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How do Labor Market Institutions affect the Link between Growth and Unemployment: the case of the European countries

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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 between employment and R&D activities. Unemployment is caused by the wage-setting behavior of unions. We show that: (i) Increases in the labor costs or in the power of 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 the insights from our empirical analysis based on 183 European Regions, between 1980-2003.

JEL Classification: E24, J51, O33, O4, O52.

Keywords: Endogenous Growth, Unemployment, Labor Market Institutions.

1. Introduction

The observed high unemployment in continental Europe and the slowdown in economic growth in the last 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.[4] The same is true on the theoretical side.[5] Nevertheless, the endogenous growth theory predicts that 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 economic growth and long-run unemployment are linked through the labor market institutions.

In this paper we investigate the issue of the long run link between growth and unemployment at two levels. First, we construct a theoretical economy to study the role of labor-market variables on the bad performance of European regions. The three main hypotheses of our model are the following: *(i)* Innovations are the engine of growth. *(ii)* Agents have the choice of being employed or being trying their hand at R&D. *(iii)* Unemployment is largely caused both by the wage-setting behavior of unions, and by

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[4] See Mortensen (2005) for a wide review of the empirical literature, which shows the diversity of results regarding the correlation between growth and unemployment.

[5] 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.

the labor costs associated to the tax/benefit system.[6] Second, at the light of this model, we explore the growth and unemployment experiences across 183 European regions. The observed heterogeneity is so large that it is difficult to distinguish some relation between these two variables, relation that is often found at national level. Hence, we try to recover a link through the expected effects of several institutions present on the labor market. To this end, we assess the effect of institutions on the (regional) growth and unemployment rates.[7]

The key implications of the theoretical model are the following. First, the bargaining power of unions, the unemployment compensation, the taxes on labor and the employment protection have a positive effect on unemployment and a negative effect on the economic growth. Second, a more coordinated bargaining process increases employment, at the price of a lower economic growth. The first result clearly contrast with the results of Lingens (2003) or Mortensen (2005): Lingens (2003) treats the impact of unions in a model with two kind of skills, and shows that the bargain over the low-skilled labor wage causes unemployment but the growth effect is ambiguous. Similarly, in a matching model of schumpeterian growth, Mortensen (2005) finds a negative effect of labor market policy on unemployment, but an ambiguous effect on growth.

On the other side, the main insights from the empirical exercise are twofold. First, the tax wedge and the unemployment benefits are positively correlated with the regional unemployment rates. Conversely, the employment protection and the level of coordination in the wage bargaining process are negatively correlated with the regional unemployment rates. Second, the tax wedge and the unemployment benefits are negatively correlated with the regional growth rates of the Gross Domestic Product (GDP) per capita. Conversely, more coordination in the wage bargaining process is associated to lower regional growth rates. This points to the existence of a trade-off between unemployment and growth, if we focus on the impact of coordination in the wage bargaining process.

These results are in accordance with the Daveri and Tabellini (2000)' results, who using aggregate (national) data, 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 GDP per capita and the tax on labor income, either over time and across countries.

[6] The two first hypotheses are the same as those of Aghion and Howitt (1994). As in their model, there is some unemployment due to the creative destruction process. However, job creations and job destructions occur simultaneously.

[7] The originality of this approach is to take into account the large heterogeneity between regions among a country.

2. The model economy

In this section we develop a theoretical model to study the equilibrium link of economic growth and the long run unemployment at the light of the labor market institutions.[8]

2.1 Preferences

The economy is populated by L identical agents, each endowed with one unit flow of labor. At each time, they may be employed (x), trying their hand at R&D (n) or unemployed (u): $L=x+n+u$. Employed agents pay a tax τ^w on their labor income whereas unemployed agents receive the unemployment benefits B.

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

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

where $\varrho>0$ is the subjective rate of time preference and C_t is the per capita 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 agent's behavior implies $\varrho=r_t$ $\forall t$. Hence, the level of consumption is undefined. A standard solution to this problem is to assume that agents consume all their wage income. This assumption allows us to analyze the impact of several labor market policies.

2.2 Goods sector

The final good is produced by perfectly competitive firms that use the latest vintage (ν) of a continuum of intermediate inputs x_j,

$$C = \int_0^1 A_j x_j^\alpha dj, \quad 0 < \alpha < 1, \quad j \in [0,1] \qquad (2)$$

A_j represents the productivity of the intermediate good j and is determined by the number of technical improvements realized up to date t, knowing that between two consecutive innovations the gain in productivity is equal to $q>1$ ($A_{\nu+1}=qA_\nu$). In turn,

[8] This economy can be thought off either as a region or as a country.

intermediate goods are produced by monopolistic firms. Production of one unit of intermediate good requires one unit of labor as input.

2.3 R&D sector

Technology improvements lead to good-specific public knowledge allowing to start improvement efforts upon the current vintage ν. Innovations on good *j* arrive randomly at a Poisson rate hn_j, where n_j is the amount of labor used in R&D, and $h>0$ a parameter indicating the productivity of the research technology. Finally, the size of the R&D sector is given by the arbitrage condition:[9]

$$\frac{(1-\tau^w)W_{j',\nu}}{h} \leq \min_j V_{j,\nu+1} \quad \forall j,j' \in [0,1] \tag{3}$$

That is, the opportunity cost of *R&D* is the hourly net wage prevailing in industry *j*, $j,\ (1-\tau^w)W_{j',\nu}$, times the expected duration of the innovation process, $1/h$.[10] On the other hand, the expected payoff of next innovation, $V_{j,\nu+1}$, is equal to the net discounted value of an asset yielding $\Pi_{j,\nu+1}$ per period until the arrival of next innovation, at the arrival rate $hn_{j,\nu+1}$.

We assume that the employment protection laws imply a cost *E* (a firing tax) of shutting down a firm, which occurs as current producers are replaced by next ones. Then:

$$V_{j,\nu+1} = \frac{\Pi_{j,\nu+1} - hn_{j,\nu+1}E_{\nu+1}}{r + hn_{j,\nu+1}} \tag{4}$$

Assuming that Firms pay a proportional payroll tax τ over employment, the instantaneous monopolistic profits earned by the successful innovator are:

$$\Pi_{j,\nu+1} = p(x_{j,\nu+1})x_{j,\nu+1} - W_{j,\nu+1}(1+\tau)x_{j,\nu+1} \tag{5}$$

[9] Equivalently, the entry condition also reflects the fact that labor can be freely allocated between production and research: **Errore.** is the net value of an hour in production while **Errore.** is the expected value of an hour in research.

[10] Equivalently, we can assume that the opportunity cost is worth to the unemployment benefits, or even to a linear combination of the earnings of both, employed and unemployed agents.

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

$$p(x_{j,\nu}) = \frac{\partial C}{\partial x_{j,\nu}} = \alpha A_{j,\nu} x_{j,\nu}^{\alpha-1} \tag{6}$$

Then, after normalization of last expressions by the productivity level associated to the $(\nu+1)^{th}$ innovation, we obtain:

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

Hence the free entry (3) condition becomes:

$$\begin{aligned} (1-\tau^w)w_{j',\nu} &\leq qh\nu_{j,\nu+1} \\ &= qh\left(\frac{\pi_{j,\nu+1} - hn_{j,\nu+1}e}{r + hn_{j,\nu+1}}\right) \end{aligned} \tag{8}$$

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

2.4 Government

The government faces the following budget constraint:

$$Bu + T = (\tau + \tau^w)\int_0^1 w_j x_j dj + Eh\int_0^1 n_j dj \tag{9}$$

Any change in the revenue caused by changes in taxes and subsidies is rebated to household through the lump-sum transfer *T*.

2.5 Wage bargaining and labor demand

The wage rate is the solution to the bargaining problem between the monopolistic producer of good *j* and the trade union representing the workers' interests. We model the bargaining process as a a generalized Nash bargaining game, with union's relative bargaining power $0<\beta<1$. In case of disagreement, workers get the unemployment benefits and the monopolist pays the firing costs *E*. Given the bargained wages, the monopolistic producer chooses the level of employment that maximizes her profit flow. That is,

$$W_{j,\nu+1} = \arg\max\left\{\left[\left(\left(1-\tau^{w}\right)W_{j,\nu+1} - B_{j,\nu+1}\right)x\left(W_{j,\nu+1}\right)\right]^{\beta}\left(\Pi_{j,\nu+1} - hn_{j,\nu+1}E - \bar{\pi}_{j,\nu+1}\right)^{1-\beta}\right\} \quad (10)$$

$\bar{\pi}_{j,\nu+1} \equiv -hn_{j,\nu+1}E$ is the firm's disagreement point.

2.6 Equilibrium

Given ϱ>0, for all intermediate good sector j and for all vintage ν a ***steady-state (or balanced growth path) equilibrium*** is defined as follows:

Wage rule:

$$w = \frac{\beta_1 b}{1-\tau^{w}}, \quad \beta_1 \equiv 1 + \frac{\beta(1-\alpha)}{\alpha} \quad (11)$$

for $w \equiv \frac{W}{A}$

(ii) Labor demand:

$$x = \left(\frac{\alpha^2(1-\tau^{w})}{(1+\tau)\beta_1 b}\right)^{\frac{1}{1-\alpha}} \quad (12)$$

(iii) **R&D**

Symmetry on wages, and so on labor demand, implies identical expected gains across industries from an innovation: $V_{j'}=V_j$ $\forall j,j' \in [0,1]$. In consequence, the amount of labor allocated to R&D is the same for any intermediate good j: $n_j=n$. Then, from the free entry condition we deduce:

$$n = \left(\frac{1}{h}\right)\left(\frac{qh\pi - r\beta_1 b}{\beta_1 b + qhe}\right) \quad (13)$$

where

$$\pi = \frac{(1-\alpha)(1+\tau)\beta_1 b}{\alpha(1-\tau^{w})}x \quad (14)$$

(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:

$$u = L - x - n \tag{15}$$

(v) Government:

The balanced budget of government is:

$$bu + \top = (\tau + \tau^{w}) wx + ehn \tag{16}$$

were $b \equiv \frac{B}{A}$, and $\top \equiv \frac{T}{A}$.

(vi) Economic growth:

Between two consecutive innovations final output is augmented a fixed amount q: $C_{\nu+1} = qC_{\nu}$. Then, between date t and date t+1 expected output is:

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

By taking logarithms and arranging terms we get:

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

Then, at the steady state ($n_t = n$):

$$g = hn \ln(q) \tag{17}$$

2.7 The impact of labor market institutions on growth and unemployment

2.7.1 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. As is common in the literature, this later is modeled as a cost of terminating the employment of workers at the end of a product's life. This can be viewed as a firing tax.

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

This result is very intuitive (see the proof in the appendix): higher labor costs imply higher wages (equation (11)) and so a decline in the labor demand (equation (12)). This reduce the monopolistic profits and so the expected value of an innovation. Moreover, the higher wages make production more attractive than R&D. As the size of the R&D sector declines, the growth rate falls. Since neither the wage rate nor the labor demand change, the only effect is a contraction of profits. This reduces the agents' incentives to engage in R&D. Then the growth rate falls and the unemployment increases.

2.7.2 The wage bargaining processes

The impact of unions is analyzed at two levels. First, we derive the implications of a higher bargaining power in the case of uncoordinated wage bargain. Second, we compare the outcome from an efficient bargaining process (that is, with simultaneous bargain of wages and labor demand) with the inefficient outcome computed above.

The bargaining power

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.

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

Uncoordinated vs. efficient bargain

If the monopolistic firm and the trade union in each industry bargain over either labor demand and wages, the outcome is said to be efficient since all externalities are taken into account during the bargain. Formally, the wage and firm size pairs solve (we add a subindex E to denote the efficient outcomes):

$$\left(w^E_{j,v+1}x^E_{j,v+1}\right) = \arg\max\left\{\left[\left(\left(1-\tau^w\right)w^E_{j,v+1}-b\right)x^E_{j,v+1}\right]^\beta\left(\pi^E_{j,v+1}-hn^E_{j,v+1}e-\bar{\pi}^E_{j,v+1}\right)^{1-\beta}\right\} \quad (18)$$

The disagreement point and the instantaneous profit flow are respectively:

$$\bar{\pi}_{v+1} \equiv -hn_{v+1}e$$

$$\bar{\pi}^E_{j,v+1} = \alpha(x^E_{j,v+1})^\alpha - w^E_{j,v+1}(1+\tau)x^E_{j,v+1}$$

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

$$w_E = \frac{\beta_1 b}{1-\tau^w} \quad (19)$$

$$x_E = \left(\frac{(1-\tau^w)\alpha^2}{(1+\tau)b}\right)^{\frac{1}{1-\alpha}} \quad (20)$$

$$n_E = \left(\frac{1}{h}\right)\left(\frac{qh\pi_E - r\beta_1 b}{\beta_1 b + qhe}\right) \quad (21)$$

$$\pi_E = \frac{(1-\alpha\beta_1)(1+\tau)b}{\alpha(1-\tau^w)} x_E \quad (22)$$

Proposition 3. Under efficient bargaining, employment is higher but the economic growth is lower than under uncoordinated bargaining. However, the comparison is ambiguous for unemployment.

The gain in employment is due to the coordination in the setting of wages and labor demand for production. The decreasing returns to research and the unchanged opportunity cost of R&D explain why economic growth is lower under efficient bargaining (see the proof in the appendix).

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. 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 (Blanchard and Wolfers, 2000), or for low hours worked and/or low participation in European countries (Kaitila, 2006), the statistical relation between unemployment-causing variables and long run economic growth is a moot point. For instance, Layard and Nickell (1999) and Kaitila (2006) show that the link between unemployment-causing variables and TFP growth is weak or nonexistent. Conversely, Daveri *et al.* (2000) or Alonso *et al.* (2004) report a negative significant impact of these labor market institution variables on the growth rate of a large panel of OECD countries. These empirical findings constitute an interesting point to be investigated deeply. With this aim, in this section we explore the growth and unemployment experiences across European countries at a regional level as well as the impact of the national labor market institutions on these variables. In particular, we try to identify the sign of the correlation between growth and unemployment *via* the correlation of each variable with some indicators of the labor market institutions.

Even if we find interesting results at the regional level that are in accordance with the previous results at national level, it is important to note that some other interesting institutional features are left for future research. That is the case, for instance, the increasing labor market segmentation observed in many developed countries.[11] It would be interesting, for instance, to assess the impact on growth and unemployment of having temporary contracts (rescinded at not cost) and permanent contracts (which are costly to revoke).[12]

3.1 The data

Disaggregated data come from the Eurostat European Regional Database (Summer 2006, NUTS 2 regions).[13]

The selection criterion of regions was the availability of data for the 1980-2003 period.[14] So, we end with 183 regions belonging to 13 countries: Austria (AT), Belgium (BE), Germany (DE), Denmark (DK), Spain (ES), Finland (FI), France (FR), Ireland (IE), Italy (IT), Netherlands (NL), Portugal (PT), Sweden (SE) and the United Kingdom (UK). The disaggregated data we use come from the Eurostat *European Regional Database (2005).*

Concerning the labor market institution indicators, we use the data provided by Blanchard and Wolfers (2000): Tax wedge (TW), Unemployment benefits (UB), Employment protection (EP), Coordination (CO), Active labor market policies (ActPol) and Collective bargaining coverage (CbC).

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

To shed some light on the relation between the growth rate of the regional Gross Domestic Product (GDP) per capita and the regional unemployment rate, we estimate the joint density of these two variables (figure 1), but we do not find a clear relation between them.

Nevertheless, the joint distribution of the growth rate of Total Factor Productivity (TFP) with both, the growth rate of GDP per capita (figure 2), and the unemployment rate (figure 3) suggest an interesting 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. Hence, the regional development, as measured by the growth of TFP, is associated to more output per capita and to less unemployment. But in the latter case, the negative relationship is not strong enough to put in evidence a clear link between GDP growth and unemployment.

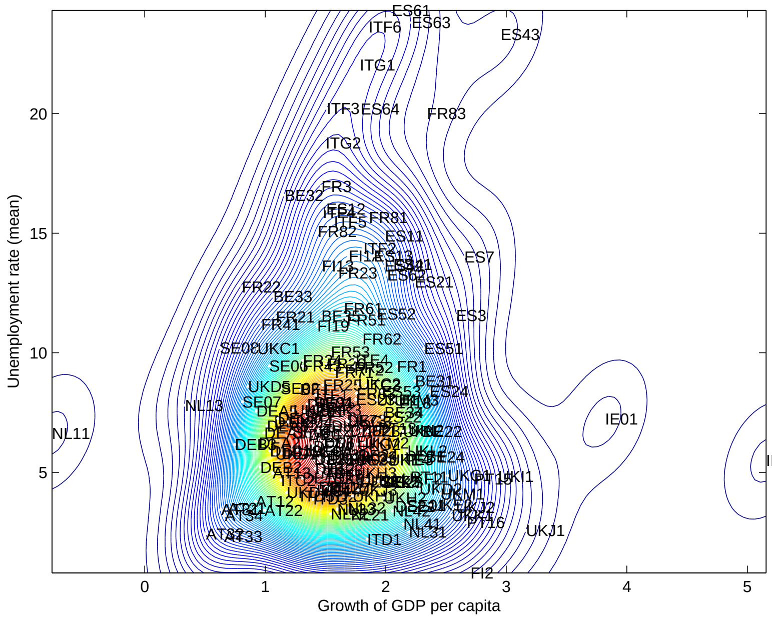
[11] See for example Mortensen and Pissarides (1999), Albrech and Vroman (2002) or Cheron, Langot and Moreno-Galbis (2010).

[12] Some previous works on this issue are the following. Models of segmented labor markets: Blanchard and Landier (2002); effects of firing policy: Alvarez and Veracierto (2006); labor market protection in search and matching models: Cahuc and Postel-Vinay (2002).

[13] 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: *http://europa.eu.int/comm/eurostat/ramon/nuts*

[14] In particular, this ruled out Norway from the sample.

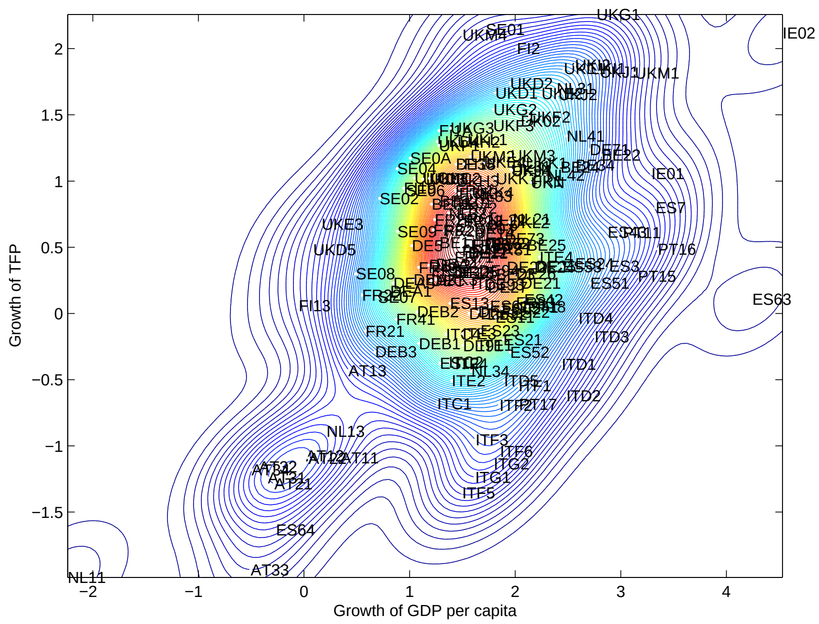
*Figure 1: GDP per capita growth and unemployment rate, 1980-2003**



Joint distribution. The contour plots correspond to the kernel (non-parametric) estimator of the bivariate density.

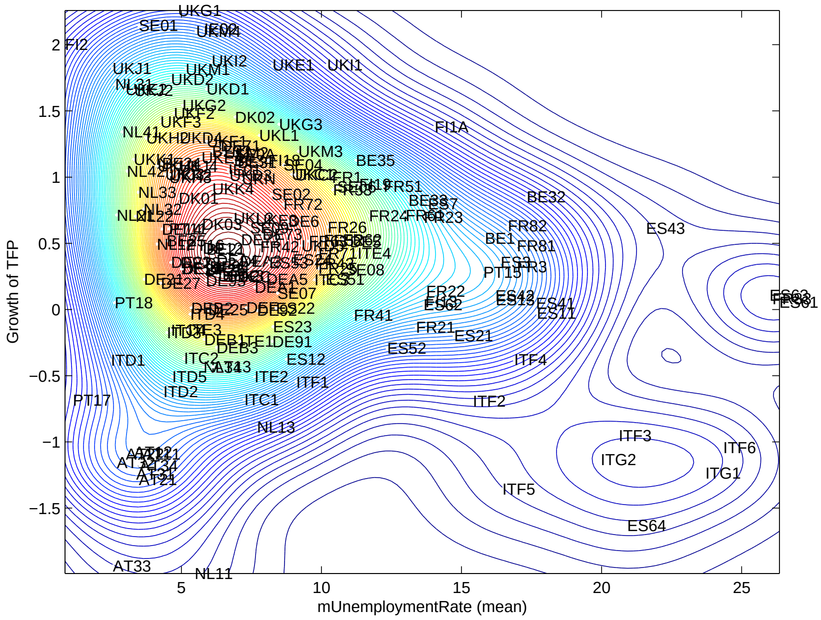
**: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK).*

Figure 2: Growth of GDP per capita and Growth of TFP (mean), 1980–1995.*



*Joint distribution. *: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK).*

Figure 3: Unemployment rates and Growth of TFP (mean), 1980–1995.*



*Joint distribution. *: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK).*

3.3 Recovering the missing link: an econometric analysis

At a disaggregated level, the GDP 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 the regional GDP per capita growth and the regional unemployment rates.

The specificity of each European region is accounted by the mean growth rate of its Solow residual, which is computed assuming that the technology in each region is Cobb-Douglas.[15] Since this exercise intends simply to look for possible correlations between the variables, we are not dealing at this level with identification or endogeneity problems. Instead, the issue of causality is treated in the theoretical economy developed earlier in the paper. Nevertheless, matter of robustness, in appendix **Errore. L'origine riferimento non è stata trovata.** we consider two alternative indicators to the TFP for the specific technology available in a region: the growth rates of the regional capital share (K_j) and the regional employment on the energy and manufacturing sector ($E^{e\&m}_{j}$).[16]

[15] The theoretical model can be viewed as a regional economy with specific innovation process.

[16] A better indicator would be the share of employment in the industrial sector, but we don't have data on this variable.

3.3.1 Empirical models

Let 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 $N=\sum_{c=1}^{C} N_c$ as the total number of European regions in our sample. Let **c** be a mapping from the regional indexes to the national indexes:

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

The empirical models are defined by the following equations:

$$\begin{aligned} g_j &= \alpha^g + \mathrm{X}_{c(j)}\beta^g + SR_j\gamma^g + \varepsilon_j^g \\ u_j &= \alpha^u + \mathrm{X}_{c(j)}\beta^u + SR_j\gamma^u + \varepsilon_j^u \end{aligned} \tag{23}$$

where g_j and u_j are respectively the growth rate of GDP per capita and the unemployment rate (averages) 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, IT; and dum_3: IE, UK. These dummy variables regroup countries according to an specific socioeconomic organization (Nordic, Anglo-Saxon and Continental countries) which is not included in our set of explanatory variables. $\varepsilon_{g,j}$ and $\varepsilon_{u,j}$ are two zero expectation random variables such that $E\left[\varepsilon_{s,j}\varepsilon_{s,j}\right]=\sigma^{2,s}$, $E\left[\varepsilon_{s,j}X_{\mathbf{c}(j)}\right]=0$ for $s=u,g$ and $E\left[\varepsilon_{u,j}\varepsilon_{g,j}\right]=0$[17]. Finally, the growth rate of the Solow residual is denoted by SR_j.

3.3.2 Empirical strategy

The estimation of models (23) may be done using OLS equation by equation, but this approach would eventually be sensitive 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:

[17] Under these assumptions we can estimate (23) equation by equation.

$$\hat{b}^{g}_{LAD,N} \equiv \left(\hat{\alpha}^{g}_{LAD,N}, \hat{\beta}^{g}_{LAD,N}, \hat{\gamma}^{g}_{LAD,N}\right) = \arg\min_{\{\alpha^{s},\beta^{s},\gamma^{s}\}} \sum \left| g_{j} - \alpha^{g} - \mathrm{X}_{c(j)}\beta^{g} - SR_{j}\gamma^{g} \right| \quad (24)$$

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:

$$\sqrt{N}\left(\hat{b}^{g}_{LAD,N} - \beta\right)_{N\to\infty} \Rightarrow \mathrm{N}\left(0, \frac{1}{2 f_{\varepsilon^{g}}(0)}\left(X'X\right)^{-1}\right) \quad (25)$$

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 $f_{\varepsilon^{g}}$ 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 $\hat{b}^{g}_{LAD,N}$ 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.

3.3.3 Results

We estimate two regressions. In the first one the endogenous variable is the average growth rate of GDP per capita of each European Region (labeled Growth). In the second one, the endogenous variable is the average regional unemployment rate (labeled Unemployment). In both cases, the dependent variables are the mean values of our collection of labor market indicators, as well as the average growth rates of the Solow residuals.[18] Estimations are reported in table 1.

[18] We take average values mainly because of the few observations of labor market indicators, which have a five-year periodicity. Moreover, this allow us to be consistent with the equilibrium framework developed above (endogenous growth). That theoretical framework, also explains why we are not including initial conditions in the regressions.

Table 1: Baseline specification.

	Growth		**Unemployment**	
	B	**p-value**	**β**	**p-value**
gTFP	0.7983	0.0000	-0.9349	0.0070
TW	-3.0425	0.0000	5.1462	0.0250
UB	-0.5436	0.0000	2.8232	0.0000
EP	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	–

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).*

In the growth equation, excepting for the employment protection (EP), the active labor market policies (Actpol) and the collective bargaining coverage (CbC), all the point estimates significantly differ from zero at a 5% level. Finally, the positive link between the growth rate of TFP and the growth rate of GDP per capita, suggested by figure 2, is confirmed by this statistical analysis. Regarding the unemployment equation, all the variables have the expected signs, except the active labor market policies (ActPol) and are significant, except the collective bargaining coverage (CbC).

Summary:

• The tax wedge (TW) and the unemployment benefits (UB) are negatively correlated to the growth rates but positively correlated with the unemployment rates.

• The coordination of the wage bargaining (CO) is negatively correlated with both the growth rates and the unemployment rates.

• The TFP growth is positively correlated (negatively correlated) with the GDP per capita growth (unemployment rate).

Most of the theoretical results are in accordance with our empirical findings. The few exceptions are:

• Converse to the empirical insights, the theoretical model predicts an ambiguous link between unemployment and coordination.

• Even if the correlation between the bargaining power and the GDP growth is not significant, it has the unambiguous sign predicted by our theoretical model. These results can be explained by the poor approximation of our statistical measure (collective bargaining coverage (CbC)) to the workers' bargaining power.

Finally, the R^2 is 68% for the growth equation, and 35% for the unemployment equation, meaning that our collection of labor-market-related policy variables and the TFP growth explain 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

To close our empirical analysis, in this section we propose an evaluation of the marginal impact of both national (labor market institutions) and regional (TFP growth) components on the predicted growth and unemployment rates of a given European region.

The methodology

Let us consider the following experience: 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 for its specific regional variable. Using the previous estimations of the growth and unemployment rates we can 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:

$$\hat{g}_{j,UK} = \hat{c}_g + X_{UK}\hat{\beta}_g + SR_{j,UK}\hat{\beta}_g \qquad (26)$$

with $X_{UK} \equiv (TW_{UK}, UB_{UK}, EP_{UK}, CO_{UK}, ActPol_{UK}, CbC_{UK})$

• 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:

$$\tilde{g}^{TW}_{j',FR} = \hat{c}_g + \tilde{X}^{TW}_{FR}\hat{\beta}_g + SR_{j',UK}\hat{\beta}_g \tag{27}$$

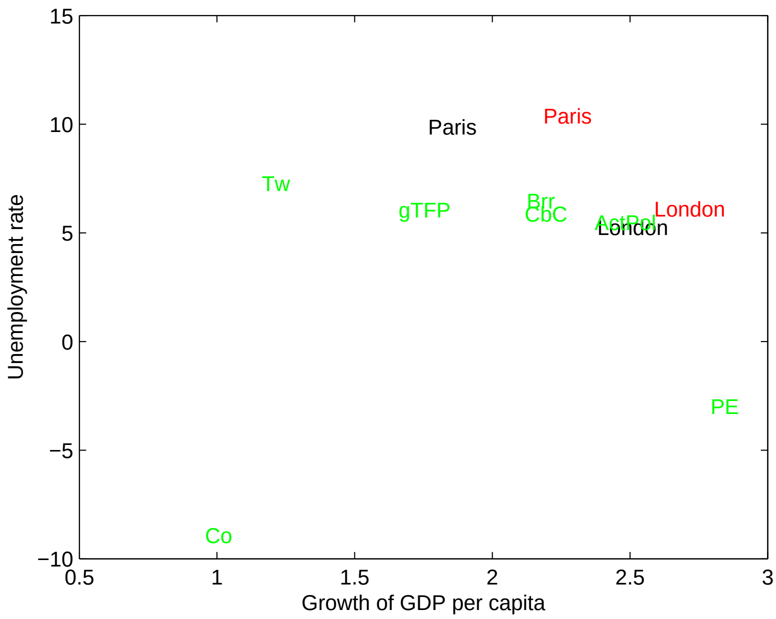
with $\tilde{X}^{TW}_{FR} \equiv (TW_{FR}, UB_{UK}, EP_{UK}, CO_{UK}, ActPol_{UK}, CbC_{UK})$

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

Results

Due to the large number of Regions (183), we focus only on typical cases. We take London as reference and we evaluate the marginal impact of typical European labor market experiences: a north continental country (France), a south continental country (Spain) and a Nordic country (Sweden). For the two first countries, we assess the marginal impacts of the explanatory variables on two regions: a highly developed region ("Ile de France", which contains Paris and its surroundings, and "Madrid") and a poor one ("Corsica" and "Andalusia").

Figure 4: The French case (I): London versus Paris.

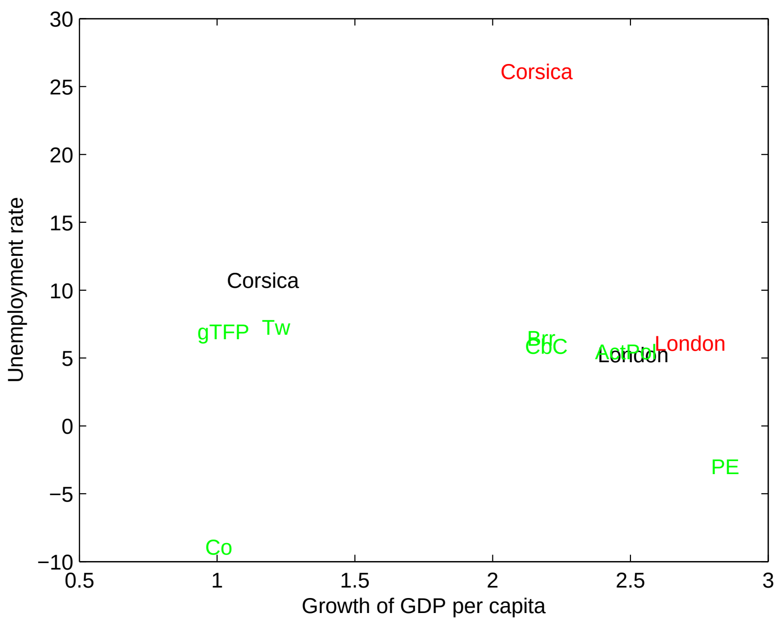


*Observed and predicted London are respectively denoted "London" and "**London**". We use the same color convention for Paris. The marginal effects of our explanatory variables are in soft color (CbC, Tw, etc…).*

Figures 4 and 5 display results for the French economy. Figure 4 shows that the predictions of the econometric model are close to the observed values. Point TW represents the prediction of the model if all the explanatory variables, except 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 French taxation[19]. The higher unemployment and the lower growth in Paris than in London are mainly due to the higher tax wedge (TW) in France and to the lower TFP growth (gTFP) in Paris. Moreover, the wage bargaining coordination (CO) in France implies less unemployment but at the price of a lower GDP per capita growth. Figure 5 shows that the model predictions for Corsica are quit poor. Nevertheless, the experience for Corsica underlines that, beyond the national component (the high tax wedge already mentioned for Paris), it is the insufficient *R&D* investment that largely explains the lower performance of this Region.

Figure 6 illustrates the case of a Nordic Region, Stockholm. Results indicate that the higher taxes in Sweden than in UK lead to more unemployment and to less growth. Nevertheless, contrary to the French region, the high TFP growth allows this Nordic Region to converge towards London. Moreover, since the coordination of the wage bargain is higher than in France, we observe a large decrease in the unemployment rate, whereas the impact of this labor market institution is negligible in the growth equation.

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



[19] The same interpretation holds for all the explanatory variables: employment protection (EP), unemployment benefits (UB), *etc...*

Figure 6: The Nordic case: London versus Stockholm

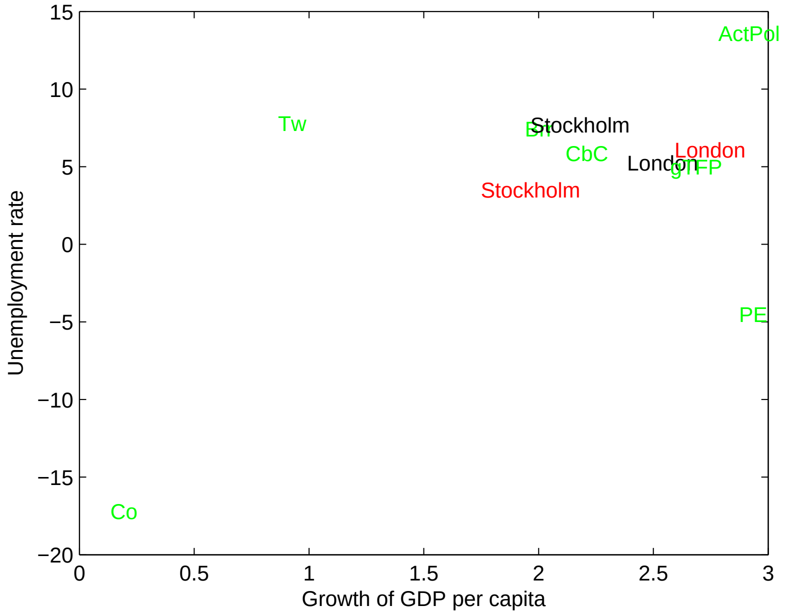


Figure 7: The Spanish case (I): London versus Madrid

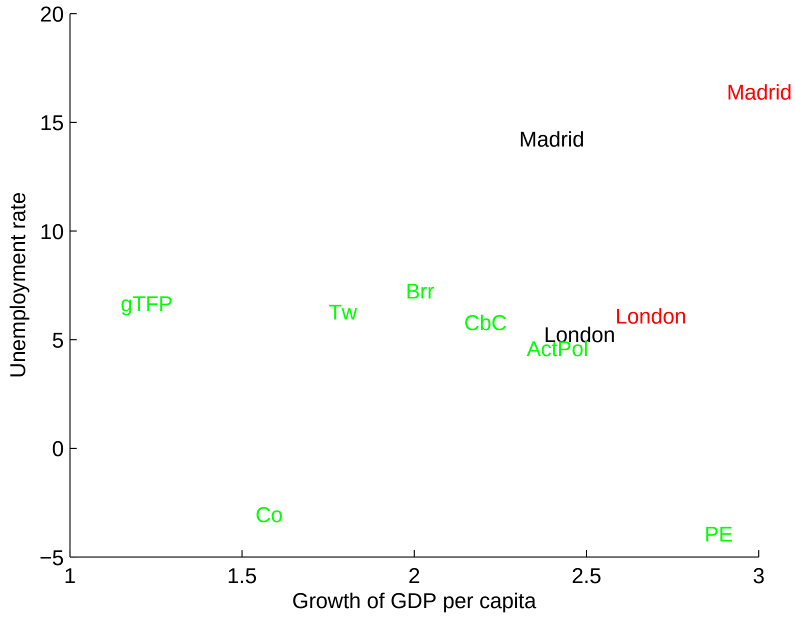
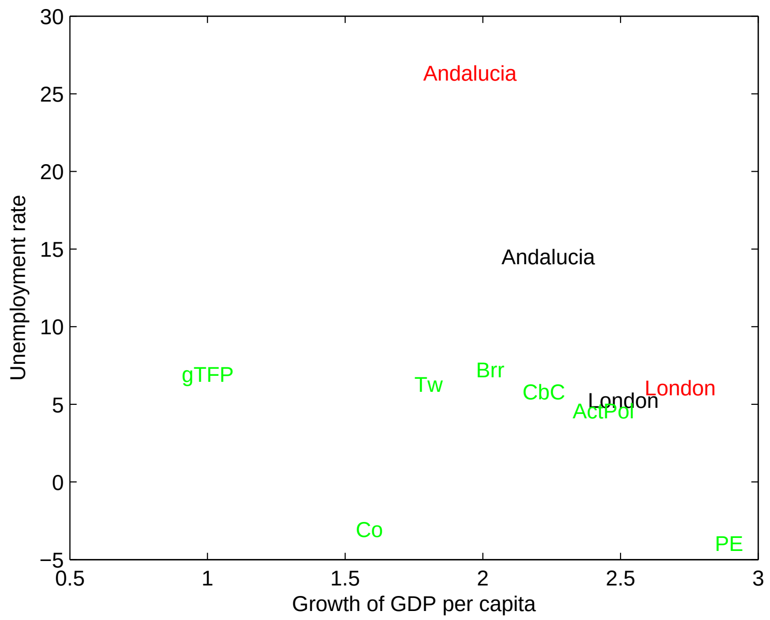


Figure 8: The Spanish case (II): London versus Andalusia



What do we learn from the Spanish cases? Figures 7 and 8 show that the higher unemployment rates are mainly due to the lower TFP growth. Moreover, the high growth rate of GDP per capita (equal or higher than the one observed in London) is not explained by a high level of technology (gTFP), but by a catch-up phenomenon. The poor performances (measured by the TFP growth), even in Madrid, would lead the Spanish government to give more incentives to invest in the R&D sector. Finally, the estimations also show that the labor market institutions in Spain lead to better economic performances than in France.

4. Conclusion

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 agents' incentives to engage in R&D activities. We have shown that increases in the labor costs or in the power of trade unions lead to higher unemployment and to a slowdown of the economic growth, whereas an efficient bargain allows to higher employment, but has an ambiguous effect on economic growth.

Next we have explored if these theoretical relations are empirically supported. Using cross-section data 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 and growth. In particular, the tax wedge and the unemployment benefits are positively correlated to the regional unemployment rates whereas the employment protection and the coordination in the bargaining process are negatively correlated to the regional unemployment rates. On the other hand, either the tax wedge and the unemployment benefits are positively correlated to the GDP per capita growth. Nevertheless, a high level of coordination in the bargaining process is associated with lower growth rates. This last points to a trade-off between unemployment and growth if we focus on the impact of coordination on the wage bargain.

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Appendix A: Proofs

Proposition 1. a. $\frac{\partial g}{\partial i}|_{i=b,\tau,\tau^w} = h\ln(q)\frac{\partial n}{\partial i}|_{i=b,\tau,\tau^w}$. It is easy to show that: $\frac{\partial x}{\partial i}|_{i=b,\tau,\tau^w} < 0$. So,

$$\begin{aligned}
\frac{\partial n}{\partial b} &= -\frac{\beta_1}{h(\beta_1 b + qhe)}\left(qh\left(\frac{1+\tau}{1-\tau^w}\right)x + r + n\right) < 0 \;\Rightarrow \\
\frac{\partial g}{\partial b} &= < 0 \;\; and \;\; \frac{\partial u}{\partial b} = -\left(\frac{\partial x}{\partial b} + \frac{\partial n}{\partial b}\right) > 0 \\
\frac{\partial n}{\partial \tau} &= -\frac{q}{\beta_1 b + qhe}\left(\frac{\beta_1 b}{1-\tau^w}\right)x < 0 \;\Rightarrow \frac{\partial g}{\partial \tau} = < 0 \;\; and \;\; \frac{\partial u}{\partial \tau} > 0 \\
\frac{\partial n}{\partial \tau^w} &= -\frac{q}{\beta_1 b + qhe}\left(\frac{1+\tau}{(1-\tau^w)^2}\right)x < 0 \;\Rightarrow \frac{\partial g}{\partial \tau} = < 0 \;\; and \;\; \frac{\partial u}{\partial \tau} > 0
\end{aligned}$$

In a similar way, we deduce: **b.** **b.** $\frac{\partial x}{\partial e} = 0 \;\Rightarrow$

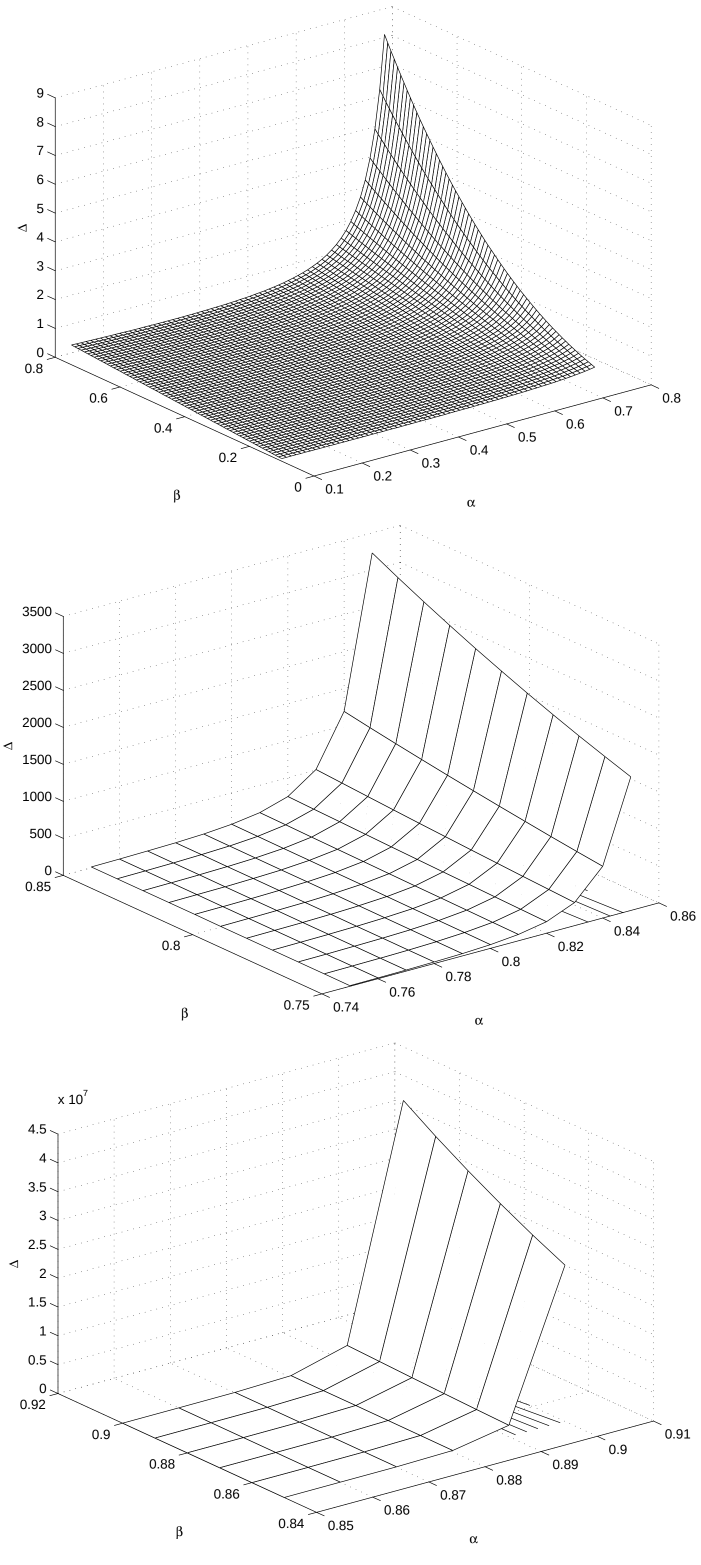
$$\begin{aligned}
\frac{\partial g}{\partial e} &= -\frac{qh\ln(q)n}{\beta_1 b + qhe} < 0 \\
\frac{\partial u}{\partial e} &= -\frac{\partial n}{\partial e} > 0
\end{aligned}$$

The first inequality comes from the fact that $q>1$.

Proposition 2. Analogous to the proof of proposition 1: $\frac{\partial x}{\partial \beta} < 0$ and $\frac{\partial n}{\partial \beta} < 0$. So, $\frac{\partial g}{\partial \beta} < 0$ and $\frac{\partial u}{\partial \beta} > 0$.

Proposition 3. It is easy to verify that $x_E = x\beta_1^{\frac{1}{1-\alpha}}$. Since $\beta_1>1$, then $x<x_E$. On the other hand, $\frac{\pi_E}{\pi} = \frac{1-\alpha\beta_1}{(1-\alpha)\beta_1}\frac{x_E}{x}$. But $\frac{1-\alpha\beta_1}{(1-\alpha)\beta_1} < 1$ and $\frac{x_E}{x} > 1$, so that the comparison of profits (and then of the number of researchers and growth rates) seems ambiguous. However, even if we cannot provide a full analytical proof, our numerical computations for a large grill of points satisfying $0<\alpha<1$, and $0<\beta<1$, yields in all cases $\frac{\pi_E}{\pi} < 1$. Indeed, we have $\pi - \pi_E = \Delta\left(\frac{(1+\tau)b}{\alpha(1-\tau^w)}x_E\right)$ where $\Delta = (1-\alpha)\beta_1^{\frac{-\alpha}{1-\alpha}} - 1 + \alpha\beta_1$ with $\beta_1 = 1 + \beta^{\frac{1-\alpha}{\alpha}}$. The figure 9 shows that Δ is always positive. We do not represent Δ for α and β larger than 0.9 because $\Delta \rightarrow \infty$ in this case.

Figure 9: Numeraical analysis of the gap $\pi - \pi_E$



Appendix B: Alternative indicators of the regional development

The growth rates of the capital share of region *j* (K_j) and the employment on the energy and manufacturing sector of region *j* ($E^{e\&m,j}$) are defined as follows:

$$\mathcal{K}_j = \frac{K_{j,i}}{Ki} \tag{27}$$

$$\mathcal{E}_j^{e\&m} = \frac{E_{j,i}^{e\&m}}{Ei} \tag{28}$$

where $K_{j,i}$ is the regional capital stock, and K_i is the national capital stock. Similarly, $E_{j,i}^{e\&m}$ and E_i are respectively the regional employment in the energy and manufacturing sector, and the national employment.

B1 Empirical alternative models

$$\begin{aligned} g_j &= \alpha^g + \mathrm{X}_{c(j)}\beta^g + \mathrm{K}_j\gamma^g + \mathrm{E}_j^{e\ell m}\delta^g + \varepsilon_j^g \\ u_j &= \alpha^u + \mathrm{X}_{c(j)}\beta^u + \mathrm{K}_j\gamma^u + \mathrm{E}_j^{e\ell m}\delta^u + \varepsilon_j^u \end{aligned} \tag{29}$$

B2 Estimations

In the growth equation, the point estimates significantly differs from zero at a 5% level, and have the expected sign for the following variables: regional capital share, tax wedge (TW), replacement rate (UB), and coordination (CO). Concerning the unemployment equation, all variables have the expected sign, except ActPol (active labor market policies) and are significant at 5% or 10% level. In addition to the intuitions from the baseline specification, we find that the bargaining power is associated to higher unemployment.

Finally, the R^2 is respectively 44% and 28%, meaning that our collection of labor-market-related policy variables and the growth rate of the two regional-specific variables explains about 1/2 of the heterogeneity of the growth rates and roughly 1/3 of the heterogeneity of the unemployment rates.

Table 2: Second Specification.

	Growth		Unemployment	
	β	p-value	β	p-value
K_j	0.4487	0.0000	-1.1516	0.0001
$E_{e\&m,j}$	-0.0015	0.9138	-0.1278	0.0685
TW	-1.2368	0.0002	2.7331	0.0996
UB	-0.1379	0.0320	2.6579	0.0000
EP	0.0037	0.9847	-3.9600	0.0001
CO	-1.4539	0.0000	-16.5395	0.0000
ActPol	0.1208	0.2149	3.8073	0.0000
CbC	0.2634	0.4732	4.0794	0.0305
dum1	12.2149	0.0000	116.2032	0.0000
dum2	18.8026	0.0000	213.3097	0.0000
dum3	1.9634	0.0001	16.7360	0.0000
Fischer	218.2335	0.0000	71.3733	0.0000
R^2	0.44314	–	0.28323	–
♯ Observations	183	–	183	–

LAD estimation. Student and associated p-values are computed with a bootstrap procedure as advocated by Greene (2002).