Growth, Unemployment and Tax/Benefit system in European Countries: Theoretical and Empirical Investigations

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Abstract

This paper analyzes how the frictions in the labor market simultaneously affect the economic growth and the long run unemployment. To this goal, we develop a *schumpeterian* model of endogenous growth: agents have the choice of being employed in production or being engaged in R&D activities. Unemployment is caused by the wage-setting behavior of unions. We show that: *(i)* High labor costs or powerful trade unions lead to higher unemployment and lower economic growth. *(ii)* Efficient bargain allows to increase employment, at the price of a lower growth rate. These theoretical predictions are consistent with our empirical analysis based on 183 European Regions, between 1985-1995.

JEL: E24, J5, O41. *Keywords: endogenous growth, unemployment, labor market institutions.*

Introduction

The observed high unemployment in continental Europe and the slowdown in economic growth in the lasts decades naturally raise the question of whether these two phenomena are related. On the empirical side, there is no consensus regarding the sign of the correlation between growth and unemployment, either across countries or over time within a country.[1] The same is true on the theoretical side.[2] Nevertheless, the endogenous growth theory predicts that the distortions due to fiscal instruments lead to a lower growth whereas the equilibrium unemployment theory predicts that these distortions lead to a higher unemployment rate. This suggests that the link between growth and unemployment can be viewed through the simultaneous link between growth, unemployment and labor market institutions.

Following this intuition, in this paper we construct a theoretical economy to assess the explicative role of labor-market variables on the bad performance of European countries. The main hypotheses of our model are the following: *(i)* Innovations are the engine of growth. This implies a "creative destruction" process generating jobs reallocation. *(ii)* Agents have the choice of being employed in production or being engaged in R&D activities; and *(iii)* Unemployment is caused by the wage-setting behavior of the unions representing the workers' interests.

We show that: *(i)* Powerful trade unions or higher labor costs associated to increases in one or more of the labor-market variables (*e.g.*, unemployment compensation, payroll tax, tax on labor income, cost of the employment protection) cause more unemployment and the slowdown of the economic growth. *(ii)* A coordinated bargaining process increases employment, at the price of a lower growth rate. These theoretical predictions are consistent with our empirical analysis and with that of Daveri, Tabellini, Bentolila, and Huizinga (2000).

Using national level data, Daveri *et al.* (2000) find that most continental European countries exhibit a strong positive correlation between the unemployment rate and both, the effective tax rate on labor income and the average replacement rate. Conversely, they find a strong negative correlation between the growth rate of per capita GDP and the tax on labor income. That is true both over time and across countries.

[1]See Mortensen (2004) for a wide review of the empirical literature, which shows the diversity of results about the correlation between growth and unemployment.

[2]This is due to the offsetting nature of two main effects: a higher rate of growth in productivity will reduce unemployment trough a positive "capitalization" effect on investment in job creation; whereas the "creative destruction effect", inherent to the growth process, leads to a faster obsolescence of technologies and so to a faster rate of job destruction.

In contrast, in this paper we explore the heterogeneity of growth and unemployment experiences across 183 European regions and we evaluate how much of this heterogeneity is accounted by the national labor market institutions. The originality of this approach is to take into account the large heterogeneity between regions among a country. We find that: *(i)* the tax wedge and the unemployment benefits increase the regional unemployment rates whereas the employment protection and a high level of coordination in the wage bargaining process decrease the regional unemployment rates, *(ii)* increases in the tax wedge and in the unemployment benefits decrease the regional growth rates of GDP per capita. *(iii)* Nevertheless, a high level of coordination in the wage bargaining process diminishes the regional growth rates of GDP per capita. This last result shows that there is an arbitration between unemployment and growth if we focuss on the impact of the coordination in the wage bargaining process. These empirical results are in accordance with our theoretical model.

The paper is organized as follows. Section 1 describes the model. Section 2 presents the analysis of the impact of labor market institutions on growth and unemployment. Finally, section 3 presents some empirical evidences from a Regional European data set.

1 The model

1.1 Preferences

We assume that the economy is populated by L agents. Each agent is endowed with one unit flow of labor, so L is also equal to the aggregate flow of labor supply. They may be employed in production (x), engaged in research and development activities (n) or unemployed (u): $L = x + n + u$. When employed, workers pay a tax t on their labor income.

All individuals have the same linear preferences over lifetime consumption C of a single final good:

$$U(C) = E_0 \int_0^\infty C_t e^{-\rho t} dt \tag{1}$$

where $\rho > 0$ is the subjective rate of time preference and C_t is the individual's consumption of the final good at time t. Each household is free to borrow and lend at interest rate r_t. However, given linear preferences, the optimal household's behavior implies $\rho = r_t \ \forall t$. Hence, the level of consumption is undefined. A standard solution to this problem is to assume that households consume all their wage income without saving. Under this assumption we can analyze the impact of the unemployment benefit system.

1.2 Final-good sector

The final good is produced by perfectly competitive firms that use the latest vintage of a unit continuum of intermediate inputs,[3]

$$C = \int_0^1 A_j x_j^\alpha dj, \quad 0 < \alpha < 1, \quad j \in [0, 1] \tag{2}$$

A_j represents the productivity of the latest vintage of intermediate good j and is determined by the number of technical improvements realized up to date t, knowing that between two innovations the gain in productivity is equal to $q > 1$ (step size).

Taking the final good as *numéraire* the profits flow is equal to

$$C - \int_0^1 p(x_j) x_j dj$$

1.3 Intermediate-goods sector

Production of one unit of intermediate good j requires one unit of labor as input: $x_j = x_j$.

Since the final-good sector is perfectly competitive, the price of the intermediate good j, $p(x_j)$, is equal to the value of its marginal product:

$$p(x_j) = \frac{\partial C}{\partial x_j} = \alpha A_j x_j^{\alpha - 1} \quad \forall j \tag{3}$$

1.4 R&D sector

Technological spillovers lead to good-specific public knowledge allowing to the potential innovators to begin their efforts to improve upon the current "state of the art". But there are no spillovers between sectors. Then, when an amount n_j of labor is used in R&D on good j, innovations arrive randomly at a Poisson rate hn_j, with $h > 0$ a parameter indicating the productivity of the research technology: a potential entrant obtains ideas for new products at frequency h per period. Albeit the innovation frequencies are independent across goods, the expected gains are the same everywhere, hence $\forall j \; n_j = n \quad \Rightarrow \quad A_j = A$.

[3]We omit the time index since between two innovations all is constant.

1.5 Arbitrage condition for innovators

At the "state of the art" v, the aggregate number of potential innovators on some good j is given by the following arbitrage condition:

$$\frac{(1-t)W_{j,v}}{h} \leq \min_i V_{i,v+1} \quad \forall i,j \in (0,1) \tag{4}$$

The cost of $R\&D$ can be viewed as an opportunity cost: the income that the individual loses $(1-t)W_{i,v}$ times the expected duration of the innovation process $1/h$. On the other hand, $V_{j,v+1}$ is the discounted expected payoff of next innovation on sector j,[4]. However, given that the expected gains from an innovation are identical across sectors, at equilibrium $V_i = V_{i'}$ $\forall i, i' \in (0,1)$. V is determined by the asset equation:

$$rV_{j,v+1} = \Pi_{j,v+1} - hn_{v+1}(V_{j,v+1} + E_{v+1}) \tag{5}$$

$\Pi_{j,v+1}$ are the monopolistic profits earned by the successful innovator, who gets a patent on her innovation, from the sales to the final-good sector until the arrival of next innovation. We assume that the employment protection laws imply a cost E of shutting down a firm, and that the monopolist pays a proportional payroll tax τ over employment. Then,

$$\Pi_{j,v+1} = \alpha A_{v+1} x^{\alpha}_{j,v+1} - W_{j,v+1}(1+\tau)x_{j,v+1} \tag{6}$$

so, the expected income generated by a patent on an innovation is equal to the instantaneous profit minus the expected capital loss that will occur when the current innovator is replaced by a new innovator (the flow probability of the profits loss is the arrival rate hn_{v+1} which is the same for all j, as was argued above). Normalizing the lasts expressions by the productivity level associated to the $(v+1)^{th}$ innovation we obtain:

$$\pi_{j,v+1} = \alpha x^{\alpha}_{j,v+1} - w_j(1+\tau)x_{j,v+1} \tag{7}$$

hence the free entry (4) condition becomes:

$$\begin{aligned} (1-t)w_{j,v} &= qhv_{j,v+1} \\ &= qh\left(\frac{\pi_{j,v+1} - hn_{v+1}e}{r + hn_{v+1}}\right) \end{aligned} \tag{8}$$

for $\pi \equiv \frac{\Pi}{A}$, $w \equiv \frac{W}{A}$, $e \equiv \frac{E}{A}$ and $v \equiv \frac{V}{A}$.

[4]Equivalently, the entry condition also reflects the fact that labor can be freely allocated between production and research: $(1-t)W_{j,v}$ is the net value of an hour in production while $hV_{j,v+1}$ is the expected value of an hour in research.

1.6 Wage bargaining

For each intermediate good sector there is a trade union representing the workers' interests. So the wage rates are the solutions to the bargaining problems between each monopolist and each trade union. We model the bargaining process as a a generalized Nash bargaining game with relative bargaining power β. Given this way of sharing surplus, the union chooses the wage, and the firm chooses the level of employment given this wage (the "right-to-manage" assumption). We assume that all jobs are equally productive and that all workers have the same unemployment benefits so that the wage fixed for each type of job is the same everywhere. But the firm and the trade union in sector j are too small to influence other markets, so the wage rates are settled taking everything else constant.

The union anticipates the labor demand as

$$x_{j,v+1}(w_j) = \arg\max\{\pi_{j,v+1}(x_{j,v+1})\} = \left(\frac{\alpha^2}{(1+\tau)w_j}\right)^{\frac{1}{1-\alpha}}$$

Then, for $0 \leq \beta \leq 1$, the bargained unskilled wage is:

$$\begin{aligned} w_j &= \arg\max\left\{[((1-t)w_j - b)x_{j,v+1}]^{\beta}(\pi_{j,v+1} - hn_{\tau+1}e - \bar{\pi}_{\tau+1})^{1-\beta}\right\} \\ &= \left(1 + \frac{\beta(1-\alpha)}{\alpha}\right)\left(\frac{b}{1-t}\right) \end{aligned}$$

$\bar{\pi}_{\tau+1} \equiv -hn_{\tau+1}e$ denotes the firm's disagreement point and $b \equiv \frac{B}{A}$ the adjusted unemployment compensation.

1.7 Equilibrium

Given $r > 0$, for all intermediate good sector j and for all "state of the art" v a ***steady-state (or balanced growth path) equilibrium*** is defined as follows:

(i) **Wage rule:**

$$w = \frac{\beta_1 b}{1-t}, \quad \beta_1 \equiv 1 + \frac{\beta(1-\alpha)}{\alpha} \tag{9}$$

(ii) **Labor demand for production:**

$$x = \left(\frac{\alpha^2(1-t)}{(1+\tau)\beta_1 b}\right)^{\frac{1}{1-\alpha}} \tag{10}$$

(iii) **Potential Innovators**
From the free entry condition we deduce:

$$n = \left(\frac{1}{h}\right)\left(\frac{qh\pi - r\beta_1 b}{\beta_1 b + qhe}\right) \tag{11}$$

where

$$\pi = \frac{(1-\alpha)(1+\tau)\beta_1 b}{\alpha(1-t)} x \tag{12}$$

(iv) **Unemployment:**
Unemployment u is deduced from the employment identity given the endowment of labor L, the labor demand for production x and the aggregate number of potential innovators n:

$$u = L - x - n \tag{13}$$

(iv) **Economic growth:** The rate of growth in aggregate consumption is given by (see the appendix A):

$$g_t = hn\ln(q) \tag{14}$$

2 The impact of labor market institutions on growth and unemployment

2.1 Labor market policies

In this section we analyze the consequences for growth and unemployment of, *(ii)* a more generous unemployment insurance, *(ii)* higher taxes on labor incomes, and *(iii)* the employment protection.

Proposition. 1 *An increase in the unemployment compensation (b), or in the payroll taxes (τ), or in the taxes on labor income (t) or in the employment protection (e), leads to (i) higher unemployment and (ii) lower rate of growth.*

Proof. a. It is easy to show that:

$$\frac{\partial x}{\partial n}|_{n=b,\tau,t} < 0 \quad \text{and} \quad \frac{\partial \pi}{\partial n}|_{n=b,\tau,t} < 0$$

So,

$$\frac{\partial g}{\partial n}|_{n=b,\tau,t} = \frac{qh\ln(q)}{\beta_1 b + qhe}\frac{\partial \pi}{\partial n}|_{n=b,\tau,t} < 0$$

This result is very intuitive: a higher labor cost implies a higher wage (equation (9)) and so a decline in the labor demand (equation

(10)). The total outcome is a contraction of the monopolistic profits with the subsequent reduction in the expected value of an innovation. This, together with the fact that the higher wages make production more attractive with respect to R&D, tends to reduce the number of researchers. Thus, the growth rate falls too.

b. $\frac{\partial x}{\partial e} = 0 \Rightarrow \frac{\partial u}{\partial e} = -\frac{\partial n}{\partial e} > 0$.

Since neither the wage rates or the labor demands change, the only effect is a contraction of the profits. This discourages that workers engage in *R&D* activities, and then the growth rate falls and the unemployment raises.

2.2 The wage bargaining processes

The impact of the unions can be analyzed in two steps. First, for an uncoordinated wage bargaining process one can derive the implications of a higher bargaining power. Second, we can compare the outcome of an efficient bargaining process with the inefficient outcome computed above.

2.2.1 The bargaining powers

Proposition. 2 *An increase in the unions' bargaining power leads to an increase in the unemployment level and to a decrease in the economic growth.*

Proof. Analogous to the proof of proposition 1: $\frac{\partial x}{\partial \beta} < 0$ and $\frac{\partial \pi}{\partial \beta} < 0$. So, $\frac{\partial g}{\partial \beta} = -\frac{(1-\alpha)\ln(q)}{\beta_1 b + qhe}\left(\frac{\pi}{(1-\alpha)\beta_1} + \frac{(r+hn)b}{\alpha}\right)$.

The economic intuition is the following: a bigger bargaining power implies higher wages. Then the labor demand for production declines, this contracts the monopolistic profits and so the expected value of an innovation. This discourages workers from R&D. The total outcome is higher unemployment and lower economic growth.

2.2.2 Inefficient v.s. efficient bargain

If in each sector the monopolistic firm and the trade union bargain over both the labor demand and the wage rate jointly, the outcome is the efficient one (E). That is, the wage and the firm size pairs are the solution to the following problem:

$$(w^E_{j,v+1}, x^E_{j,v+1}) = \arg\max\Big\{[((1-t)w^E_{j,v+1} - b)x^E_{j,v+1}]^\beta$$
$$(\pi^E_{j,v+1} - hn^E_{v+1}e - \bar{\pi}^E_{v+1})^{1-\beta}\Big\}$$

The firm's disagreement points and the instantaneous profit flow are respectively:

$$\begin{aligned}
\bar{\pi}_{v+1} &\equiv -hn_{v+1}e \\
\pi^E_{j,v+1} &= \alpha(x^E_{v+1})^\alpha - w^E_{j,v+1}(1+\tau)x^E_{j,v+1}
\end{aligned}$$

Then at equilibrium, for all j and for all vintage v:

$$w_E = \frac{\beta_1 b}{1-t} \tag{15}$$

$$x_E = \left(\frac{(1-t)\alpha^2}{(1+\tau)b}\right)^{\frac{1}{1-\alpha}} \tag{16}$$

$$n_E = \left(\frac{1}{h}\right)\left(\frac{qh\pi_E - r\beta_1 b}{\beta_1 b + qhe}\right) \tag{17}$$

$$\pi_E = \frac{(1-\alpha\beta_1)(1+\tau)b}{\alpha(1-t)}x_E$$

Proposition. 3 *Under efficient bargaining, employment levels are larger but the rate of economic growth is also lower than under uncoordinated bargaining. However, the comparison is ambiguous for unemployment.*

Proof. It is easy to verify that $x_E = x\beta_1^{\frac{1}{1-\alpha}}$. Since $\beta_1 \geq 1$, then $x \leq x_E$.

On the other hand, $\pi_E < \pi \Rightarrow n_E < n \Rightarrow g_E < g$. Because there are less researchers but more employed in production, we don't know the total effect on u.

The gain in employment for the same labor costs is due to the coordination in the setting of wages and the labor demand for production. Yet, the decreasing returns to research induce a contraction of the monopolistic profits while the opportunity cost of R&D is unchanged. Consequently, there are less researchers under efficient bargaining.

3 Empirical Analysis

The observed high unemployment in continental Europe and the slowdown in economic growth in lasts decades naturally raised the question of whether these two phenomena are related. Our theoretical framework clearly shows that the labor market institutions imply high unemployment and low growth. However, on the empirical side, no consensus was found regarding the sign of the correlation between growth and unemployment, either across countries or over time within a country.

Whereas the institutions causing elevate labor costs are accepted in the empirical literature as the primary cause for high unemployment in continental European countries[5], the statistical relationship between unemployment-causing variables and long run economic growth is a moot point. For instance, Layard and Nickell (1999) show that the relationship between unemployment-causing variables and TFP growth is weak or nonexistent. Conversely, Daveri *et al.* (2000) or Alonso, Echeverria, and Tran (2004) report a negative significant impact of these labor market institution variables on the growth rate of a large panel of OECD countries. These recent empirical findings constitute an interesting point to be explored deeply. With this aim, in this section we explore if the heterogeneity of growth and unemployment experiences across European countries prevails at a regional level and, if that is the case, how much of this is accounted by the labor market institutions.

3.1 The data

The disaggregated data we use comes from the Eurostat *European Regional Database (2005).* The Statistical regions of Europe correspond to the second level of the Nomenclature of Territorial Units for Statistics (NUTS 2 regions). The average size of the regions in this category is between 800 000 and 3 million. Details on this classification can be found at European Union's web site.[6]

The corresponding countries to the regions considered are: Austria (AT), Belgium (BE), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Ireland (IE), Italy (IT), Netherland (NL), Portugal (PT), Sweden (SE) and the United Kingdom (UK), for the period 1980-1995.

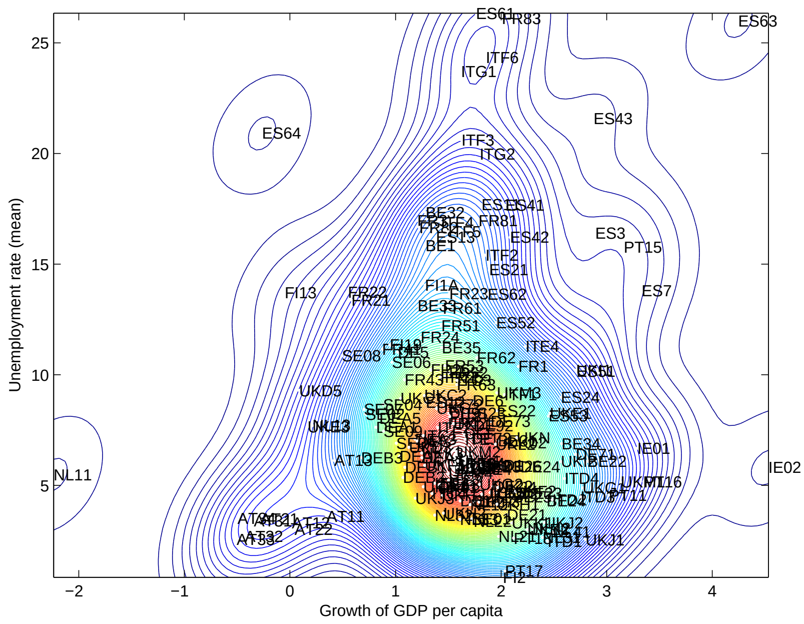
Concerning the labor market institution indicators, we use the data provided by Blanchard and Wolfers (1999) and by the OECD (1999): Tax wedge (TW), Unemployment benefit (BRR), Employment protection (PE), Coordination (CO), Active labor market policies (ActPol) and Collective bargaining coverage (CbC).

[5]See, among others, Blanchard and Wolfers (1999).
[6]*http://europa.eu.int/comm/eurostat/ramon/nuts*

3.2 Growth and Unemployment at a regional level: a descriptive analysis

To shed some light on the relation between GDP per capita growth and unemployment, we can estimate the joint density of these two variables. This is done in figure 1 where we have drawn the contour plot associated to the kernel (non-parametric) estimator of this bivariate density. Looking at the regional level, we do not find a clear relation between output per capita growth and unemployment.

Figure 1: Joint distribution. GDP per capita growth and unemployment rate (mean), 1980–1985*.



*: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK). The variance in 1980 is normalized to one.

Nevertheless, the joint distribution of the growth of the TFP and the growth of GDP per capita (figure 2) and the joint distribution of the growth of the TFP and the relative unemployment rate (figure 3) suggest a stronger result. The correlation between the growth of the TFP and the growth of the GDP per capita is clearly positive, whereas the correlation between the growth of the TFP and the unemployment rate is negative. The regional development, measured by the growth of TFP, leads to more output per capita and less unemployment. In the latter case, the negative relationship is not strong enough to imply a clear link between growth of GDP and unemployment.

Figure 2: Joint distribution. Growth of GDP per capita and Growth of TFP (mean), 1980–1985*.

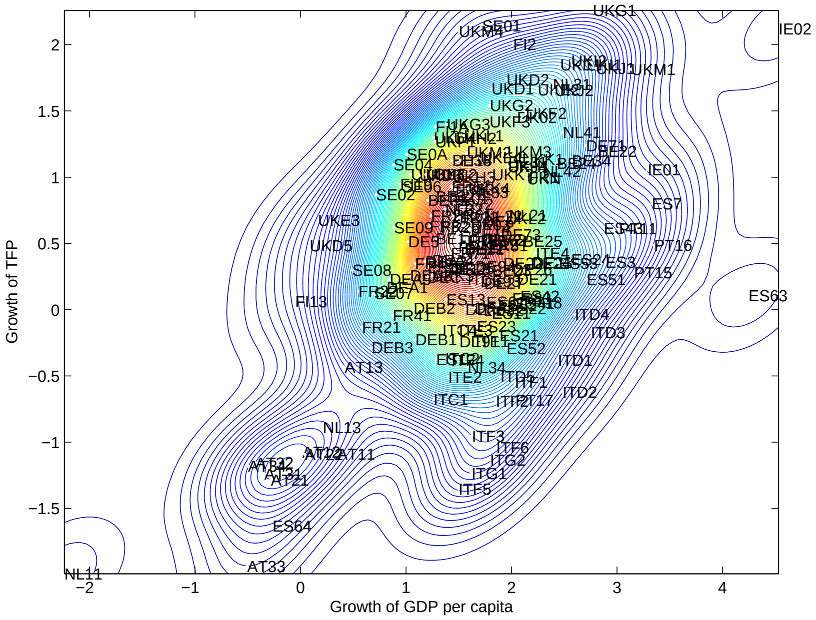
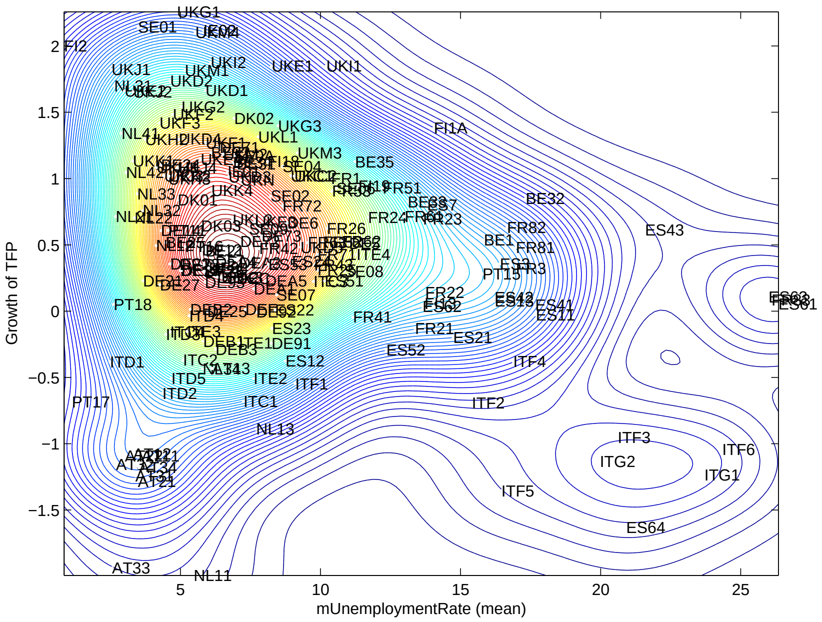


Figure 3: Joint distribution. Unemployment rates and Growth of TFP (mean), 1980–1985*.



3.3 Recovering the missing link: an econometric analysis

At a disaggregated level, the gross domestic product per capita growth and the unemployment rate seem to be very weakly related. According to Daveri and Tabellini (2000) the relation between these two variables at the national level has mainly to be explained by common job-market-related national policies, and more precisely by taxes on wages. In this section we propose a formal statistical test allowing to evaluate the impact of national labor market institutions (taxes on wages, union density, unemployment benefits, employment protection, *etc*...) on GDP per capita growth and on Unemployment rate, measured at a regional level. Hence, the originality of the approach is to take into account the large heterogeneity between regions among a country.

The specificity of each European region is measured by the mean of the growth rate of its Solow residual, which is computed assuming that the technology in each region is Cobb-Douglas. This indicator can be viewed as the closest measure of the specific technology available in a specific region[7].

3.3.1 Empirical model

Let $\mathcal{X}_c$ be a $1 \times k$ vector gathering the policy variables of country $c = 1, \ldots, C$. Each country c is divided in N_c regions $i = 1, \ldots, N_c$ and we define $N = \sum_{c=1}^{C} N_c$ the total number of European regions in our sample. Let $\mathbf{c}$ be a mapping from the regional indices to the national indices:

$$\begin{aligned} \mathbf{c} : \{1, \ldots, N\} &\mapsto \{1, \ldots, C\} \\ j &\rightarrow \mathbf{c}(j) \end{aligned}$$

Our empirical model is defined by the two following equations:

$$\begin{aligned} g_j &= \alpha^g + \mathcal{X}_{\mathbf{c}(j)}\beta^g + \mathcal{S}R_j\gamma^g + \varepsilon_j^g \\ u_j &= \alpha^u + \mathcal{X}_{\mathbf{c}(j)}\beta^u + \mathcal{S}R_j\gamma^u + \varepsilon_j^u \end{aligned} \tag{18}$$

where g_j and u_j are respectively the growth rate of GDP per capita and the unemployment rate (average) of region j, α^g and α^u are two constants that will eventually be replaced by the following set of dummy variables: dum_1 : DK, SE, NL, FI; dum_2 : BE, DE, FR, ES, PT, AT; and dum_3 : IE, UK. ε_j^g and ε_j^u are two zero expectation random variables such that $E\left[\varepsilon_j^s\varepsilon_j^s\right] = \sigma_s^2$, $E\left[\varepsilon_j^s\mathcal{X}_{\mathbf{c}(j)}\right] = 0$ for $s = u, g$

[7]In the theoretical model, we can assume that the innovation process is specific to each region.

and $E\left[\varepsilon_j^u \varepsilon_j^g\right] = 0$[8]. Finally, the growth rate of the Solow residual is denoted by $\mathcal{S}R_j$.

3.3.2 Empirical strategy

The estimation of model (18) may be done using OLS equation by equation, but this approach would eventually be sensible to the existence of outliers. Figures 1, 2 and 3 suggest that there is a number of such observations, so a more robust approach is needed. In order to obtain point estimates less sensible to outliers we use a median-regression (LAD) instead of mean-regression (OLS). For instance, in the case of the growth equation this estimator is defined as follows:

$$\begin{aligned} \widehat{b}^g_{LAD,N} &\equiv \left(\widehat{\alpha}^g_{LAD,N}, \widehat{\beta}^g_{LAD,N}, \widehat{\gamma}^g_{LAD,N}\right) \\ &= \arg\min_{\{\alpha^s,\beta^s,\gamma^s\}} \sum_{j=1}^{N} \left| g_j - \alpha^g - \mathcal{X}_{\mathbf{c}(j)}\beta^g - \mathcal{S}R_j\gamma^g \right| \end{aligned}$$

we minimize the sum of the absolute values of the residuals instead of the sum of the squared residuals. The asymptotic distribution of this estimator is given by:

$$\sqrt{N}\left(\widehat{b}^g_{LAD,N} - \beta\right)_{N\to\infty} \Longrightarrow \mathcal{N}\left(0, \frac{1}{2f_{\varepsilon^g}(0)}(X'X)^{-1}\right)$$

where X is a $N \times (k+2)$ matrix gathering the constant, the set of policy variables and the growth rate of the Solow residual, and f_{ε^g} the density function associated to the error term. As a consequence, to test if a parameter significantly differs from zero we have first to evaluate the density of the error term at zero. To evaluate the variance of $\widehat{b}^g_{LAD,N}$ we can (i) impose a parametric shape to the error term, (ii) use a nonparametric (kernel) estimate of the density at zero or (iii) use a bootstrap approach as described in Greene (2002). In what follows we consider the latter solution, which has the advantage over (i) and (ii) to be exact at finite distance.

To understand why this approach is less sensible to outliers than a mean-regression approach we can consider a simple example. Let $y_i = \gamma + \epsilon_i$, with $\epsilon_i \equiv \mathcal{N}(0,\sigma^2)$ and $i = 1, \ldots, N$, be our Data Generating Process. The OLS estimator of γ is defined by $\widehat{\gamma}_{OLS,N} = \arg\min_{\{c\}} \sum_{i=1}^N (y_i - c)^2 = \bar{y}$. The LAD estimator of γ is defined by $\widehat{\gamma}_{LAD,N} = \arg\min_{\{c\}} \sum_{i=1}^N |y_i - c| =$ median of $\{y_i\}$. If, say, ϵ_N is an outlier (for instance $\epsilon_N = 100$) the median (LAD) will be much less affected than the mean (OLS).

[8]Under these assumptions we can estimate (18) equation by equation.

3.3.3 Results

Estimations are reported in table 1. We estimate two regressions: a first one where the endogenous variable is the growth rate of GDP per capita for each European Region (labeled Growth) and a second one where the endogenous variable is the Regional unemployment rate (labeled Unemployment).

In the growth equation, excepting for the PE (Employment protection), the Actpol (active labor market policies) and the CbC (collective bargaining coverage), all the point estimates significantly differs from zero at a 5% level. Moreover, the estimates show the expected signs. These results largely confirm the predictions of the theoretical model. Nevertheless, in the theoretical model, we find that an increase in the employment protection and in the wage bargaining power leads to a decrease in the growth rate. This gap between the theoretical and the empirical findings can be explained by the data used to approximated the employment protection (PE) and the bargaining power (CbC). Concerning the variable Actpol (active labor market policies), our theory does not provide any information on the link between the economic growth and this variable. Finally, the positive link between the growth rate of the regional TFP and the growth rate of GDP per capita, suggested by figure 2, is confirmed by this statistical analysis.

Concerning the unemployment equation, all the variables have the expected signs, except ActPol (active labor market policies) and are significant, except CbC (collective bargaining coverage).

In summary, the following empirical results confirm our theoretical approach:

- the tax wedge (TW) and the unemployment benefits (BRR) lower the growth rates but increase the unemployment rates,
- the coordination of the wage bargaining (CO) lowers the growth rates and the unemployment rates. More than a validation, this last result gives the sign of the link between unemployment and coordination which is ambiguous in our theoretical model,
- the growth rate of the TFP increases (decreases) the growth of the GDP per capita (the unemployment). In our model, an higher TFP is due to a more efficient *R&D* sector (*i.e.* a higher value of h).

Nevertheless, the links between the bargaining power and the endogenous variables are not significant, whereas our theoretical model suggests unambiguous relationships. These results can be explained by the bad approximation of the bargaining power by our statistical measure (collective bargaining coverage (CbC)). Our empirical results

	Growth		Unemployment	
	β	p-value	β	p-value
gTFP	0.7983	0.0000	-0.9349	0.0070
TW	-3.0425	0.0000	5.1462	0.0250
BRR	-0.5436	0.0000	2.8232	0.0000
PE	0.4098	0.1006	-7.7997	0.0000
CO	-2.0250	0.0000	-20.453	0.0000
ActPol	0.2215	0.0718	4.3593	0.0000
CbC	-0.2311	0.6081	0.5911	0.8058
dum1	5.1820	0.0153	156.33	0.0000
dum2	8.4435	0.0152	279.67	0.0000
dum3	-1.5131	0.0179	17.819	0.0000
Fischer	232.04	0.0000	81.07	0.0000
R^2	0.6789	–	0.3484	–
♯ Observations	183	–	183	–

Table 1: LAD estimation. The dependent variables are annual mean GDP per capita growth rate for the **Growth** regression and mean unemployment rate for the **Unemployment** regression. Student and associated p-values are computed with a bootstrap procedure as advocated by Greene (2002).

suggest to extend the theoretical model in order to take into account the active labor market policies (ActPol) because they significantly increase the unemployment rate.

Finally, for the growth and unemployment equations, the R^2 are respectively 68% and 35%, meaning that our collection of labor market related policy variables and the growth rate of the TFP explains more than 2/3 of the heterogeneity in growth rates and roughly 1/3 of the heterogeneity in unemployment rates. As expected, the role of Solow residuals is much more important explaining growth than unemployment.

3.3.4 Counterfactuals

In this section, we propose to evaluate the marginal impact of both national (each labor market institution) and regional (the growth rate of the TFP) components on the predicted growth and unemployment rate of an European region.

The methodology

Let considers the following experience. We assume that a Region j' in France has the same environment than a region j in UK excepting for one of its national specific variables (labor market policies) or its specific regional one. Using the estimation of the growth and unemployment rate, this experience allows us to evaluate the marginal impact of the national/regional specific variables.

More precisely, we construct these counterfactual experiences as follows:

- Predicted GDP per capita growth of Region j in UK is defined by:

  $$\widehat{g}_{j,UK} = \hat{c}_g + \mathcal{X}_{UK}\hat{\beta}_g + \mathcal{S}R_{j,UK}\hat{\beta}_g$$

  with $\mathcal{X}_{UK} \equiv (TW_{UK}, BRR_{UK}, PE_{UK}, CO_{UK}, ActPol_{UK}, CbC_{UK})$

- Suppose that Region j' in France is as Region j in UK with respect to all the conditioning variables except Tax Wedge. Hence Region j' in France counterfactual GDP per capita growth will be:

  $$\widetilde{g}^{TW}_{j',FR} = \hat{c}_g + \widetilde{\mathcal{X}}^{TW}_{FR}\hat{\beta}_g + \mathcal{S}R_{j',UK}\hat{\beta}_g$$

  with $\widetilde{\mathcal{X}}^{TW}_{FR} \equiv (TW_{FR}, BRR_{UK}, PE_{UK}, CO_{UK}, ActPol_{UK}, CbC_{UK})$

  The gap between $\widehat{g}_{j',FR}$ and $\widetilde{g}^{TW}_{j',FR}$ gives a measure of the marginal effect of the French fiscal policy.

The results

Due to the high number of Regions (183), we focus only on typical cases. Then, we assume that the reference is London, and we choose to evaluate the marginal impact of typical European labor market experience. Then, we choose a north continental country (France), a south continental country (Spain) and a Nordic country (Sweden). In the two first countries, we propose to evaluate the marginal impacts of the explanatory variable in two Regions: a Region highly developed and a poor one. For France, we choose "Ile de France" because this Region encompasses Paris, and "Corse". For Sapin, we choose "Madrid" and "Andalucia".

Figures 4 and 5 present the results for the French economy. First in figure 4, we show that the predictions of the econometric model are close to the observed values. The point TW represents the prediction of the model if all the explanatory variables, except the taxes, are the same than in London. Hence, the gap between the prediction for London and this point gives a measure of the marginal impact of

Figure 4: The French case (I): London versus Paris (Ile de France). Observed and predicted London are respectively denoted "London" and "**London**". We use the same color convention for Île de France. The marginal effects of our explanatory variables are in soft color (CbC, Tw, *etc...*).

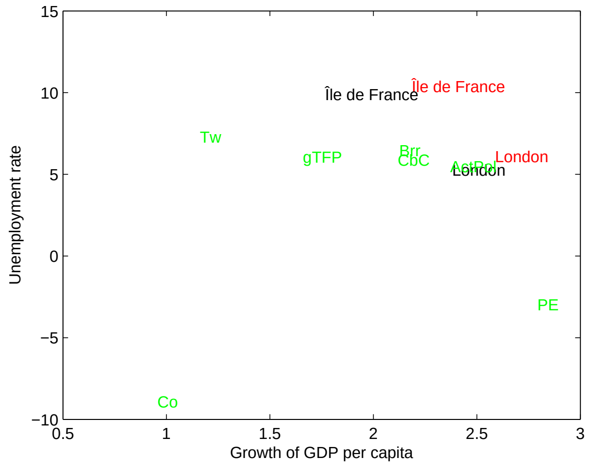
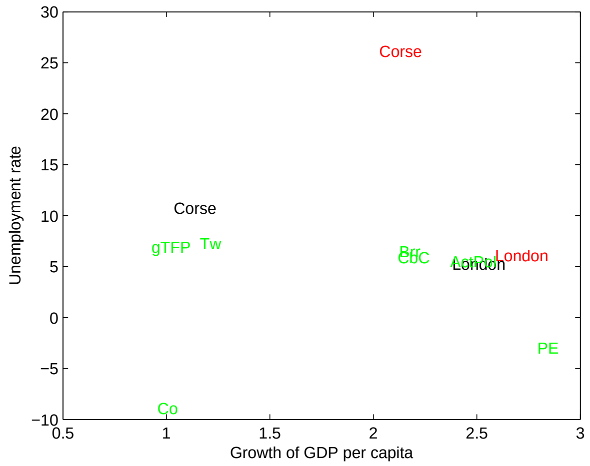


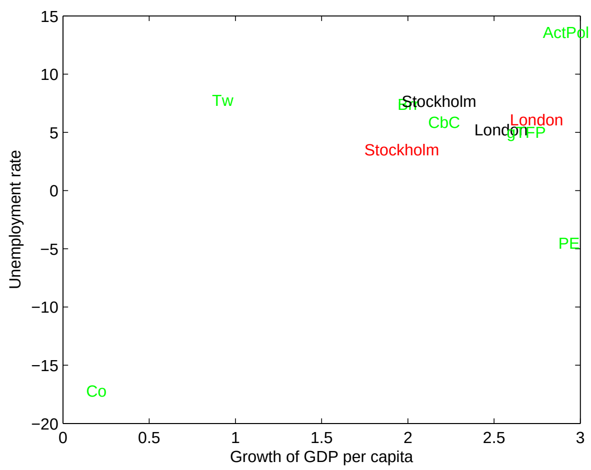
Figure 5: The French case (II): London versus Corse



the French tax[9]. The higher unemployment and the lower growth in Paris than in London are mainly due to the higher tax (TW) and to a lower growth in TFP (gTFP). Moreover, the wage bargaining coordination (CO) in France leads to less unemployment but at the price of a lower growth rate of the GDP per capita. Second, in figure 5, we show that the predictions of the model are quit poor for Corse, the poorest French Region. This clearly suggests that this region gets specific policies which lead to a higher unemployment than its model predictive value. Nevertheless, this experience for Corse underlines that, beyond the national component as the high tax (TW) already mentioned for Paris, it is the lack of $R\&D$ investments, measured by the growth rate of the TFP (gTFP) that largely explains the lower performance of this Region.

Figure 6 gives an illustration of our estimation for a Nordic Region, the Region of Stockholm. The results show that higher taxes in Sweden than in UK lead to more unemployment and less growth. Nevertheless, contrary than for the French Region, the level of the growth rate of the TFP leads this Nordic Region to converge toward the Region of London. Moreover, as the coordination of the wage bargaining is higher than in the French economy, this leads to largely decrease the unemployment rate, whereas the impact of this labor market institution is negligible in the growth equation.

Figure 6: The Nordic case: London versus Stockholm



[9]The same is tue for all the explanatory variables: employment protection (PE), unemployment benefits (Brr), *etc...*

Figure 7: The Spanish case (I): London versus Madrid

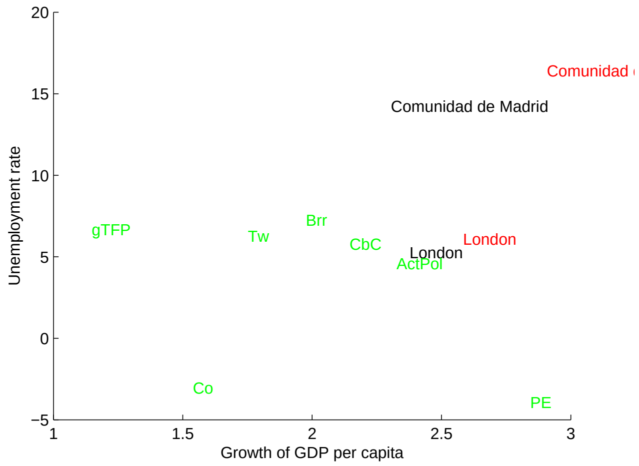
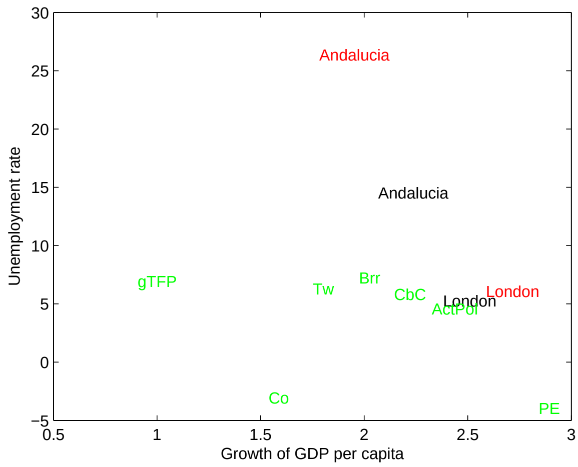


Figure 8: The Spanish case (II): London versus Andalucia



What do we learn from the Spanish cases? Figures 7 and 8 show that these higher unemployment rates are mainly due to the low level of TFP growth. If the growth rate of the GDP per capita is high, it is not explained by a high level of technology (gTFP). Then, these Regions have a high level of growth (equal or higher than the one observed in the Region of London), but this growth can be explained only by a catch-up phenomena. The poor performances measured by the growth rate of the TFP, even in Madrid, would lead the Spanish government to give some incentives in the R&D sector. The estimation also shows that the labor market institutions in Spain lead to better economic performances than in France, for exemple.

Concluding remarks

We have constructed a general equilibrium model in which economic growth and unemployment are endogenously determined by the number of innovations made in the economy, which in turn is determined by the workers' incentive to engage in R&D activities. We have shown that high labor costs or powerful trade unions lead to bigger unemployment and to a slowdown of the economic growth whereas an efficient bargain allows to higher employment, at the price of a lower growth rate.

Using a cross-section of European regions and a large set of labor market variables, we find that national institutions on the labor market are highly correlated with unemployment. Hence, the tax wedge and the unemployment benefits increase the regional unemployment rates whereas the employment protection and a high level of coordination in the wage bargaining process decrease the regional unemployment rates. On the other hand, we find that increases in the tax wedge and in the unemployment benefits decrease the regional growth rate of GDP per capita. Nevertheless, a high level of coordination in the wage bargaining process decreases the regional growth rate of GDP per capita. This last result shows that there is an arbitration between unemployment and growth if we focuss on the impact of the coordination in the wage bargaining process.

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A The Rate of Growth

The average growth rate of consumption good (or final output) is deduced as follows: we know that between two consecutive innovations, say τ and $\tau + 1$, final output is augmented a fixed amount q, $C_{\tau+1} = qC_{\tau}$. Hence, between date t and date $t + 1$ expected output is given by the following relationship

$$E[C_{t+1}] = q^{\int_0^1 hn_t dt} C_t$$

since from the law of large numbers, the expected value of the number of innovations (the aggregate arrival rate hn) is the same across sectors. Then, by taking logarithms and arranging terms we have that

$$g_t \equiv E[\ln C_{t+1} - \ln C_t] = hn_t \ln(q) \tag{19}$$