of the countries we have studied, a few remarks can be made. In Spain and in Germany, no major changes occurred in the bargaining system over the period under review. The bargaining system in Germany is centralized and co-ordinated. In Spain, there has been no constant wage co-ordination since the return of democracy. Tri-partite agreements including wage moderation have played a role in different periods of time (mid eighties, early nineties), through pay growth bands, but in the late eighties trade unions obtained wage increases above the inflation (Ebbinghaus and Visser (2000)). In the Netherlands and in France, wage moderation has become a strategy against inflation since the beginning of the eighties. In the United-Kingdom, the numerous laws against the power of the trade unions and in favor of the decentralization of wage negotiations (the *employment acts* in 1980, 1982 and 1988, the *trade union acts* in 1984 and 1992, the

wage act in 1986[11]) may instead have had concrete consequences on the wage bargaining. This could explain why this country is the only one where wage bargaining variables are significant in our estimations.

Part 3. Estimations of medium and long run equilibrium unemployment rate using an asymmetric wage-price setting model

3.1. The main assumptions

A lot of attempts to define different time horizon ERU can be found in the literature (for example, Mellis and Webb (1997) or Richardson, Boone *et al.* (2000)). However, these definitions rely more on technical considerations than on theoretical foundations. For instance, according to Richardson, Boone *et al.* (2000), the concept of "short-term NAIRU" corresponds "to the value of unemployment which stabilizes inflation over two consecutive periods" (p.35). The calculation of such a ERU generally give extremely erratic series dependant on the frequency used. Moreover the economic interpretation of such series is difficult since there is no reason for a shock to be absorbed in one period.

By focusing on inflation stability, proposed time horizon ERU definitions are often disconnected from the notion of macroeconomic equilibrium. They generally explain differences between the medium and the long run ERU with temporary shocks and inertia phenomena, but the link between the different ERU is vague and does not rely on hypotheses relative to the reactions of the economic authorities. In some studies (Richardson, Boone *et al.* (2000)), the way that the medium run ERU converges to its long run path is omitted, in some others (Mellis and Webb (1997)), this convergence follows an *ad hoc* dynamic through the introduction of the past unemployment rate.

Assuming that the wage-price setting are asymmetric allows to distinguish between a medium run and long run ERU based on a clear theoretical definition.

11. See Brown and Wadhwani (1990), Freeman and Pelletier (1990) or Edwards *et al.* (1998).

In the long run, we suppose that the growth rates of price set by firms and of their costs are the same. There is no temporary shocks affecting wages or long lasting shocks affecting the level of desired prices. Equations (2.1) to (2.4) can be simplified:

(3.1) $$\Delta w = c_1 + a(1)\Delta p_c - b_1 U + d(1)\Delta\pi + e(1)(\Delta p_V - \Delta p_c)$$ [12]

(3.2) $$\Delta p_c = (n_1(1) + n_2(1))\Delta p_V$$

(3.3) $$\Delta p_V = \Delta w - \Delta\pi$$

If $n_1(1) + n_2(1) = 1$, the long run ERU is:

(3.4) $$U_{ELR} = \frac{c_1 - (1 - a(1))\Delta p^o - (1 - d(1))\Delta\pi}{b_1}$$

If a(1) is not equal to 1, as it is the case here for France, the inflation-unemployment trade-off does not disappear in the long run. The ERU depends on the inflation target Δp^o of the central bank.

Because the value added price equation is not super-neutral, in the long run, the actual mark up of firms is a decreasing function of the inflation target:

(3.5) $$p_V - p_d = -\frac{1 - \beta(1)}{\mu}\Delta p^o$$

Rewriting equation (2.2), gives the following equation (if the hypothesis $n_1(1) + n_2(1) = 1$ is not rejected):

(3.6) $$p_c = c_2 + n_1(1)\, p_V + (1 - n_1(1))\, p_I$$

Rearranging equations (2.3), (2.4), (3.5) and (3.6) gives the *available real wage*:

(3.7) $$(w - p_c)^d = \pi - t_{cr} + \frac{1 - \beta(1)}{\mu}\Delta p^o - n_2(1)(p_I - p_V) - F(T_{INV}) - \log(\beta_1) - c_2$$

where

12. a(1) is the long run coefficient: $a(1) = \sum_{L=0}^{l} a(L)$.

$F(T_{INV}) = \log\left(1 + \frac{\Pi\beta_3}{\beta_1 W(1+T_{cr})} T_{INV}\right)$ is a measure of the investment effort[13].

Any shock that widens the gap between the real wage and the available real wage affects the medium run ERU:

(3.8) $$U_{EMR} = U_{ELR} + \frac{(w-p_c)-(w-p_c)^d}{b_1 T}$$

As explained in the paragraph 1.6 of the part 1, authorities are implicitly assumed to correct the gap caused by the shock in 8 quarters, so that T is equal to 8 and the empirical estimation of the medium run ERU is given by:

(3.8 bis) $$U_{EMR} = U_{ELR} - \frac{1-\beta(1)}{\mu b_1 T}\Delta\Delta p^o + (1-f(1))\frac{\Delta t_{cr}}{b_1 T} + \frac{\Delta F(T_{INV})}{b_1 T} + (1-\alpha_1(1))(a(1)-e(1))\frac{(\Delta p_I - \Delta p_V)}{b_1 T}$$

In order to capture the effects of the trend investment effort, the variable $F(T_{INV})$ has been smoothed over with a HP filter. The inflation target is supposed to be equal to the trend inflation calculated with a HP filter. Other shocks are fixed at their average level over the last eight quarters, which is consistent with the hypothesis that authorities correct the shocks in eight quarters: one eighth of the shock is corrected in one quarter. The equations we use are those presented in the tables A.5, B and C of the annex.

In presence of partial hysteresis (case of Germany), an additional term is incorporated in the medium run ERU:

(3.9) $$\frac{b_2(U-U_{ELR})}{(b_1+b_2)T}$$

which captures the speed limit effects that affect the convergence of the unemployment rate towards the long run equilibrium rate of unemployment. In the case of full hysteresis, as it is the case for the United-Kingdom, our structural model does not allow to estimate an ERU.

13. As in none of the six countries an effect of the financial costs was found.

3.2. The ERU estimations

The medium and long run ERU for the six countries are shown in the graphs (3.1) to (3.5). In order to identify separately the effect of shocks, three ERU are represented: UEL represents the long run ERU, UEM1 is the medium run ERU excluding the inflation target effects, UEM2 is the medium run ERU that incorporates all shocks (hence including the variation of the inflation target).

As expected, the slowdown of productivity growth since the mid seventies has led to an increase of the long run ERU in European countries (a little more than five percentage points in France between 1970 and 1998, more than 15 points in Spain, 4.5 points in the Netherlands, but less than one point in Germany, where the productivity slowdown was stopped during the eighties). On the other hand, it is quite stable in the United-States, at an average standard level of 5%. In the case of France, the long run ERU incorporates the trend variation of the purchasing power of the minimum wage. The effect of the minimum wage has progressively declined over the period. In the first half of the 1970's, it induced an increase of 1 percentage point of the ERU whereas the impact is only of 0.25 point in the late 1990's.

The inclusion of shocks and of the variations of the inflation target leads to substantial gaps between the long run and the medium run ERU in most countries in the seventies and especially in the first half of the eighties. The gap in the seventies is explained by the first oil shock and the increase of employer's social contribution rate that followed the first oil shock. The sharpest increase of the employer's social contribution rate has been observed in Spain, but its effect on the medium run ERU has been partly compensated by the fact that it is partly paid by the employees according to our estimations. Because of the non linear specification of the wage equation, the unemployment cost of the shocks is the biggest in the Netherlands, albeit the relative import prices variations were similar to the other countries (the first oil shock has induced an increase of around 3% of the relative prices, the second oil shock an increase of 2%).

In most countries, except in Spain and to a smaller extend in Germany, the change in the inflation target of the monetary authorities achieved by higher real interest rates at the beginning of the eighties explains nearly all the increase of the unemployment rate of that period.

In all countries, the medium run ERU was near to the long run ERU and to the actual

unemployment rate in the late eighties, following the counter oil shock of 1986 and the recovery of the second half of the eighties. The nineties are characterized by somehow different evolutions. In the United-States, the sharp decrease of the employer's social contribution rate, but also the improvement of the terms of trades have allowed a sharp decline of the medium run ERU until 1997, so that the decrease in inflation was mainly explained by identified favorable supply shocks. On the other hand, in European countries – except for Germany –, the medium run ERU lies close to the long run ERU. Therefore the gap between the actual and the long run ERU results from the effects induced by the restrictive economic policies conducted to achieve the monetary union.

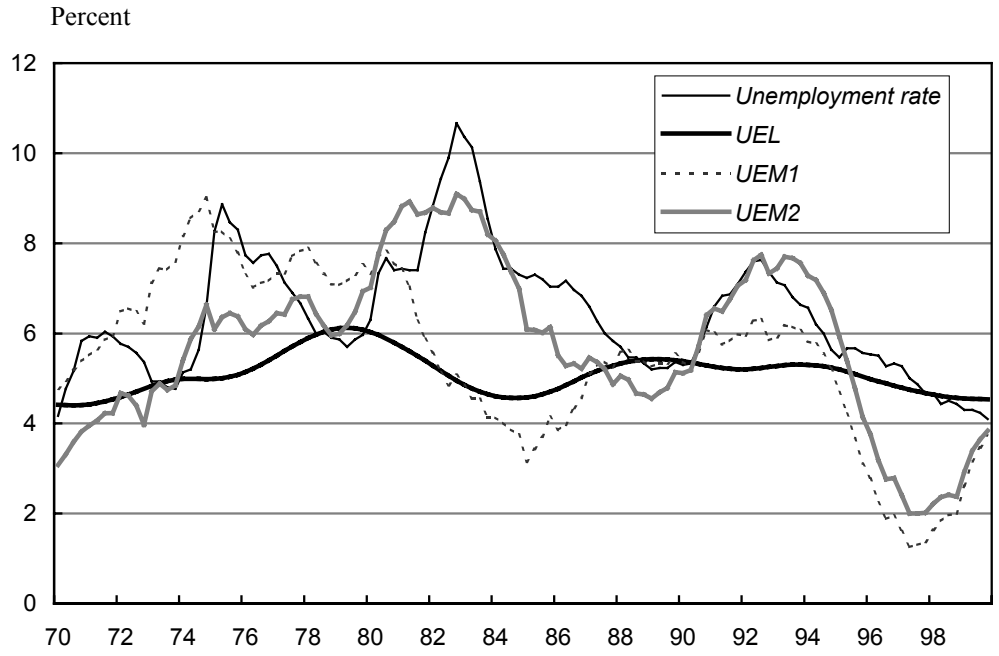
The case of Germany is specific. Because of a very sluggish price adjustments and the presence of hysteresis – which leads to lower responsiveness of wages to the level of unemployment –, the medium run ERU is highly sensitive to supply shocks. Another particular feature of Germany is that it had the lowest gap between the actual unemployment and the medium run ERU in 1994 (one percentage point), because of the negative supply shocks induced by the financial cost of the reunification. We capture this shock through the increase of the employer's social contribution rate.

Concluding remarks

This paper had one theoretical objective and two empirical objectives. The first was to distinguish in a Phillips curve based model between the long run ERU and the medium run constraint that supply shocks impose to the path of the unemployment rate. The first empirical objective was to test the impact of institutional variables in an asymmetric wage-price setting. In contrast to most of the TV-NAIRU reduced approaches[14], our approach provides explanations to the evolutions of the unemployment rate within an explicit structural model. As in other studies, the empirical results concerning the impact of institutions are not very conclusive. The second empirical objective was to estimate long run and medium run ERU based on a clear theoretical definition. Even if our estimations do not reveal the direct impact of the interest rate, our medium run ERU calculations intercept relatively well the increase of the unemployment rate due to the restrictive monetary policy of the first part of the eighties. They also show a clear excess supply in most European countries in the nineties.

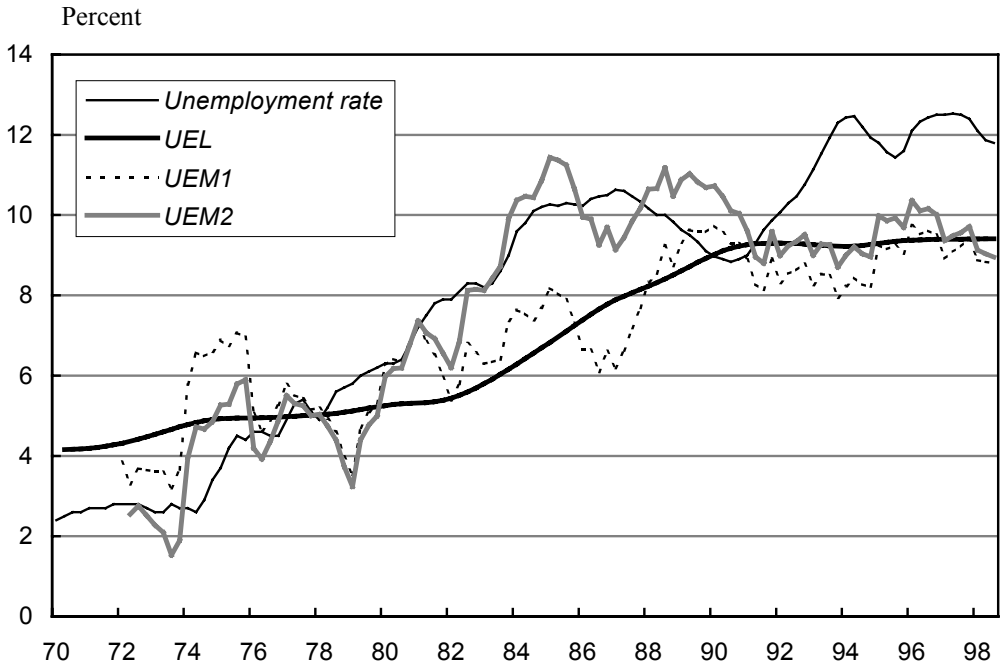
14. See Gordon (1997) and Richardson, Boone *et al.* (2000).

Graph 3.1 – United-States



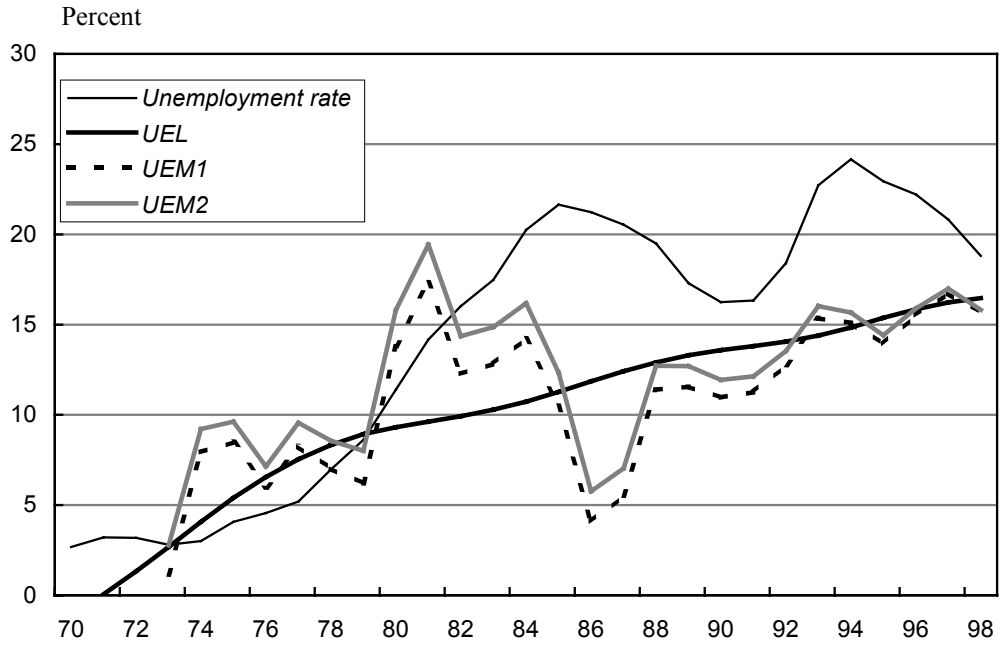
Sources: calculation of the authors, BLS.

Graph 3.2 – France



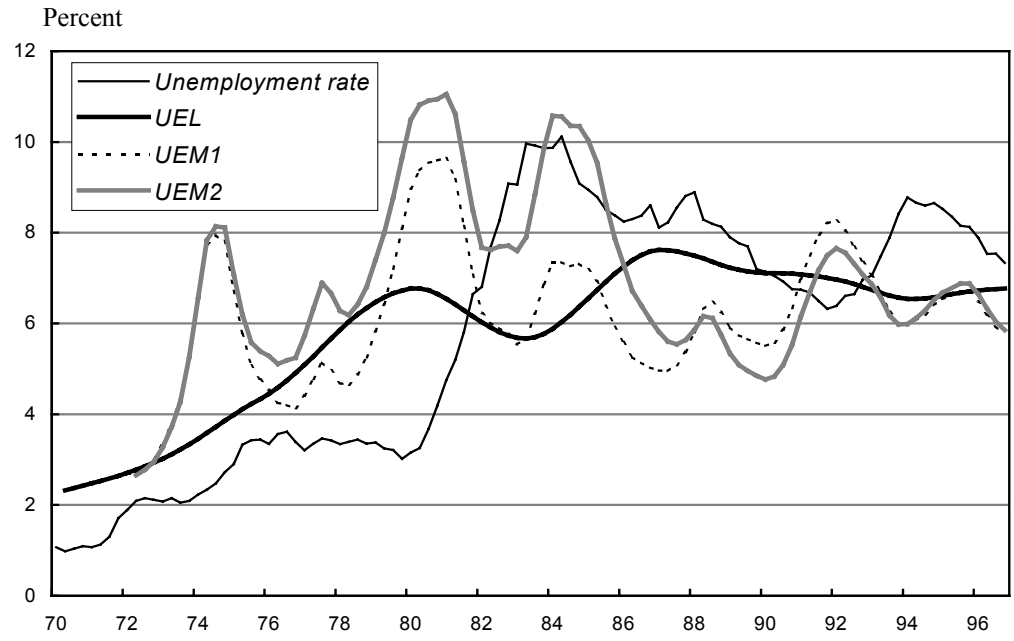
Sources: calculation of the authors, INSEE.

Graph 3.3 – Spain



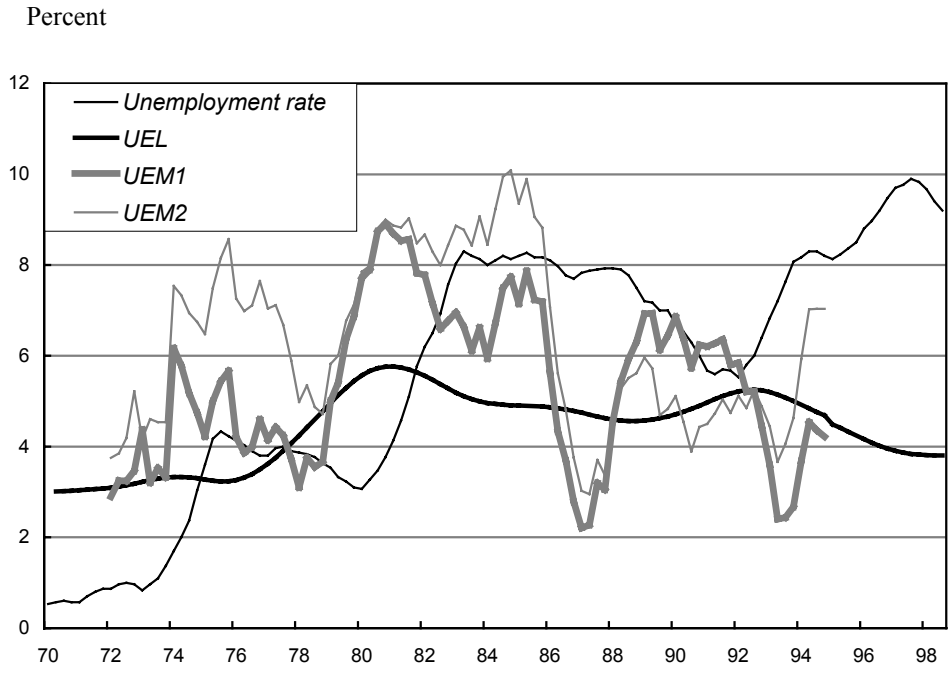
Sources: calculation of the authors, INE.

Graph 3.4 – Netherlands



Sources: calculation of the authors, CBS.

Graph 3.5 – Germany



Sources: authors' calculation, Statistiches Bundesamt.

References

Bean C. (1994), "European unemployment: a survey", *Journal of Economic Literature*, Vol. XXXII, pp. 573-619.

Belot M. and J. C. Van Ours (2001), "Unemployment and labor market institutions: an empirical analysis", University of Tilburg, *Discussion paper*, n° 2001-50.

Blanchard O. and L. F. Katz (1997), "What We Know and Do Not Know About the Natural Rate of Unemployment", *Journal of Economic Perspectives*, vol. 11, n° 1, winter.

Blanchard O. and L. F. Katz (1999), "Wage Dynamic: Reconciling Theory and Evidence", *NBER Working Paper Series*, n° 6924, February 1999.

Blanchard O. and J. Wolfers (2000), "The Role of Shocks and Institutions in the Rise of European Unemployment: the Aggregate Evidence", *The Economic Journal*, vol. 110, pp.1-33, March.

Blanchard O. J. and L. H. Summers (1986), "Hysteresis and the European Unemployment", *NBER Macroeconomics Annual*, Stanley Fischer ed., vol. 1, Fall 1986, Cambridge: MIT Press, pp. 15-78.

Broer P., N. Draper and F. Huizinga (1999), "The equilibrium rate of unemployment in the Netherlands", Central Plan Bureau, *Research Memorandum*, n° 156.

Brown W. and S. Wadhwani (1990), "The economic effects of industrial relations legislation since 1979", *National Institute Economic Review*, n° 131, pp. 57-70.

Bruno M. and J. Sach (1985), *The economics of Worldwide Stagflation*, Basil Blackwell, Oxford.

Burda M. and M. Weder (2001), "Complementarity of Labor Market Institutions, Equilibrium Unemployment and the Propagation of Business Cycles", University of Berlin, National Research Center, *Working Paper*, n° 49.

Cadiou L., S. Guichard and M. Maurel (1999), "La diversité des marchés du travail en Europe: Quelle conséquences pour l'Union Monétaire", *CEPII Working Paper*, n° 99-11, June.

Cahuc P. and A. Zylberberg (1996), *Economie du travail: La formation des salaires et les déterminants du chômage, Bruxelles*, De Boeck.

Calmfors L. and J. Driffill (1988), "Bargaining structure, corporatism and macroeconomic performences", *Economic Policy*, vol. 60, pp. 163-195.

Clark P. B. and D. Laxton (1997), "Phillips curves, Phillips Lines and unemployment Costs of Overheating", *IMF Working Paper*, n°97/17, Washington.

Cotis J.-P., R. Meary and N. Sobczak (1996), "Le chômage d'équilibre en France: Une évaluation", *Direction de la Prévision Working Paper*, n° 96-14.

Debonneuil M. and H. Sterdyniak (1984), "La boucle prix-salaires dans l'inflation", *Revue économique*, vol. 35, n° 2, March.

Den Haan W. J., C. Haefke and G. Ramey (2001), "Shocks and Institutions in a Job Matching Model", University of California, *Discussion Paper*, n° 2001-14.

Ebbinghaus B. and J. Visser (2000), *Trade Unions in Western Europe since 1945*, Macmillan.

Economie et Prévision (1998), « Structure et propriétés de cinq modèles macroéconomiques français », *Economie et Prévision*, n° 134.

Elmeskov J. and M. MacFarlan (1993): "Persistance du chômage*", OECD Economic Review,* n° 21, winter, Paris.

Edwards P., M. Hall, R. Hyman, P. Marginson, K. Sisson, J. Waddington and D. Winchester (1998), "Grait Britain: From Partial Collectivism to Neo-Liberalism to Where?", *in* Ferner A. and R. Hyman eds., *Changing Industrial Relations in Europe*, Oxford: Basil Blackwell, pp.1-54.

Fabiani S., A. Locarno, G. P. Oneto and P. Sestito (1997), "NAIRU: Incomes Policy and Inflation", *OECD Economics Department Working papers*, n° 187.

Fitoussi J.-P. and O. Passet (2000), *Réduction du chômage, les réussites en Europe*, Rapport du CAE, La documentation française.

Fitoussi J.-P., D. Jestaz, E. S. Phelps and G. Zoega (2000), "Roots of the Recent Recoveries: Labor Reforms or Private-Sector Forces?", *Brookings Papers on Economic Activity*, n° 1.

Freeman R. and J. Pelletier (1990), "The Impact of Industrial Relations Legislation on British Union Density", *British Journal of Industrial Relations*, n° 28(2), pp. 143-64.

Gordon R. J. (1997): "The Time-varying *NAIRU* and its Implications for Economic Policy", *Journal of Economic Perspectives*, vol. 11, n° 1.

Layard R., S. Nickell and N. Jackman (1991), *Unemployment, Macroeconomic Performance and the Labour Market*, Oxford University Press.

L'Horty Y. and C. Rault (1999), "Les causes du chômage en France: Une ré-estimation du modèle WS-PS", *CSERC Working papers*, n° 99-01.

L'Horty Y. and C. Rault (2001), "Why is French Unemployment so high: an Estimation of the WS-PS model", University of Evry, *Document de recherche de l'EPEE,* n° 01-18.

L'Horty Y. and N. Sobczak (1996), "Identification de la courbe de salaire et déterminants du chômage d'équilibre dans un modèle de négociation salariale"*, Direction de la Prévision Working Paper,* n° 96-7

L'Horty Y. and N. Sobczak (1997), "Les déterminants du chômage d'équilibre: estimation d'un modèle WS-PS sur données trimestrielles Françaises", *Economie et Prévision*, n° 127, pp. 101-117.

Lindbeck A. (1993), *Unemployment and Macroeconomics*, The MIT Press, Cambridge.

Lipsey R. (1960), "The Relation Between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957: A further analysis", *Economica*.

Manning A. (1993), "Wage bargaining and the Phillips Curve: The indentification and specification of aggregate wage equations", *The Economic Journal*, n° 103, January, pp.98-118.

Mellis C. and A. E. Webb (1997), "The United Kingdom NAIRU: concepts, measurement and policy implications", *OECD Economics Department Working papers*, n° 144.

OECD (1994), "Le chômage et les prestation sociale », *L'étude de l'OCDE sur l'emploi*, vol. 2, Paris.

OECD (1997), "Négociation collective et performance économique" in *Perspective de l'emploi*, July 1997.

Passet O. and D. Jestaz (1998), *Flexibilité et performances comparées des marchés du travail dans les pays de l'O.C.D.E*, Institut de Recherche Economiques et Sociales.

Pisani-Ferry J. (2000), *Plein emploi*, Rapport du CAE, La documentation française.

Richardson P., L. Boone, C. Giorno, M. Meacci, D. Rae and D. Turner (2000), "The concept, policy use and measurement of structural unemployment: estimating a time varying NAIRU across 21 OECD countries", *OECD Economics Department Working Papers,* n° 250.

Samuelson P. A. and R. M. Solow (1960), "Analytical Aspects of Anti-Inflation Policy", *American Economic Review*, May.

Sargan J. D. (1964), "Wage and prices in the United Kingdom: a study in Econometric methodology" *in* Hart P., G. Mills and J. K. Whittaker ed, *Econometric Analysis for National Economic Planning*, London, Butterworths.

Soskice D. (1990), "Wage determination: the changing role of institutions in advanced industrialized countries", *Oxford Review of Economic Policy*, vol. 6, pp. 36-61.

Sterdyniak H., H. Le Bihan, P. Cour and H. Delessy (1997), "Le taux de chômage d'équilibre, anciennes et nouvelles approches", *Revue de l'OFCE*, n° 60, January.

Tyrväinen T. (1995), « Real wage resistance and Unemployment: Multivariate Analysis of Cointegration Relations in 10 OECD countries », *OECD Jobs Study Working Paper Series*, n° 10.

Annex - Results of the wage-price setting estimation

A.1. - "Standard" wage equation

Country	c_1	a(L)		b_1	b_2	d(L)		e(L)		Dummies	Statistics		
		L				L		L			R^2	SEE	DW
Germany	0.0069	0	1.02	-0.38	-0.66	0	0.51		0.32	D84:2 D84:3	0.64	0.73%	2.18
Quart.: 70:1-94:4	(**1.7**)		(4.17)	(2.25)	(1.88)	1	(5.51)		(2.58)				
Germany	0.007	0	1**	-0.38	-0.65	0	0.51		0.32	D84:2 D84:3	0.64	0.73%	2.18
Quart.: 70:1-94:4	(4.09)			(3.62)	(2.16)	1	(5.5)		(2.6)				
USA	0.0077	0	1.04	-0.492	_	0	0.522		_	_	0.57	0.46%	1.69
Quart.: 70:1-99:4	(3.3)	6	(11.6)	(3.2)		6	(3.2)						
USA	0.0077	0	1**	-0.454	_	0	0.4972		_	_	0.57	0.46%	1.69
Quart.: 70:1-99:4	(3.3)	6		(3.4)		6	(3.2)						
France	0.022	1	0.769	-0.687	_	0	0.159		_	D82:1-82:2	0.93	0.34%	**0.97**
Quart.: 70:1-98:3	(11.1)	3	(17)	(11.8)		2	(2.2)			D82:3			
NLD	0.0086	0	0.865	-0.375	_	4	0.187		_	_	0.63	0.7%	2.11
Quart.: 70:1-96:4	**(1.65)**	2	(3)	**(1.7)**		7	(2.1)						
NLD	0.0054	0	1**	-0.242	_	4	0.168		_	_	0.6	0.72%	2.14
Quart.: 70:1-96:4	(2.74)	2		(2.22)		7	(1.93)						
UK	0.0099	0	0.945	-0.159	_		_		_	Drevenu[1]	0.63	0.94%	1.78
Quart.: 70:1-99:2	(3.2)	3	(12.1)	**(1.4)**						D75:2			
UK	0.008	0	1**	-0.105	_		_		_	Drevenu[1]	0.62	0.96%	1.8
Quart.: 70:1-99:2	(4.4)	3		**(1.1)**						D75:2			

Country	c_1	a(L)		b_1	b_2	d(L)		e(L)		Dummies	Statistics		
		L				L		L			R^2	SEE	DW
Spain Ann.: 1970-1998	0.039 (4.17)	0	1**	-0.15 (2.57)	_		_		_	_	0.82	2.5%	1.7
NLD Ann.: 1970-1996	0.0196 **(1.47)**	0	1.02 (7.1)	-0.28 **(1.96)**	_	1	0.396 (2.33)		_	_	0.9	1.3%	1.39
NLD Ann.: 1970-1996	0.021 (2.5)	0	1**	-0.27 (2.35)	_	1	0.41 (2.6)		_	_	0.9	1.3%	1.39

Notations: DW: Durbin-Watson statistic; SEE: Standard Error of Estimate; centered R^2; Student statistic between brackets.
**: The restriction a(L) = 1 is not rejected.
1. Drevenu is calibrated according to the intensity of the 1970's income policies: 2 from 72: 4 to 73: 1, 0 from 73: 2 to 73: 3, – 1 from 73: 4 to 74: 2, – 4 from 74: 3 to 75: 2, 2 from 75: 3 to 76: 2, 3 from 76: 3 to 77: 2, 2 from 77: 3 to 78: 2, 1 from 78: 3 to 79: 2, and 0 otherwise.

As developed in part 2, the model consists in 4 equations. The notations are the same as the one in the text. However, here the coefficients can be negative.

(4.1) $\Delta w = c_1 + a(L)\Delta p_c + b_1 U + b_2 (U - U_t) + d(L)\Delta\pi + e(L)\Delta(p_v - p_c) + \sum_{w=1}^{n} \alpha_w Z k_w$

(4.2) $\Delta p_c = n_1(L)\Delta p_v + n_2(L)\Delta p_t$

(4.3) $P_d = \left(\beta_1 . \frac{W.(1+T_{cr})}{\Pi} + \beta_2 . \frac{UCC}{Y} + \beta_3 . T_{INV} \right)$

(4.4) $\Delta p_v = \beta(L)\Delta p_d + \mu(p_{v_{-1}} - p_{d_{-1}}) + \beta_4(L)\Delta p_t$,

A.2. - Hysteresis

Country	c_1	a(L)		b_1	B_2	d(L)		e(L)		i(L)	Statistics		
		L				L		L			R^2	SEE	DW
Germany Quart.: 77:3-94:4	0.009 (2.5)	0	1**	0.73^{LD} (1.16)	-0.93^{CD} (2.18)	0 1	0.49 (1.7)		0.66 (3.85)	_	0.66	0.6%	2.3
Germany Quart.: 77:3-94:4	0.008 (2.32	0 2	1**	-0.55^{CD} (2.01)	_	0 1	0.437 (4.06)		_	_	0.65	0.61	2.2
Germany Quart.: 70:1-94:4	0.0064 (3.47)	0 2	1**	-0.29^{U} (2.53)	-1.55^{CD1} (3.04)		0.48 (4.67)	1	0.43 (2.67)	_	0.69	0.72%	2.4
UK Quart.: 70:1-98:4	-0.026 (4.3)	0 3	0.58 (5.3)	_	-0.66^{CD1} (4)		_		_	0.105 (5.4)	0.75	0.78%	1.96

Notations: i(L): trade union membership density; CD: short term unemployment rate (less than one year); LD: long term unemployment rate (one year and more); $CD1 = U - \sum_{i=1}^{n} \lambda_{-i} U_{-i}$ avec $\sum_{i=1}^{n} \lambda_{-i} = 1$ (UK i = 20, Germany i=5), U: unemployment rate.

A.2.1. - Non linearity

Country	c_1	a(L)		B_1	B_2	d(L)		e(L)		G(L)	Statistics		
		L				L		L			R^2	SEE	DW
Germany Quart.: 70:1-94:4	-0.006 (3.8)	0	1**	-0.003^{log} (3.91)	_		0.58 (5.6)		0.31 (2.65)	_	0.61	0.76%	2.1
France Quart.: 70:1-98:3	-0.031 (10.9)	0 3	0.85 (22.6)	-0.0094^{log} (11.2)	_		0.121 **(1.8)**		_	0.0948 (2.8)	0.94	0.31%	1.14
NLD Quart:70:1-96:4	-0.019 (4.55)	0 4	1**	-0.086^{log} (5.43)	_				_	_	0.66	0.70%	2.11

Notations: g(L): minimum wage; log: log of unemployment rate.

A.3. - Wage equations with minimum wage and employer's social contribution rate

Country	c_1	a(L)		b_1	b_2	d(L)		e(L)		f(L)		g(L)	Statistics		
		L				L		L		L			R^2	SEE	DW
Germany Quart.: 70:1-99:4	0.0076 (4.43)	0 2	1**	-0.40 (3.97)	-0.40 (**1.42**)	0 1	0.57 (6.4	0	0.27 (**1.69**)	0	-0.17 (3.05)	_	0.64	0.73%	2.3
Spain Ann.: 1970-1998	0.051 (6.2)	0	1**	-0.21 (4.25)	_		_		_	0	-0.84 (4.09)	_	0.88	2.1%	1.4
France Quart.: 70:1-98:3	0.0196 (10.5)	1 3	0.794 (17.6)	-0.62 (11.2)	_		0.135 (1.9)		_	0 1	-0.329 (2.3)	0.112 (3.5)	0.95	0.3%	1.12
NLD Quart.: 70:1-96:4	0.0081 **(1.62)**	0 2	0.846 (2.71)	-0.317 **(1.5)**	_	4 7	0.187 **(1.84)**		_		_	0.123 (3.15)	0.68	0.65%	2.21
UK Quart.: 70:1-99:2	0.0094 (5)	0 3	1**	-0.177 **(1.75)**	_		_		_	0	-0.836 (2.7)	_	0.63	0.95%	1.84

Notations: f(L): employer's social contribution rate; g(L): minimum wage.

A.4. - Wage equations with wage bargaining variables

Country	c_1	a(L)		b_1	b_2	d(L)		g(L)	i(L)	$j(L)^1$	k(L)	Statistics		
		L				L						R^2	SEE	DW
UK	-0.006	0	0.607	-0.302	_		_	_	0.066^N	_	_	0.73	0.79%	1.85
Quart.: 70:1-98:4	**(1.1)**	3	(7.4)	(2.4)					(3.8)					
	0.005	0	1**	-0.144	_		_	_	0.102^V	_	_	0.63	0.95%	1.81
Quart.: 70:1-98:4	(2)	3		**(0.7)**					**(1.5)**					
	0.0086	0	0.828	-0.159	_		_	_	_	0.0116^N	_	0.69	0.87%	1.87
Quart.:70:1-98:4	(2.9)	3	(11.2)	**(1.4)**						(2.96)				
	-0.003	0	0.843	-0.134	_		_	_	_	_	0.052^N	0.68	0.88%	1.88
Quart.: 70:1-99:2	(0.5)	3	(8.4)	**(1.2)**							(3)			
NLD	0.021	0	1**	-0.23	_	1	0.29	_	_	_	0.27^V	0.91	1.2%	1.44
Ann.: 1970-1996	(2.6)			(2.2)			(1.86)				(1.8)			

Notations: g(L): minimum wage ; i(L): trade union membership density; j(L): strikes; k(L): replacement ratio; N: level; V: growth rate.
1. Days lost because of strikes per employee: moving average (20 quarters).

A.5.- Wage equations with "all" institutional variables

Country	c_1	a(L)		b_1	b_2	d(L)		e(L)		f(L)		g(L)	i(L)	Statistics		
		L				L		L						R^2	SEE	DW
Germany = hysteresis Quart.: 70:1-94:4	0.0064 (3.47)	0 2	1**	-0.29^{U} (2.53)	-1.55^{CD1} (3.04)	0 1	0.48 (4.67)	1	0.43 (2.67)	_		_	_	0.69	0.72%	2.4
France Quart.: 70:1-98:3	-0.0306 (10.9)	1 3	0.875 (23.2)	-0.0092^{log} (11.2)	_		0.118 **(1.81)**		_	0 1	-0.331 (2.6)	0.0979 (3)	_	0.95	0.298 %	1.18
Spain = employ. Social contr. Rate Ann.: 70:1-98:3	0.051 (6.2)	0	1**	-0.21 (4.25)	_		_		_	-0.83 (4.09)		_	_	0.88	2.1%	1.4
UK Quart.: 70:1-98:4	-0.024 (4.2)	0 3	0.64 (5.8)	_	-0.64^{CD1} (3.8)		_		_	-0.564 **(1.82)**		_	0.11 (6.6)	0.75	0.77%	1.97
NLD = non linearity Quart.: 70:1-98:4	-0.019 (4.55)	0 4	1**	-0.0086^{log} (5.43)	_		_		_	_		_	_	0.66	0.70%	2.10

Notations: f(L): employer's social contribution rate; g(L): minimum wage; i(L): trade union density; log, CD1, U: see table A.2 and A.21.

B - Consumer price equations

Country	Estimation period	$n_1(L)\Delta p_V$		$n_2(L)\Delta p_I$		Statistics		
		L		L		R^2	SEE	DW
*Germany**	Quart.: 1970:1-1994:4	0-4	0.84 (40.3)	0-3	0.16 (7.9)	0.51	0.4%	2.1
Spain *	Annual.: 1970-1998	0	0.916 (119)	0	0.084 (10.83)	0.99	0.4%	1.2
USA *	Quart.: 1970:1-1999:4	0-3	0.9455 (112.2)	0	0.0545 (6.5)	0.9	0.19%	1.16
France *	Quart.: 1970:1-1998:3	0-1	0.879 (74.2)	0-1	0.121 (10.2)	0.9	0.33%	2.3
NLD *	Quart.: 1970:1-1996:4	0-4	0.905 (3.85)	0-1	0.095 (3.8)	0.50	0.65%	2.35
UK *	Quart.: 1970:1-1999:2	0-1	0.913 (61.4)	0	0.087 (5.8)	0.84	0.55%	2.07

* The restriction $n_1(1) + n_2(1) = 1$ is not rejected.

C - Value added price equations

Country	$\beta(L)$		μ	β_1	β_3	β_2 β_5	$\beta_4(L)$		Dummies	Statistics		
	L						L			R^2	SEE	DW
Germany Quart.: 70:1-94:4	0	0.24 (8.1)	-0.072 (4.8)	1.51 (17.3)	0.91 (2.7)	_		–	–	0.44	0.43%	1.97
Spain Ann.: 1970-1998	0 1	0.684 (5.74)	-0.21 (2.7)	2.4 (2.7)	_	n.a.		–	_	0.92	1.4%	1.22
USA Quart.: 70:1-99:4	0	0.442 (8.83)	-0.08 (3.7)	1.99 (11.5)	_	_	1 5	0.09 (4.3)	_	0.71	0.35%	1.83
France Quart.: 70:1-98:3	0	0.288 (5.4)	-0.106 (8.9)	1.679 (21.5)	0.872 (2.8)	_		–	_	0.84	0.41%	1.47
NLD Quart.: 70:1-96:4	0	0.419 (2.79)	-0.123 (3.4)	1.54 (5.78)	1.417 (2.1)	_		–	_	0.32	1.78%	2.77
UK Quart.: 70:1-99:2	0 1	0.442 (7.6)	-0.134 (6.8)	1.75 (21.2)	0.589 **(1.54)**	_		–	D732741 D793	0.81	0.67%	2.3

Notations: β_5: capacity utilization rate; n.a.: Non available data.