UNEMPLOYMENT IN THE EUROPEAN UNION: INSTITUTIONS, PRICES, AND GROWTH

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Abstract

This paper presents a reappraisal of unemployment movements in the European Union. Our analysis is based on the chain reaction theory of unemployment, which focuses on (a) the interaction among labor market adjustment processes, (b) the interplay between these adjustment processes and the dynamic structure of labor market shocks, and (c) the interaction between the adjustment processes and economic growth. We divide the shocks into institutional variables, price variables, and growth drivers. Estimating a system of labor market equations for a panel of EU countries, we derive the dynamic unemployment responses to each shock. Our analysis permits us to distinguish between the short- and long-run effects of the shocks. Different shocks generate different degrees of "unemployment persistence" (responses to temporary shocks) and "unemployment responsiveness" (responses to permanent shocks). We find that the growth drivers play a dominant role in accounting for the main swings in EU unemployment.

JEL Code: E30, E37, J32, J60, J64.

Keywords: unemployment, natural rate, labor market shocks, chain reaction theory, employment, labor force participation, wage determination, dynamic contributions, homogeneous dynamic panels, panel unit root tests.

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1. Introduction

The two standard approaches to interpretting movements of unemployment in the European Union are the "structural" and "hysteresis" approaches. The *structural approach* involves dividing unemployment into cyclical components (depicting business cycle variations, lasting a few years) and structural components (depicting longer-term movements), which are largely independent of one another. This mainstream view is often associated with the natural rate or NAIRU hypothesis. According to the *hysteresis approach*, the labor market equilibrium gets stuck at wherever it happens to be currently. Thus current unemployment is the best predictor of its future values, since it has a unit root. In this context, it is impossible to distinguish between structural and cyclical components, since each cyclical variation has long-term effects.

Both approaches have had a rather uneasy relationship to the empirical facts. EU unemployment has drifted upwards in a series of big jumps coinciding largely with past recessions (those of the mid-1970s, the early 1980s, the early 1990s, and the early 2000s). While unemployment increased promptly with each recession, it has had a well-known tendency to remain high for considerable periods after the slump in product demand ended. This behavior is difficult to explain within an analytical framework where structural and cyclical unemployment are largely independent of one another. At the other extreme, hysteresis combined with random shocks to unemployment implies that unemployment hits 0 or 100 percent with probability one in finite time - clearly a counterfactual implication.

This paper pursues a different approach, that of the *chain reaction theory* of labor market activity.[1] Here movements in unemployment are viewed as the cumulative outcome of prolonged adjustments to a stream of labor market shocks. The *shocks* may be temporary (such as oil price shocks) or permanent (such as changes in the level of productivity) or they may have a variety of other dynamic features (e.g. AR or MA components); they may be anticipated or unanticipated by the labor market participants. The *prolonged adjustments* arise from adjustment costs, such as costs of hiring and firing, search costs, training costs, or costs of entering into and exiting from the labor force. Since the adjustments can be very prolonged - much longer than the standard business cycle variations - it is not appropriate to divide movements in unemployment into cyclical and structural components. But since the adjustments are not infinitely long, hysteresis is not present.

It would be profoundly misleading to dismiss the chain reaction theory as merely an intermediate position between the structural and hysteresis approaches. In particular, the focus of the chain reaction theory (CRT) is different from either in the following respects:

- *The CRT examines the temporal interactions among different labor market adjustment*

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[1] See, for example, Henry and Snower (1996), Henry, Karanassou and Snower (2000), Karanassou and Snower (1998, 2000).

processes. For example, it investigates whether prolonged adjustments in employment, wage setting, and labor force participation are complementary with one another in propagating temporary and permanent labor market shocks beyond the time spanned by business cycles. Such issues are not central to the structural approach, since it presumes that lagged adjustments die out after a few years. Nor does it play a significant role in the hysteresis approach, since unemployment is there assumed to have a unit root regardless of what the underlying adjustment processes might be.[2]

- *The CRT examines the interplay between the dynamic structure of the shocks and the characteristics of the adjustment processes.* For example, it explores whether changes in adjustment processes that make the after-effects of temporary shocks more persistent also impart more inertia to the after-effects of permanent shocks. These matters lie outside the purview of the structural approach, which focuses primarily on the business cycle fluctuations generated by temporary shocks. The hysteresis approach also focuses on temporary shocks, but now they are taken to have permanent effects. (Permanent shocks would lead to explosive labor market behavior under hysteresis.)

- *The CRT focuses on the interaction between economic growth and adjustment processes.* In the presence of economic growth in the labor market - e.g. growth of productivity leading to a steady rise in labor demand and growth in population leading to a steady rise in labor supply - the lagged adjustment processes never have a chance to work themselves out entirely. Under these circumstances, the equilibrium levels of unemployment are not the same as the frictionless equilibrium levels of unemployment. Rather, they depend on how far these levels remain behind their moving (frictionless) targets on account of the lagged adjustment processes.

This paper uses the CRT to explain EU unemployment in the following way. We begin by depicting EU labor markets through a system of equations, including a labor demand, wage setting, labor supply, production function, and unemployment equation. We estimate this system for a macro dynamic panel of EU countries. The panel of countries, together with cross-country restrictions on the adjustment processes, provide enough data points to enable us to distinguish between the unemployment effects of changes in our exogenous variables and those of the dynamic adjustments to these changes.

Then we use the estimated system to decompose the movements of EU unemployment into the dynamic responses to different labor market shocks. The shocks are changes in

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[2] Since the structural and hysteresis approaches downplay the temporal interactions among different adjustment processes, labor market behavior is usually analyzed in terms of single-equation models (e.g. an unemployment equation). By contrast, the CRT analyzes it in terms of multi-equation models - comprising labor demand, labor supply, and wage setting behavior - in order to depict distinct adjustment processes that interact with one another.

the exogenous variables of our system. These exogenous variables are divided into three groups: *institutional variables*, *price variables* and what we call *growth drivers* (viz., factors responsible for long-term economic growth).

Formally, let us begin with a few definitions:

Definition A *shock* at period t is the change in an exogenous variable x_i from some fixed point in time τ (base period) to period t: $s_{it} = x_{it} - x_{i\tau}$, where $t \geq \tau$.

Thus, the deviation through time of each exogenous variable from its base period level is identified with a time series of one-off shocks: $s_{it} = x_{it} - x_{i\tau}$, $s_{i,t+1} = x_{i,t+1} - x_{i\tau}$, $s_{i,t+2} = x_{i,t+2} - x_{i\tau}$, ...

Definition An *unemployment response* to a shock $\left(u_{t+j}^{R}\left(s_{it}\right),\ j \geq 0\right)$ is the change in the unemployment rate at period $t+j$ resulting from the period t shock s_{it}.

Each shock s_{it} leads to an intertemporal stream of unemployment responses: $u_{t}^{R}\left(s_{it}\right)$, $u_{t+1}^{R}\left(s_{it}\right)$, $u_{t+2}^{R}\left(s_{it}\right)$, ... These unemployment responses may be derived by simulating our estimated system, deriving the responses of all endogenous variables, and then using the movements in these endogenous variables to derive the associated movements in unemployment.

Definition The *dynamic contribution* of the exogenous variable x_i to unemployment represents the response of unemployment at each point in time to all past and contemporaneous shocks associated with the exogenous variable x_i.

Since each shock s_{it} in term period t generates a stream of unemployment responses, $u_{t+j}^{R}\left(s_{it}\right)$ for $j \geq 0$, the time series of shocks for each exogenous variable x_i $(s_{it}, s_{i,t+1}, s_{i,t+2}, ...)$ is associated with a cumulated stream of unemployment responses: $u_{t}^{DC}\left(x_i\right) = u_{t}^{R}\left(s_{it}\right)$, $u_{t+1}^{DC}\left(x_i\right) = u_{t+1}^{R}\left(s_{it}\right) + u_{t+1}^{R}\left(s_{i,t+1}\right)$, $u_{t+2}^{DC}\left(x_i\right) = u_{t+2}^{R}\left(s_{it}\right) + u_{t+2}^{R}\left(s_{i,t+1}\right) + u_{t+2}^{R}\left(s_{i,t+2}\right)$, ... The time series $u_{t+j}^{DC}\left(x_i\right)$, $j \geq 0$, constitutes the dynamic contributions of the exogenous variable x_i to unemployment.

The aim of this paper is to reassess the driving forces underlying the swings in EU unemployment over the past three decades through an analysis involving the following steps: (i) identify salient groups of shocks, viz., institutional variables, price variables, and "growth drivers" (sources of economic growth), (ii) estimate a labor market system for the EU countries, (iii) use this system to generate the unemployment responses to the above shocks, and (iv) calculate the dynamic contribution of each exogenous variable to unemployment, thereby shedding new light on the evolution of EU unemployment.

The empirical assessment of how a particular set of exogenous variables influences EU unemployment depends significantly on the intertemporal propagation channels we take into consideration. The estimated influence of our exogenous variables in the context above will turn out to be quite different from that in the more standard empirical setup, where these variables are depicted as influencing unemployment directly within a single unemployment equation. The resulting empirical assessment will show that the influence of shocks depends importantly on the temporal progation channels (consisting of the interrelated labor market adjustment processes).

We find the growth drivers play a much more important role in accounting for the main swings in EU unemployment than the institutional or price variables. In the context of our dynamic model, the movements in EU unemployment may be understood in terms of the after-effects from temporary and permanent shocks to our exogenous variables. The after-effects of temporary shocks measure the degree of "unemployment persistence," whereas the after-effects of permanent shocks measure the degree of "unemployment responsiveness." Since different exogenous variables enter different labor market equations with different dynamic characteristics, temporary shocks to different exogenous variables are associated with different degrees of unemployment persistence, and permanent shocks to different exogenous variables generate different degrees of unemployment responsiveness. These dynamic features help explain the movements of EU unemployment.

The paper is organized as follows. Section 2 outlines the structure of our model. Section 3 presents our empirical model for the EU. Section 4 presents the resulting analysis of the driving forces underlying the major movements in EU unemployment. Section 5 contrasts our results with those generated by a single-equation analysis of EU unemployment. Section 6 presents empirical impulse response functions. Finally, Section 7 concludes.

2. Structure of the Model

We estimate a structural vector autoregressive distributed lag model for the EU countries:[3]

$$\mathbf{A}(L)\,\mathbf{y}_t = \mathbf{B}(L)\,\mathbf{x}_t + \boldsymbol{\varepsilon}_t, \ \ t = 1, 2, ..., T, \tag{2.1}$$

where L is the lag operator, $\mathbf{y}_t$ is a vector of endogenous variables, $\mathbf{x}_t$ is a vector of exogenous variables (including deterministic trends), $\boldsymbol{\varepsilon}_t$ is a vector of identically independently distributed error terms, $\mathbf{A}$ and $\mathbf{B}$ are coefficient matrices, and

$$\mathbf{A}(L) = \mathbf{A}_0 - \mathbf{A}_1 L - ... - \mathbf{A}_p L^p, \ \mathbf{B}(L) = \mathbf{B}_0 + \mathbf{B}_1 L + ... + \mathbf{B}_q L^q.$$

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[3] The dynamic system (2.1) is stable if, for given values of the exogenous variables, all the roots of the determinantal equation

$$|\mathbf{A}_0 - \mathbf{A}_1 L - ... - \mathbf{A}_p L^p| = 0$$

lie outside the unit circle. Note that the estimated equations in Section 3 below satisfy this condition.

The endogenous variables of our system are employment (n_t), the labor force (l_t), the real wage (w_t), output (q_t), and the unemployment rate (u_t). All variables are national aggregates and all (except the unemployment rate) are in logarithms. The equation system (2.1) consists of five equations:

- a labor demand equation, describing the equilibrium employment,
- a labor supply equation, describing the equilibrium size of the labor force,
- a wage setting equation, describing real wage determination,
- a production function, and
- a definition of the unemployment rate (not in logs):[4]

$$u_t = l_t - n_t. \tag{2.2}$$

Substituting the estimated equations (2.1) into (2.2), and further algebraic manipulation, leads to the following fitted "*reduced form*" unemployment rate equation:[5]

$$u_t = \sum_{j=1}^{I} \phi_j u_{t-j} + \sum_{j=0}^{J} \boldsymbol{\theta}_j' \mathbf{x}_{t-j},\ t = 1, 2, ..., T, \tag{2.3}$$

where the autoregressive parameters ϕ and the vectors $\boldsymbol{\theta}$ of the coefficients of the exogenous variables are functions of the estimated structural parameters of (2.1).

For expositional simplicity in explaining our decomposition of EU unemployment into dynamic contributions of exogenous variables, consider a simple model where the unemployment equation (2.3) is of first order and the vector $\mathbf{x}_t$ consists of the contemporaneous values of two exogenous variables, x_{1t} and x_{2t}:

$$u_t = \phi_1 u_{t-1} + \theta_1 x_{1t} + \theta_2 x_{2t}. \tag{2.4}$$

Using backward substitution, we can express the unemployment rate in terms of its pre-sample value u_0:

$$u_t = \phi_1^t u_0 + \theta_1 \sum_{j=0}^{t-1} \phi_1^j x_{1,t-j} + \theta_2 \sum_{j=0}^{t-1} \phi_1^j x_{2,t-j},\ t = 1, 2, ..., T. \tag{2.5}$$

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[4] Given then the labor force and employment are in logarithms, this is an approximation.

[5] The stability of each of the equations in the dynamic system (2.1) does not necessarily imply the stability of the reduced form unemployment rate equation (2.2). For the stability of the latter we need all the roots of the polynomial

$$1 - \phi_1 L - ... - \phi_I L^I = 0$$

to lie outside the unit circle. Note that our estimations in Section 3 below satisfy this condition.

In this context, we first compute the *base run* unemployment rate $\left(u_t^{BR}\right)$ by keeping the exogenous variables constant at their initial period ($t = 1$) levels throughout our span of analysis (i.e., $x_{1,t-j} = x_{11}$ and $x_{1,t-j} = x_{11}$ for $j = 0, ..., t-1$):

$$u_t^{BR} = \phi_1^t u_0 + \theta_1 \sum_{j=0}^{t-1} \phi_1^j x_{11} + \theta_2 \sum_{j=0}^{t-1} \phi_1^j x_{21}. \tag{2.6}$$

We then subtract the base run values (2.6) from the unemployment rate equation (2.5) to identify the *dynamic contributions* of the exogenous variables in the sample period:

$$u_t^{DC} \equiv u_t - u_t^{BR} = \theta_1 \sum_{j=0}^{t-1} \phi_1^j \left(x_{1,t-j} - x_{11}\right) + \theta_2 \sum_{j=0}^{t-1} \phi_1^j \left(x_{2,t-j} - x_{21}\right). \tag{2.7}$$

We now decompose the above series into the dynamic contributions associated with the exogenous variable x_1:

$$u_t^{DC}\left(x_1\right) = \theta_1 \sum_{j=0}^{t-1} \phi_1^j \left(x_{1,t-j} - x_{11}\right), \tag{2.8}$$

and the dynamic contributions associated with the exogenous variable x_2:

$$u_t^{DC}\left(x_2\right) = \theta_2 \sum_{j=0}^{t-1} \phi_1^j \left(x_{2,t-j} - x_{21}\right). \tag{2.9}$$

Equations (2.8)-(2.9) measure the effect of each exogenous variable on the unemployment trajectory relative to the base run.[6]

Therefore, the unemployment rate equation (2.5) can be seen as the sum of three components:

$$u_t = u_t^{DC}\left(x_1\right) + u_t^{DC}\left(x_2\right) + u_t^{BR}, \tag{2.10}$$

i.e., the dynamic contributions of the exogenous variables and the base run unemployment rate.

Next, we derive further influences of the exogenous variables on unemployment:

- The *direct effect* of an exogenous variable on unemployment is the contemporaneous effect, occurring before the lagged adjustments take place. Specifically, the direct effects of the exogenous variables x_1 and x_2 on unemployment are the initial dynamic contributions of these variables given by the first terms on the right side of equations

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[6] It is important to note that this is simply a dynamic accounting exercise, answering the question: how much of the movement in unemployment can be accounted for by the movements in each of the exogenous variables. It does not tell us what would happen to unemployment if the exogenous variables followed different trajectories, because in that event agents may change their behavior patterns and thus the parameters of our behavioral equations may change (in accordance with the Lucas critique).

(2.8) and (2.9), respectively:

$$u_t^{DE}(x_1) = \theta_1 (x_{1t} - x_{11}) \text{ and } u_t^{DE}(x_2) = \theta_2 (x_{2t} - x_{21}). \tag{2.11}$$

- The *frictionless contribution* of an exogenous variable to unemployment measures how this variable would influence unemployment if all temporal adjustment processes worked themselves out within each period of analysis. Specifically, the *frictionless contribution* of each exogenous variable is obtained by computing the steady state[7] of the unemployment equation (2.4), $u_t = \frac{\theta_1 x_{1t} + \theta_2 x_{2t}}{1-\phi_1}$, and subtracting from it the steady state unemployment when that exogenous variable remains constant at its initial period 1 value:

  $$u_t^{FC}(x_1) = \frac{\theta_1}{1-\phi_1}(x_{1t} - x_{11}) \text{ and } u_t^{FC}(x_2) = \frac{\theta_2}{1-\phi_1}(x_{2t} - x_{21}). \tag{2.12}$$

  Clearly, when the autoregressive order of the reduced form unemployment equation is one, as assumed in the above illustration, the frictionless contributions series of each exogenous variable represents a rescaling of its direct effects. However, the two measures will not be rescaled versions of one another in the more plausible case where the multi-equation model (2.1) reduces to an unemployment equation of autoregressive order greater than one.[8]

We now proceed to estimate the above influences and thereby glean new insights into what drives the movements in EU unemployment.

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[7] The steady state of a difference equation is derived by setting the lagged value of the endogenous variable equal to its current value.

[8] To demonstrate this result, consider the following two-equation model:

$$n_t = \alpha_1 n_{t-1} + \beta_1 x_t, \quad l_t = \alpha_2 l_{t-1} + \beta_2 x_t.$$

We can use the lag operator L to rewrite the above model as:

$$(1 - \alpha_1 L) n_t = \beta_1 x_t, \quad (1 - \alpha_2 L) l_t = \beta_2 x_t.$$

Next, we multiply both sides of the above labor demand and supply equations by $(1 - \alpha_2 L)$ and $(1 - \alpha_1 L)$, respectively, to obtain:

$$\begin{aligned} (1 - \alpha_1 L)(1 - \alpha_2 L) n_t &= \beta_1 (1 - \alpha_2 L) x_t, \\ (1 - \alpha_1 L)(1 - \alpha_2 L) l_t &= \beta_2 (1 - \alpha_1 L) x_t. \end{aligned}$$

Recall that unemployment is defined as $u_t = l_t - n_t$. Thus the dynamic reduced form unemployment rate equation is simply given by

$$(1 - \alpha_1 L)(1 - \alpha_2 L) u_t = \beta_2 (1 - \alpha_1 L) x_t - \beta_1 (1 - \alpha_2 L) x_t.$$

Observe that (i) the contemporaneous effect of the exogenous variable x_t on the unemployment rate is $\beta_2 - \beta_1$, and (ii) the steady-state (frictionless) impact of x on u is obtained by setting the lag operator L equal to unity: $\frac{\beta_2}{1-\alpha_2} - \frac{\beta_1}{1-\alpha_1}$. Along the lines of the above exposition, it is now easy to see that the direct

3. The Empirical Model

We have estimated a structural dynamic homogeneous panel data model comprising four equations plus the definition of the unemployment rate.[9] Our empirical model includes eleven out of the fifteen EU countries (Austria, Belgium, Denmark, Germany, Finland, France, Italy, Netherlands, Spain, Sweden and the United Kingdom). (The other four - Greece, Ireland, Luxembourg and Portugal - had to be excluded on account of data limitations.) The model is estimated on annual OECD data for the period 1970-1999. Table 1 provides the definitions of the endogenous and exogenous variables.

Table 1: Definitions of variables.

b_t	:	real Social Security benefits per person
c_t	:	competitiveness defined as $\log\left(\frac{\text{Import prices}}{\text{GDP deflator}}\right)$
k_t	:	real capital stock
l_t	:	labor force
n_t	:	total employment
o_t	:	real oil prices
q_t	:	real GDP
r_t	:	long-term real interest rates (%)
t	:	time trend
u_t	:	unemployment rate defined as $u_t = l_t - n_t$
w_t	:	real compensation per person employed
τ_t	:	indirect taxes (as a % of GDP)
θ_t	:	productivity defined as $q_t - n_t$
z_t	:	working-age population
Note:		All variables in logs except otherwise specified.
Source:		OECD.

In estimating the model, we pool the observations across these countries, capturing cross-country differences only through fixed effects (i.e. differing constants in the estimated equations). Pooling has the advantage of increasing the efficiency of the econometric estimates

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effects of the exogenous variable x are given by

$$\begin{aligned} u_t^{DE}(x) &= \beta_2 (x_t - x_1) - \beta_1 (x_t - x_1) \\ &= (\beta_2 - \beta_1)(x_t - x_1), \end{aligned}$$

and the frictionless contributions by

$$\begin{aligned} u_t^{FC}(x) &= \frac{\beta_2}{1-\alpha_2}(x_t - x_1) - \frac{\beta_1}{1-\alpha_1}(x_t - x_1) \\ &= \left(\frac{\beta_2}{1-\alpha_2} - \frac{\beta_1}{1-\alpha_1}\right)(x_t - x_1). \end{aligned}$$

The above shows that, in a multi-equation system, unless we impose the implausible assumption of identical autoregressive coefficients, the frictionless contributions are not equivalent to a rescaling of the direct effects of the exogenous variables.

[9] A broader description of the methodology underlying dynamic panel data estimation is provided in Karanassou, Sala and Snower (2003). Here we outline only the main features of our estimation procedure.

and thus provides a closer understanding of the adjustment mechanisms in dynamic relationships (see Hsiao (1986) and Baltagi (1995)).[10] Our fixed-effect model is empirically preferred to heterogenous models containing individual country estimations, as indicated below. Furthermore, Baltagi and Griffin (1997) compare a large number of panel data estimators and find that standard homogenous estimators perform better; they argue that "the efficiency gains from pooling appear to more than offset the biases due to intercountry heterogeneities" and "the gains from correcting for possible endogeneity in the lagged dependent variable are disappointing...".[11] Finally, we can justify our choice of the fixed effects (least squares dummy variables) estimator for each equation in our system by the very good fit of the estimated model (see Figure 1 below).

One of the challenges of estimating dynamic panel data models is a correct specification of the long-run relationships between the variables. In order to check if it is appropriate to use stationary panel data estimation techniques, we conduct a series of unit root tests.

The use of pooled data can generate more powerful unit root tests than the popular Dickey-Fuller (DF), Augmented DF and Phillips-Perron (PP) tests. In our empirical analysis, to test for panel unit roots we have used the statistic proposed by Maddala and Wu (1999), which is an exact nonparametric test based on Fisher (1932):

$$\lambda = -2\sum_{i=1}^{N} \ln \pi_i \sim \chi^2 (2N), \tag{3.1}$$

where π_i is the probability value of the ADF unit root test for the ith unit (country). The results of this test, displayed in table 2, indicate that we can indeed proceed with stationary panel data estimation techniques.

Table 2: Panel Unit Root Tests.

$\lambda(n_{it})$	=	36.10	$\lambda(l_{it})$	=	35.12	$\lambda(z_{it})$	=	40.57
$\lambda(q_{it})$	=	42.88	$\lambda(r_{it})$	=	47.67	$\lambda(b_{it})$	=	91.45
$\lambda(k_{it})$	=	41.19	$\lambda(o_{it})$	=	42.67	$\lambda(\tau_{it})$	=	46.24
$\lambda(w_{it})$	=	159.79	$\lambda(c_{it})$	=	46.79			

Notes: $\lambda(\cdot)$ is the test proposed by Maddala and Wu (1999).
The test follows a chi-square (22) distribution.
The 5% critical value is approximately 34.

To decide whether it is appropriate to use pooled equations, we select between each of the pooled equations and the corresponding individual regressions by using the Schwarz Information Criterion (SIC) as suggested by Smith (2000). We compute the model selection

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[10] Banerjee (1999), Baltagi and Kao (2000) and Smith (2000) provide an overview of dynamic panel data estimation techniques and nonstationary panel time series models.

[11] The cross-section and time dimensions in the Baltagi and Griffin (1997) study are very similar to the dimensions of the panel data used in this paper.

criteria as follows:

$$SIC_{pooled} = MLL - 0.5k_{pooled} \log(NT), \tag{3.2}$$

$$SIC_{individual} = \sum_{i=1}^{11} MLL_i - N\left[0.5k_i \log(T)\right], \tag{3.3}$$

where MLL_{pooled}, MLL_i denote the maximum log likelihoods of the pooled model and the ith country time series regression, respectively; k_{pooled} is the number of parameters estimated in the fixed effects model (i.e. number of explanatory variables plus the 11 country specific effects), and k_i is the number of parameters estimated in the individual country time series regression (i.e. number of explanatory variables plus an intercept); N and T denote the number of countries and estimation period, respectively. The model that maximizes the SIC is preferred. As table 3 shows, the results indicate that the fixed effects model is preferred for all our four behavioral equations:

Table 3: Homogenous vs. Heterogenous Panels.

	SIC_{pooled}		$SIC_{individual}$
Labor Demand:	1051.25	>	1032.12
Wage Setting:	851.83	>	810.05
Labor Force:	1096.94	>	1089.98
Production Function:	972.48	>	862.59

Notes: The statistics were computed using (3.2) and (3.3).
The model that maximizes the selection criterion is preferred.

Thus, we estimate a stationary dynamic panel, which is homogeneous and yields consistent fixed effects estimators for the 11 EU countries considered.[12]

Table 4 presents the estimated equations. As we can see, the *labor demand* depends negatively on the real wage and the real interest rate, and positively on the level and the growth rate of capital stock; it also depends positively on competitiveness, which is defined as the ratio of the import price to the GDP deflator, and on a linear trend. *Real wages* depend negatively on the unemployment rate and the indirect tax rate (as a ratio to GDP), and positively on productivity, social security benefits and oil prices. The *labor force* depends negatively on the level and growth of the unemployment rate and wages, whereas working-age population has a positive sign.[13] The *production function* is standard, with a positive relationship of output with respect to employment, capital stock and a time trend (to capture technological progress).

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[12] The lag structure of the model was chosen on the basis of the Akaike and Schwarz model selection criteria.

[13] The restriction of a long-run unit elasticity cannot be rejected by a Wald test at conventional significance levels. For this reason, although we report the unrestricted estimates in Table 4, we use the restricted labor supply equation in the simulations of the following sections.

Figure 1 indicates that the model tracks the actual unemployment rate remarkably well, despite the cross-country restrictions on the coefficients of the right-hand side variables.

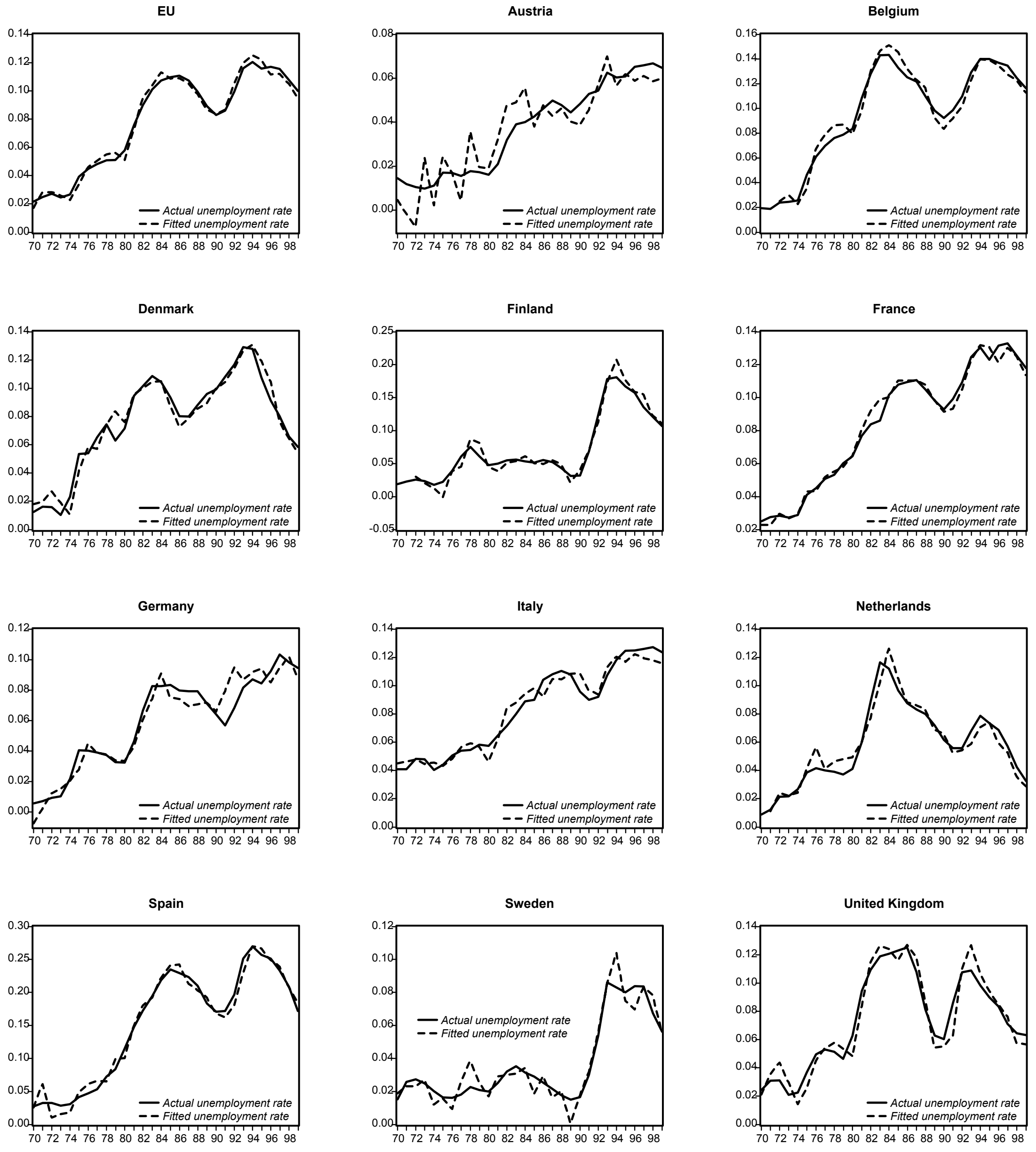
Table 4: The EU model . 1970-1999.

Dependent variable: n_t				Dependent variable: w_t			
	Coefficient	St. e.	Prob.		Coefficient	St. e.	Prob.
n_{t-1}	1.42	0.039	0.000	w_{t-1}	0.97	0.051	0.000
n_{t-2}	-0.48	0.035	0.000	w_{t-2}	-0.14	0.045	0.002
w_t	-0.03	0.012	0.011	u_t	-0.29	0.045	0.000
k_t	0.02	0.009	0.035	θ_t	0.50	0.056	0.000
Δk_t	1.99	0.070	0.000	θ_{t-1}	-0.36	0.052	0.000
Δk_{t-1}	-1.65	0.093	0.000	b_t	0.14	0.020	0.000
c_t	0.02	0.006	0.003	b_{t-1}	-0.12	0.022	0.000
r_t	-0.001	0.000	0.019	o_t	0.005	0.002	0.020
t	0.001	0.000	0.044	τ_t	-0.59	0.180	0.001
				τ_{t-1}	0.41	0.189	0.030
R^2	0.999			R^2	0.999		
MLL	1108.9			MLL	912.0		

Dependent variable: l_t				Dependent variable: Δq_t			
	Coefficient	St. e.	Prob.		Coefficient	St. e.	Prob.
l_{t-1}	1.00	0.031	0.000	q_{t-2}	-0.25	0.025	0.000
l_{t-2}	-0.08	0.026	0.005	k_t	0.02	0.013	0.095
u_t	-0.04	0.019	0.060	n_t	0.09	0.019	0.000
Δu_t	-0.21	0.037	0.000	o_t	-0.004	0.002	0.047
w_t	-0.06	0.025	0.019	t	0.004	0.001	0.000
w_{t-1}	0.05	0.025	0.039				
z_t	1.11	0.037	0.000				
z_{t-1}	-1.00	0.043	0.000				
R^2	0.999			R^2	0.999		
MLL	1151.4			MLL	1019.1		

All equations include constant country-specific terms.

Figure 1: Actual and fitted values of the EU unemployment rates.



4. Revisiting the Causes of European Unemployment

On the basis of the empirical model above, we now examine the driving forces underlying EU unemployment by deriving the dynamic contributions of our exogenous variables. We divide these exogenous variables into three groups:

1. *institutional variables*: social security benefits and indirect taxes,
2. *prices*: competitiveness, interest rates and oil prices; and
3. *growth drivers*: capital stock, technological change and working-age population

Figures 2 to 4 depict the direct effects of each exogenous variable (or group of exogenous variables), as well as their dynamic and frictionless unemployment contributions.

On account of the lagged adjustment processes in our model, the direct unemployment effects ($u_t^{DE}(x_i)$) of each exogenous variable (x_{it}) give rise to smooth unemployment dynamic contributions ($u_t^{DC}(x_i)$) in contrast with the frictionless contributions ($u_t^{FC}(x_i)$).

4.1. Contributions of the Institutional Variables

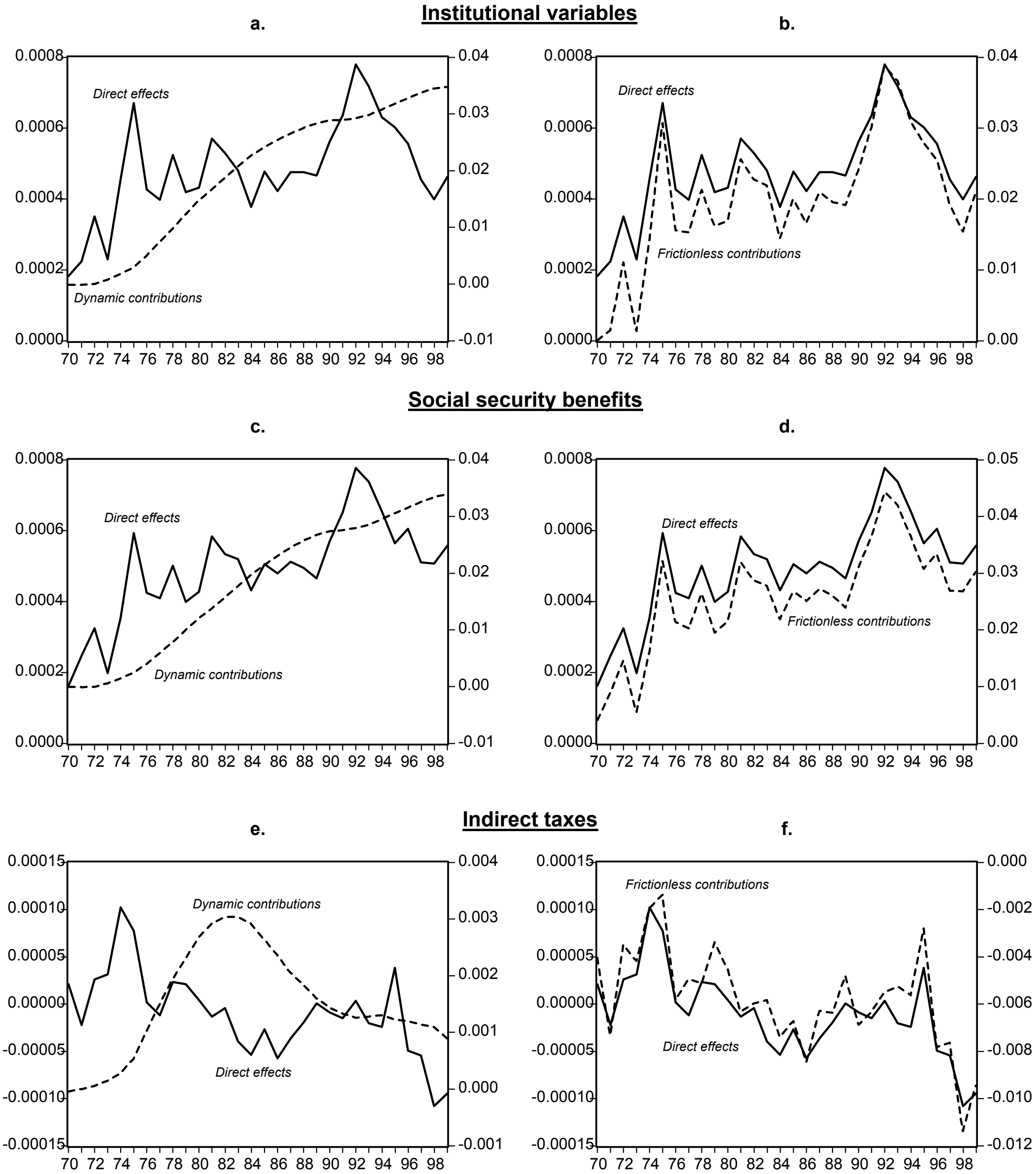
The left-hand panels of Figures 2 compare the direct effects with the dynamic contributions of the institutional variables, whereas the right-hand panels compare the direct effects with the frictionless contributions of these variables. Figures 2a and 2b describe the influence of both institutional variables together, whereas the remaining figures deal with social security contributions and indirect taxes separately.

Figure 2c shows that *social security benefits* have pushed up the EU unemployment rate by larger and larger amounts, amounting to an increase of 3.4 percentage points over our sample period. They have had a progressively increasing negative influence on EU employment, and a smaller negative influence on the EU labor force (via their influence on wages and unemployment).

A comparison of Figures 2c and 2d highlights the role of lagged adjustment processes in modifying the influence of social security benefits through time. In Figure 2c we see that social security benefits had a pronounced positive direct effect on unemployment in the first half of the 1970s, which stabilized over much of the sample period thereafter; however, the unemployment contributions of social security benefits, as noted, rise steadily over the entire sample period.

Figure 2e indicates that the contribution of *indirect taxes* to unemployment rate have been close to nill. Observe that in our model indirect taxes affect employment and the labor force only via their positive influence on the real wage. Most countries in our panel did not experience significant variations in indirect taxes (as a ratio of GDP); the only exceptions were France and Spain, which encountered changes in opposite directions, thus roughly cancelling each other out on the aggregate EU level.

**Figure 2. Institutional variables.
Dynamic contributions, direct effects
and frictionless contributions.**



4.2. Contributions of Prices

Figures 3 describe the influences of the price variables.

Figure 3c pictures the role of *competitiveness* (given the real oil price which is a separate exogenous variable). In our model, a rise in competitiveness (defined as the ratio of import prices to the GDP deflator) raises employment, presumably through import substitution. This, in turn, affects the real wage, which influences both employment and the labor force. The figure shows that the rise in EU competitiveness reduced unemployment through the second half of the 1970s and 1980s, and the fall in EU competitiveness (possibly linked to the EU's disappointing productivity performance and rate of capital accumumlation) stimulated unemployment significantly in the 1990s.

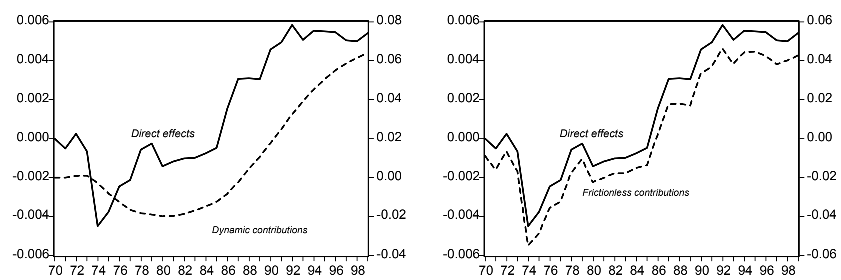
Figure 3e shows the role of the long-term *real interest rate* (given the capital stock, which is a separate exogenous variable). Similarly to competitiveness, the influence of the real interest rate on unemployment operates primarily through employment (rather than the labor force). From 1970 to 1983, interest rate movements have reduced unemployment (reaching a maximum of a 1 percentage point reduction in 1978 and 1979), but with the general shift towards tigher monetary policy, they stimulated unemployment thereafter (reaching a maximum of nearly 2 percentage points in 1996).

A comparison of Figures 3e and 3f suggests that movements in the real interest rate affect unemployment with significant lags. The direct unemployment effects of the real interest rate reached a trough in 1975, and fell to zero by 1980; but the associated dynamic contributions reached a trough only in 1978, and fell to zero by 1984. The direct unemployment effects were positive and roughly stable throughout the 1980s and first half of the 1990s; but the associated dynamic unemployment contributions rose gradually from 1984 to 1996.

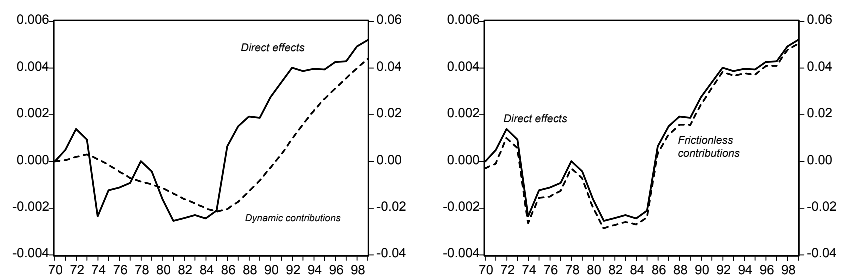
Finally, Figure 3g shows a small influence of the *oil price* on unemployment, contrary to many other studies. In part, the small magnitude may be due to the fact that the influence is assessed for a given capital stock and competitiveness (which are other exogenous variables). The oil price shocks of the mid-1970s and early 1980s undoubtedly reduced capital formation and affected competitiveness. In part, some of what we estimate to be the delayed unemployment contributions of movements in competitiveness and the capital stock are commonly ascribed to the oil price.

**Figure 3. Price variables.
Dynamic contributions, direct effects
and frictionless contributions.**

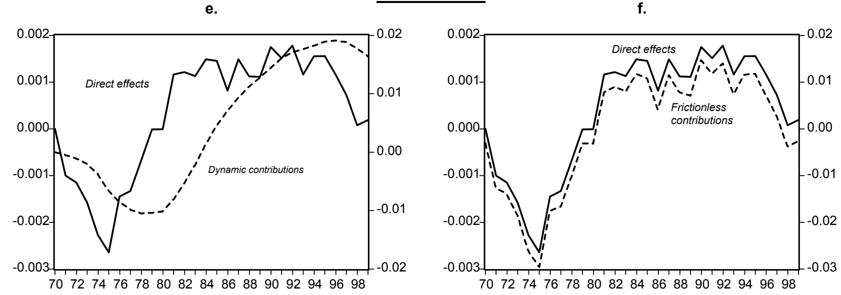
Price variables



Competitiveness



Interest rates



Oil prices

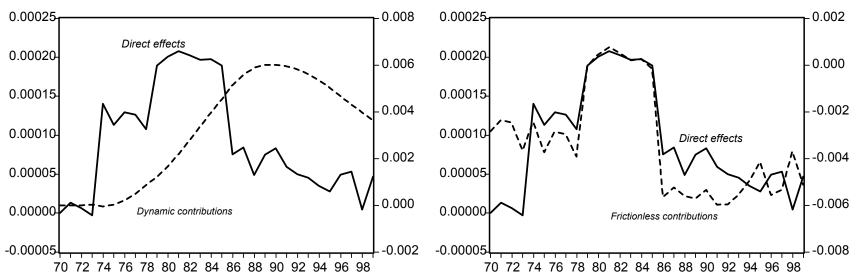
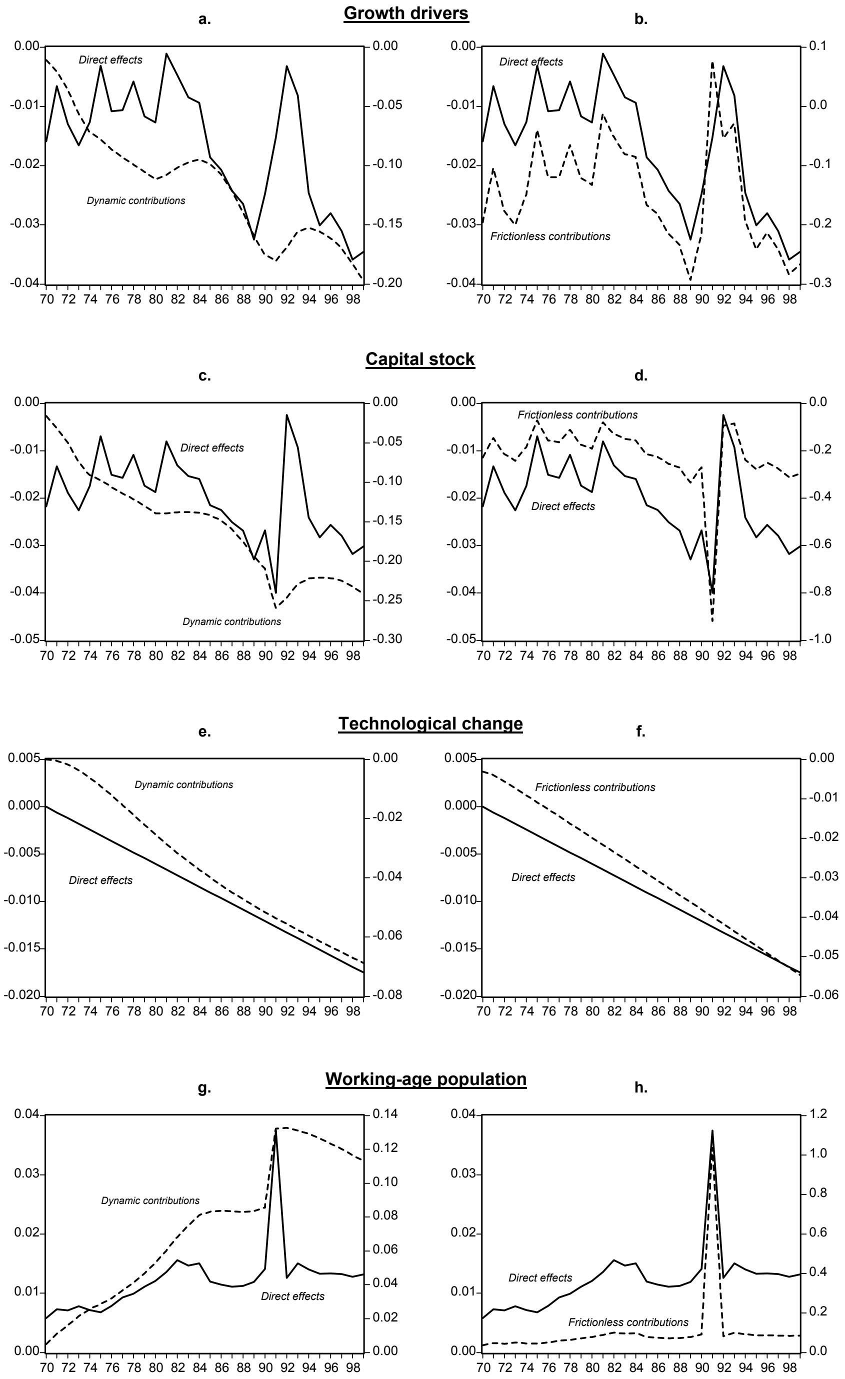


Figure 4. Growth drivers.
Dynamic contributions, direct effects
and frictionless contributions.

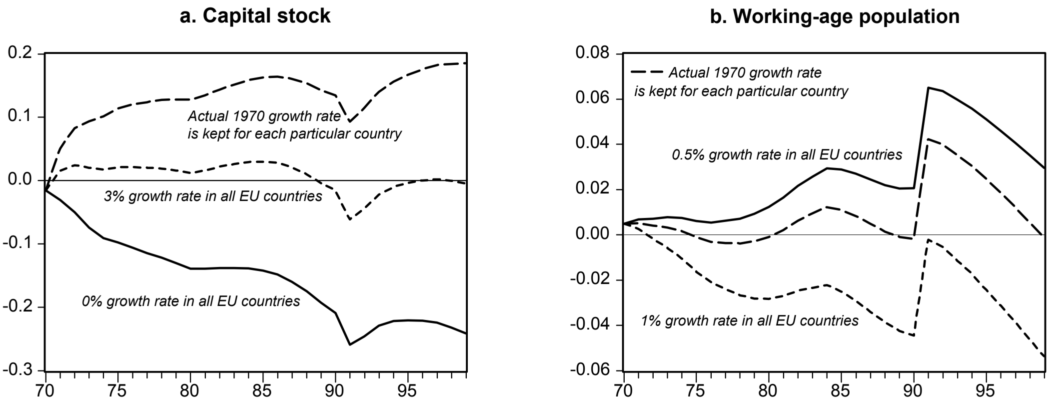


4.3. Contributions of the Growth Drivers

Figures 4c and 4g suggest that two of our growth drivers - the capital stock and working age population - play a dominant role in accounting for movements in EU unemployment, with the capital stock being the more important. The figures show the unemployment contributions to be very large, but one must keep in mind that it is quite unrealistic to imagine that the capital stock would grow as it did if the working-age population were constant (implicitly assumed in Figure 4c, since the unemployment contributions are assessed for a given population). Thus it is more informative to examine the unemployment contributions from its combined influence, as shown in Figure 4a.

The powerful influence of the capital stock and working-age population on EU unemployment is underscored Figure 5, which shows the dynamic unemployment contributions for different growth rates of capital stock and working-age population.

Figure 5. Dynamic contributions under different growing scenarios



a. Capital stock

b. Working-age population

5. Single- versus Multi-equation Models

Most empirical studies on the causes of unemployment are conducted in terms of single, aggregate unemployment equations. These equations are interpretted as reduced forms that are meant to summarize the behavior of multi-equation labor market systems, such as the one presented above. The open question is whether single-equation models are a good proxy for their multi-equation counterparts in a dynamic context. Karanassou, Sala, and Snower (2003) have shown that when the individual equations in a multi-equation system do not have the same regressors, the multi-equation models cannot be aggregated into single-equation models. How important is this limitation in explaining EU unemployment?

Naturally, single- and multi-equation models of unemployment both have their strengths and weaknesses. Theoretically, the single-equation models are simply aggregated summaries of the multi-equation counterparts. Empirically, multi-equation models require more data to be estimated and thus are associated with lower degrees of freedom. In this paper, we have sought to overcome this difficulty by pooling country data across the EU. Thus our model may be a useful tool in exploring whether single-equation models deliver biased summaries of their multi-equation underpinnings. Addressing this question can shed light on whether the difference between our analysis of EU unemployment and those in the conventional literature (e.g. Layard, Nickell and Jackman (1991), Phelps (1994), Phelps and Zoega (1998)) may be due single- versus multi-equation modeling.

Table 5 presents a version of a single-equation model where four out of the seven exogenous variables present in the multi-equation system are considered. (The other exogenous variables were statistically insignificant.) Even though the interest rate is marginally significant, it is retained to provide a better specification of the model.[14]

Table 5: Single-equation model.

Dependent variable: u_t

	Coefficient	St. e.	Prob.
u_{t-1}	1.23	0.05	0.00
u_{t-2}	-0.51	0.04	0.00
k_t	-0.014	0.01	0.02
Δk_t	-0.37	0.06	0.00
r_t	0.024	0.019	0.21
b_t	0.02	0.01	0.00
z_t	0.18	0.04	0.00
z_{t-1}	-0.13	0.04	0.00
R^2	0.979		
MLL	1081.1		

Figure 6a describes the differences in the unemployment contributions derived from the single- and the multi-equation analysis. Observe that social security benefits - commonly considered one of the main sources of EU unemployment in the mainstream literature (e.g. Layard, Nickell and Jackman (1991), Blanchard and Wolfers (2000) - have a much greater influence on unemployment in the single-equation model than in the multi-equation system.

Interest rates have also been assigned a major role in explaining the rise of EU unemployment over the 1980s and first part of the 1990s (e.g. Phelps (1994) and Phelps and Zoega (1998 and 2001)). Figure 6b shows our multi-equation model assigns a more important role to the interest rates than the corresponding single-equation model does. It is worth recalling, however, that our multi-equation model aims to capture only that part of the influence of interest rates that operates independently of the capital stock, the working-age population,

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[14] This specification allows a comparison with at least one variable belonging to each of the groups we have already distinguished: social security benefits, in the institutional variables group; interest rates, in the prices group; and, both, capital formation and working-age population as growth drivers.

The significance of interest rates at the 21% size of the test (large with respect to the standard 5% or 10%) affects only marginally the magnitude of the coefficient. Thus, the central conclusions from our decomposition analysis would remain substantially intact at a lower size of the test.

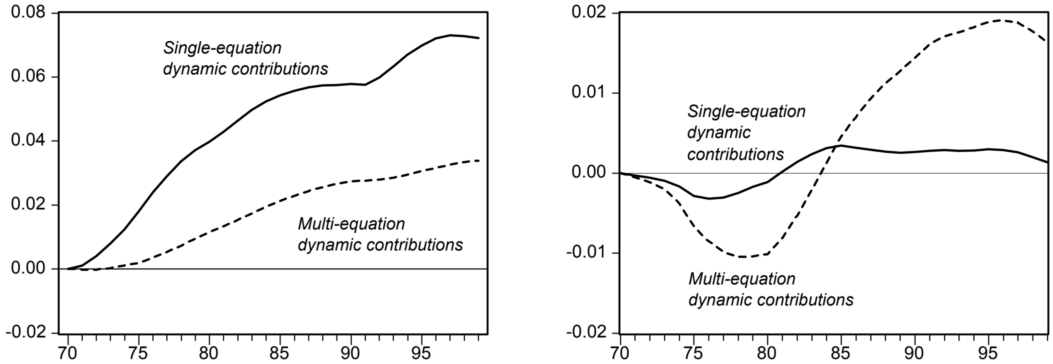
and our other exogenous variables. In the single-equation models, on the other hand, the capital stock and working-age population usually do not appear, since the latter are trended variables whereas unemployment is untrended.

Figures 6c and 6d show that when the capital stock and working-age population are included as explanatory variables in the single-equation model, the capital stock plays a much smaller role for EU unemployment than in our multi-equation model, whereas population plays a much larger role.

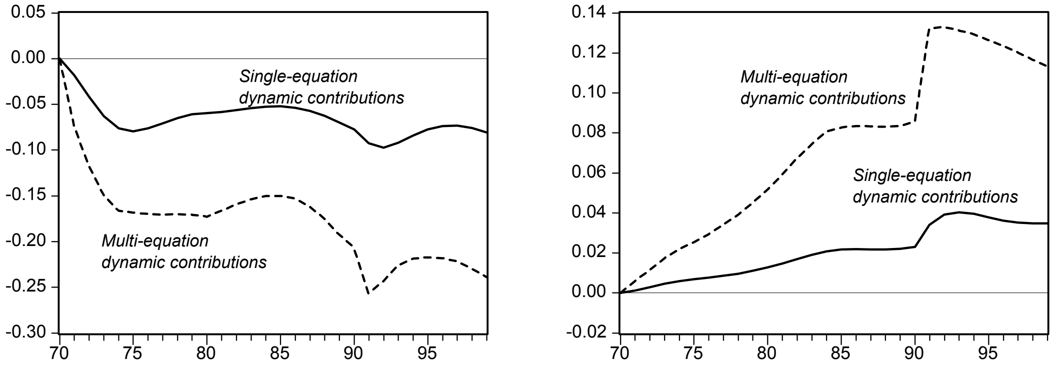
In short, our analysis suggests that single-equation models may indeed provide a biased account of EU unemployment, inflating the role of institutional variables and underplaying the role of the growth drivers.

Figure 6: Dynamic contributions of different exogenous variables: Multi-equation versus single-equation results

a. Social security benefits **b. Interest rates**



c. Capital stock **d. Working-age population**



6. Effects of Temporary and Permanent Shocks

In this section we construct aggregative measures of the dynamic unemployment responses to temporary and permanent shocks.[15] Specifically, we consider two such influences:

- (i) the persistent unemployment effects of temporary shocks, called *unemployment persistence,* and
- (ii) the delayed unemployment effects of permanent shocks, called *unemployment responsiveness.*

A *temporary shock* (TS) is identified as a one-off unit increase in an exogenous variable at time t, assuming that all other exogenous variables remain unchanged. Due to the labor market adjustment processes, the shock affects unemployment in periods subsequent to the shock; and in a dynamically stable system, the unemployment effects will of course die out with the passage of time. We denote the responses of unemployment to the above impulse by $u_{t+j}^{R(TS)}$, $j \geq 0$, where $R(TS)$ stands for "response (R) to a temporary shock (TS). This unemployment response is given by the difference between the unemployment rate in the presence and absence of the shock. The term $u_t^{R(TS)}$ is the immediate impact of the shock, and the whole time series $u_{t+j}^{R(TS)}$, $j \geq 0$, is the impulse response function (IRF) of unemployment.[16]

Our measure of *unemployment persistence*, π, captures the degree to which unemployment is affected by the temporary shock after that shock has disappeared:

$$\pi = \sum_{j=1}^{\infty} u_{t+j}^{R(TS)}. \tag{6.1}$$

Note that the total effect of the temporary shock is the sum of the immediate response and the persistence measure: $u_t^{R(TS)} + \pi$. In the absence of lagged labor market adjustment

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[15] For a detailed discussion of these measures see Karanassou and Snower (1998).

[16] Generally, the IRF is obtained by the infinite moving average (IMA) representation of the model. Consider, for example, a simple dynamic model for unemployment with one exogenous variable:

$$u_t = \alpha u_{t-1} + \beta x_t, \ \ |\alpha| < 1.$$

The IMA representation of u with respect to x is given by

$$u_t = \beta x_t + \alpha\beta x_{t-1} + \alpha^2\beta x_{t-2} + \alpha^3\beta x_{t-3} + ...$$

Assuming that in period t there is a one-off unit increase in x, the IRF of the unemployment rate is simply given by the slope coefficients of the above equation:

$$u_t^{R(TS)} = \beta, \ u_{t+1}^{R(TS)} = \alpha\beta, \ u_{t+2}^{R(TS)} = \alpha^2\beta, \ u_{t+3}^{R(TS)} = \alpha^3\beta, \ ...$$

processes, unemployment would not be affected after the temporary shock has disappeared and thus quantitative unemployment persistence π would be zero. At the opposite extreme of hysteresis, the temporary shock would have a permanent effect on unemployment and thus π would be infinite.

We derive persistence measures associated with each of the institutional and price variables[17] by simulating the empirical model of Section 3. In each simulation, the one-off shock (i.e. the change in an exogenous variable) is introduced in period $t = 1$ while all other exogenous variables remain fixed. In particular, the shock represents a one per cent increase in an exogenous variable that is in logs (e.g. benefits), and a one percentage point increase in a variable that is a rate (e.g. interest rate). Note that (a) since our estimated model is dynamically stable, the impulse response functions do not depend on the initial values of the endogenous variables; (b) due to the linearity of the model, the IRF's do not depend on the value at which the other exogenous variables are held constant; and (c) if, instead of a unit shock, we consider a shock of some arbitrary size (m) linearity of the model enables us to compute its impact on unemployment as $u_t^{R(TS)} \times m$ (i.e. multiply the size of the shock with the unemployment response to a unit shock).

Table 6 contains two types of persistence measures. Panel A gives the amount of persistence in response to a unit shock in each of the exogenous variables, i.e. the sum of the unemployment responses deflated by the size of each shock. (For example, a one-off 1% increase in competitiveness (c_t) reduces unemployment contemporaneously by 0.015 percentage points and, on aggregate, decreases future unemployment by 0.17%.) This statistic - "*normalized persistence*" - is useful since it readily enables us to compute the persistence associated with a shock of any size (for each exogenous variable): the actual degree of persistence is simply the product of normalized persistence and the size of the shock.

Panels B and C present estimates of "*average persistence*" by considering shock sizes that are in line with the historical variation of the exogenous variables. In Panel B, for each exogenous variable, the shock size is computed as the standard deviation of the change of the variable for each of the 11 countries in our sample and then taking their arithmetic average.[18] Then average persistence is calculated as the product of normalized persistence (in Panel A) and the above shock size. Panel C reports "average persistence" when the size of the shock is computed as the average of the absolute value of the change in the series.

Observe that in all cases competitiveness is associated with the highest degree of unemployment persistence, while benefits and interest rates are associated with little persistence.

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[17] Except for the tax rate and oil price which, as shown in Figure 2, have a negligible impact on the unemployment rate.

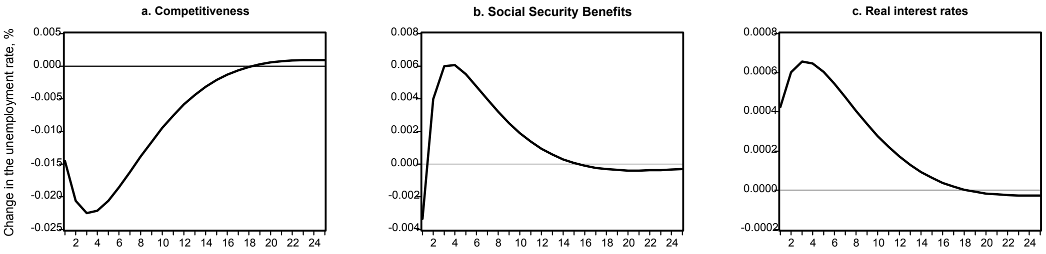
[18] Arithmetic averages of course can give only a rough indication of the average variation of the shock. Alternatively, one could weight the shocks of different countries by some measure of their contribution to the EU unemployment rate. For brevity, however, we do not pursue these possibilities here.

Table 6: Persistence of temporary shocks (%)

Panel A	c_t	b_t	r_t
size of the shock m	1	1	1
"current" effect $u_t^{R(TS)}$	-0.015	-0.003	0.000
"future" effect π	-0.170	0.037	0.005
Panel B	c_t	b_t	r_t
size of the shock m	6.35	4.77	1.25
"current" effect $u_t^{R(TS)}$	-0.10	0.01	0.000
"future" effect π	-1.08	0.17	0.006
Panel B	c_t	b_t	r_t
size of the shock m	4.34	3.55	0.96
"current" effect $u_t^{R(TS)}$	-0.07	0.012	0.00
"future" effect π	-0.74	0.13	0.005

Figure 7 plots the impulse response functions of unemployment to these temporary shocks. Since the shock occurs in period $t = 1$, the figure depicts the changes in unemployment from period 1 onwards (i.e., $u_1^{R(TS)}$, $u_2^{R(TS)}$, $u_3^{R(TS)}$,...).[19]

Figure 7. Unemployment Effects of Temporary Shocks



The shock is a one-off 1% increase in the exogenous variable in period t=1.

Next we examine the unemployment effects of a unit permanent shock (PS) that starts in period t. Our measure of *imperfect responsiveness*, ρ, captures the degree to which unemployment does not adjust fully to the new long-run equilibrium. In particular, it is specified as the sum of the differences through time between (a) the disparity between actual and long-run unemployment in the presence of the shock and (b) this disparity in the absence of the shock. This is equivalent to the differences through time between (a) the disparity between the actual unemployment rate in the presence and absence of the shock $\left(u_{t+j}^{R(PS)}\right)$, where $R(PS)$ stands for the "response (R) to a permanent shock (PS), and (b) the dis-

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[19] Since the size of the shock does not affect the time path of the responses but only rescales them, the plots in Figure 7 have been generated by a unit size shock.

parity between the long-run unemployment rate in the presence and absence of the shock $\left(u_{LR}^{R(PS)}\right)$:[20]

$$\rho = \sum_{j=0}^{\infty} \left(u_{t+j}^{R(PS)} - u_{LR}^{R(PS)}\right) \tag{6.2}$$

In the absence of lagged labour market adjustment processes, unemployment would be "perfectly responsive," i.e. ρ would be zero. If however the full effects of the permanent labour demand shock emerge only gradually, so that the short-run unemployment effects of the shock are less than the long-run effect, then unemployment will be "under-responsive:" $\rho < 0$, i.e. unemployment displays *inertia.* However if unemployment *overshoots* its long-run equilibrium, then our measure may be positive, making unemployment "over-responsive:" $\rho > 0$. Under hysteresis, ρ is infinite.

The permanent shocks in our model are associated with the growth drivers, viz., the capital stock (k_t) and working age population (z_t). Assuming that these variables grow around a linear trend, we let the permanent shock be represented by a one-off change in their period t growth rates (i.e., a parallel shift in the level of the variables). Panel A in Table 7 gives the change in the long-run unemployment rate and our measure of imperfect responsiveness for a percentage point decrease (increase) in the growth rate of capital stock (working-age population). For example, a 1% permanent decrease in capital stock leads to a 0.17% increase in the long-run unemployment rate and produces unemployment over-responsiveness of 2.9%. We call this statistic "*normalized responsiveness*". In our model, the unemployment responds to a permanent shock in both capital stock and population by overshooting, as shown in Figure 8.

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[20] The disparity between the long-run unemployment rate in the presence and absence of the shock is defined as

$$u_{LR}^{R(PS)} \equiv \lim_{j\to\infty} u_{t+j}^{R(PS)}.$$

Moreover, each permanent shocks may be viewed as an infinite sequence of temporary shocks. Thus, the unemployment response in period $t+j$, $j \geq 0$, to the unit permanent shock may be expressed by the sum of all unemployment responses to the corresponding temporary shocks up to that period:

$$u_{t+j}^{R(PS)} = \sum_{i=0}^{j} u_{t+i}^{R(TS)}.$$

Thus the long-run response to the permanent shock is

$$u_{LR}^{R(PS)} = \sum_{i=0}^{\infty} u_{t+i}^{R(TS)} = u_{t}^{R(TS)} + \pi.$$

Table 7: Responsiveness to permanent shocks (%)

Panel A	permanent decrease in k_t	permanent increase in z_t
size of the shock m	-1	1
responsiveness ρ	2.9	4.56
long-run effect $u_{LR}^{R(PS)}$	0.17	0.42

Panel B	permanent decrease in k_t	permanent increase in z_t
size of the shock m	-1.30	0.68
responsiveness ρ	3.77	3.10
long-run effect $u_{LR}^{R(PS)}$	0.22	0.29

Panel C	permanent decrease in k_t	permanent increase in z_t
size of the shock m	-3.39	0.61
responsiveness ρ	9.83	2.78
long-run effect $u_{LR}^{R(PS)}$	0.58	0.26

Similarly to our persistence measures, different sizes of the permanent shock lead to a rescaling of the normalized measures given in Panels B and C of Table 7. One plausible measure of the size of the permanent shock of a growth driver series is obtained by the standard deviation of the change of the series: 1.30 for capital stock and 0.68 for population.[21] Then "*average responsiveness*" (in Panel B of Table 7) may be computed as the product of normalized responsiveness and the size of the shock. When capital stock is permanently reduced by 1.3%, unemployment overshoots by 3.77 percentage points before it stabilizes to its new long-run value of 0.22 %. On the other hand, a 0.68% increase in population generates 3.1% of unemployment overshooting until unemployment stabilizes at 0.29%.

An alternative way to measure the size of the shock is by considering the average change (in absolute terms) in the growth driver series: 3.39 for capital stock and 0.61 for population.[22] Panel C of Table 7 shows that a 3.39% (0.61%) permanent decrease (increase) in capital stock (population) yields 9.83 (2.78) percentage points of unemployment overshooting through time. Note that the average responsiveness measures indicate that capital stock is more over-responsive than population (Panels B-C, Table 7). However, when we normalize by the size of the shock capital stock is less over-responsive than population (Panel A, Table 7).

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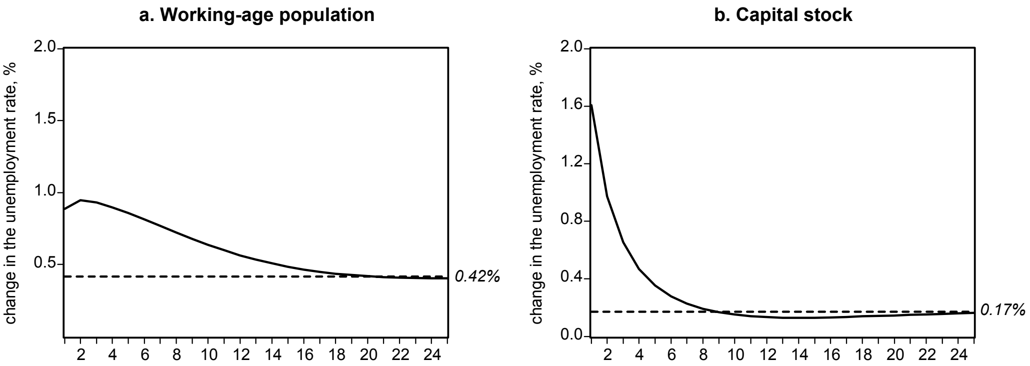
[21] We measure the size of the shock as the standard deviation of the growth rate series, σ_k. (Of course, the size of the shock reported in Table 7 is the arithmetic mean of the standard deviations of the individual countries in our sample.) Under the assumption of normality, this means that there is a 35% chance that the magnitude of the unexpected decrease or increase in the capital stock growth rate is between 0 and σ_k. (Similarly, for population.)

[22] In particular, we measure the size of the shock in the capital stock as $\frac{1}{N}\sum_{i=1}^{N}\frac{1}{T}\sum_{t=1}^{T}|\Delta k_{it}|$, where N and T are the number of countries and years in our sample. (Similarly, for the population shock.)

Figure 8: Effects of Permanent Shocks



The shock is a
1% permanent increase in working age population,
1% permanent decrease in capital stock.

7. Conclusions

This paper takes a fresh look at the sources of unemployment in the European Union. The analysis focuses on prolonged adjustments to labor market shocks, in the form of changes in institutional variables, price variables, and growth drivers (the capital stock and working-age population). We derive the unemployment responses to these shocks and compute the dynamic contributions of each shock to the movements in unemployment. In this context, it emerges that the growth drivers play a particularly important role in accounting for the main swings in EU unemployment. Regarding the institutional variables, social security benefits play a more important role than taxes; and regarding the price variables, competitiveness plays a more important role than interest rates and oil prices.

We argue that our results differ from those in the mainstream literature since we focus on prolonged labor market adjustments in the context of a dynamic multi-equation system. We have shown that single-equation models understate the importance of lagged adjustments.

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