Growth, Unemployment and Tax/Benefit system in 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 of being employed or being doing 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 1980-2003.

JEL: E24, J5, O3, O4, O52. *Keywords: endogenous growth, unemployment, labor market institutions.*

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.[1] The same is true on the theoretical side.[2] 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 the link between growth and unemployment can be viewed through the simultaneous link of growth and unemployment with the labor market institutions.

In this chapter we investigate the issue of the long run link between growth and unemployment at two levels. First, we conduct an empirical analysis to 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. Second, we construct a theoretical economy to assess the explicative role of labor-market variables on the bad performance of European countries. The main hypotheses

[1] See Mortensen (2005) 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.

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 or being trying their hand at R&D; and *(iii)* Unemployment is caused both by the wage-setting behavior of unions, and by the labor costs associated to the tax/benefit system.[3] In addition, in the appendix to this chapter, we conduct a social welfare exercise using a simplified version of this model.

The advises from the empirical exercise are that: *(i)* 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. *(ii)* 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 diminishes the regional growth rates of GDP per capita. This last result points to the existence of an arbitration between unemployment and growth, if we focuss on the impact of coordination in the wage bargaining process. These results are in accordance with those of Daveri and Tabellini (2000). Using national level data, Daveri and Tabellini (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, either over time and across countries.

On the other side, the implications of the theoretical model are the following: *(i)* 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. *(ii)* 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) and 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. Finally, in the welfare exercise, we show that the optimal growth rate can be reached by compensating the distortions on the goods-sector due to the growth process with the distortions induced by the labor market rigidities.

[3] The two first hypotheses are the same as those of Aghion and Howitt (1994).

1 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 recent empirical findings constitute an interesting point to be investigated 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.

1.1 The data

Disaggregated data come from the Eurostat *European Regional Database (Summer 2006, NUTS 2 regions)*.[4]

The selection criterium of regions was the availability of data for the 1980-2003 period.[5] So, we end with 183 regions belonging to 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 comes 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 benefit (BRR), Employment protection (PE), Coordination (CO), Active labor market policies (ActPol) and Collective bargaining coverage (CbC).

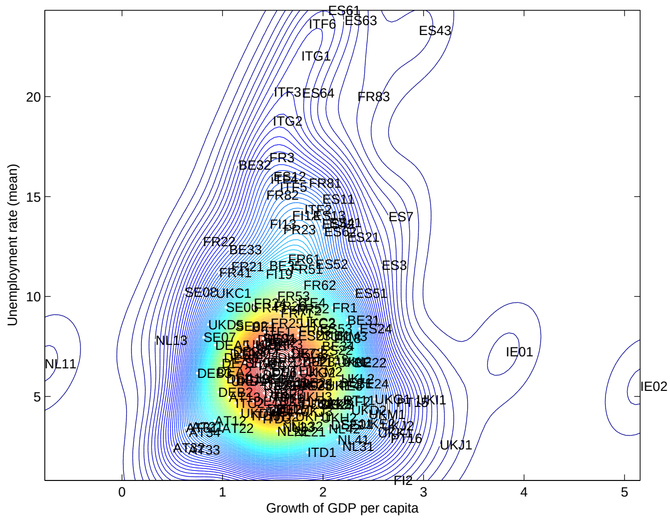
[4]The Statistical regions of Europe correspond to the second level of the Nomenclature of Territorial Units for Statistics (NUTS 2 regions). The average size of the regions in this category is between 800 000 and 3 million. Details on this classification can be found at European Union's web site: *http://europa.eu.int/comm/eurostat/ramon/nuts*

[5]In particular, this excluded Norway from the sample.

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

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

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



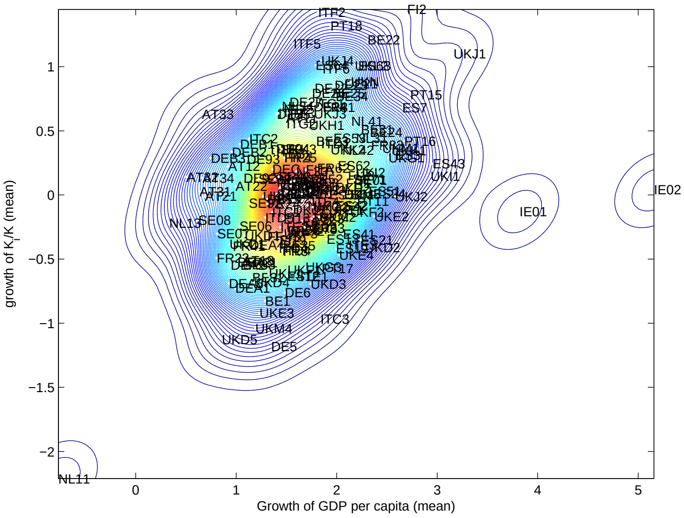
Joint distribution. The contour plots correspond to the kernel (non-parametric) estimator of the bivariate density.

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

Nevertheless, the joint distribution of the growth rate of the regional capital share (k_j) with both, the growth of GDP per capita (figure 2), and unemployment rate (figure 3) suggest an interesting result. The correlation between the regional capital share and the GDP per capita is clearly positive, whereas the correlation between the regional capital share and the unemployment rate is slightly negative. Then, the regional development, measured by the growth rate of k_j, 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.

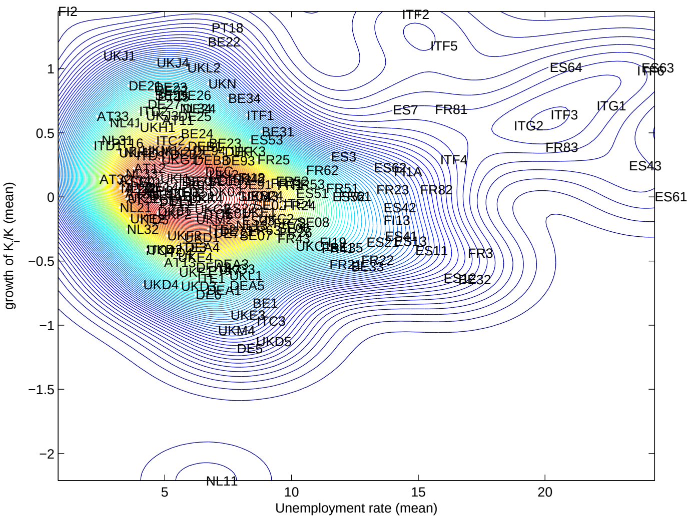
The same stronger result is suggested by the joint distribution of the growth of the Total Factor Productivity (TFP) and the growth of GDP per capita (figure 4), and by the joint distribution of the TFP growth and the relative unemployment rate (figure 5). The correlation between the growth of the TFP and the growth of the GDP per capita is clearly positive, whereas the correlation between the growth of the TFP and the unemployment

Figure 2: GDP per capita growth and regional capital share, 1980-2003*



Joint distribution. *: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK). The share of the capital stock in region j of country i is given by $k_j \equiv \frac{K_{j,i}}{Ki}$, where $K_{j,i}$ and K_i respectively denote the regional capital stock, and the national capital stock.

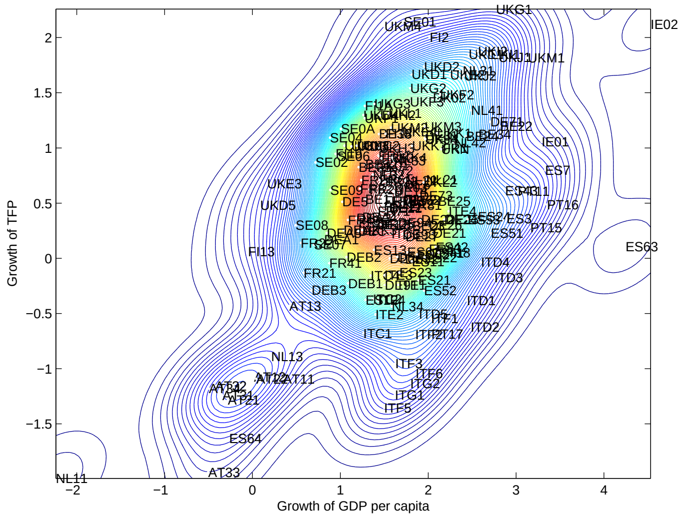
Figure 3: GDP per capita growth and Unemployment rate, 1980-2003*



Joint distribution. *: N.U.T.S. 2 regions (BE, DK, DE, FR, IE, IT, NL, ES, PT, SE, AT, FI, UK). The share of the capital stock in region j of country i is given by $k_j \equiv \frac{K_{j,i}}{Ki}$, where $K_{j,i}$ and K_i respectively denote the regional capital stock, and the national capital stock.

rate is negative. Hence, the regional development, in this case measured by the growth of TFP, leads to more output per capita and less unemployment. As with the capital share, the negative relationship is not strong enough to imply a clear link between growth of GDP and unemployment.

Figure 4: 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).

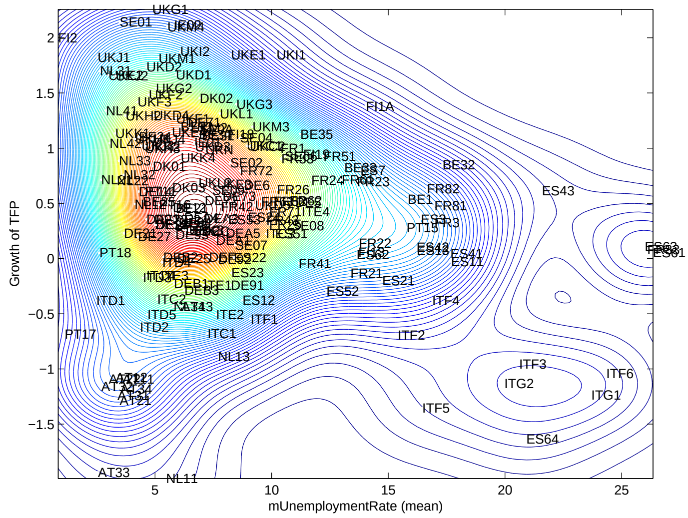
1.3 Recovering the missing link: an econometric analysis

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 unemployment rate. 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 accounted by three variables: the growth rates of the regional capital share ($\mathcal{K}_j$), the regional employment on the energy and manufacturing sector ($\mathcal{E}_j^{e\&m}$), and the mean of the growth rate of its Solow residual, which is computed assuming that the technology in each region is Cobb-Douglas. These indicators can be viewed as a close measure of the specific technology available in a specific region[6]. The first two are

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

Figure 5: 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).

defined as follows:

$$\mathcal{K}_j = \frac{K_{j,i}}{Ki}$$
$$\mathcal{E}_j^{e\&m} = \frac{E_{j,i}^{e\&m}}{Ei}$$

where $K_{j,i}$ and K_i are respectively the regional capital stock, and 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.

1.3.1 Empirical models

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 models are defined by the two following pairs of equations:

$$\begin{aligned} g_j &= \alpha^g + \mathcal{X}_{\mathbf{c}(j)}\beta^g + \mathcal{K}_j\gamma^g + \mathcal{E}_j^{e\&m}\delta^g + \varepsilon_j^g \\ u_j &= \alpha^u + \mathcal{X}_{\mathbf{c}(j)}\beta^u + \mathcal{K}_j\gamma^u + \mathcal{E}_j^{e\&m}\delta^g + \varepsilon_j^u \end{aligned} \tag{1}$$

and

$$\begin{aligned} g_j &= \alpha^g + \mathcal{X}_{\mathbf{c}(j)}\beta^g + \mathcal{S}R_j\gamma^g + \varepsilon_j^g \\ u_j &= \alpha^u + \mathcal{X}_{\mathbf{c}(j)}\beta^u + \mathcal{S}R_j\gamma^u + \varepsilon_j^u \end{aligned} \tag{2}$$

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, IT; and dum_3 : IE, UK. These dummy variables regroup countries according to an specific socioeconomic organisation which is not included in our set of explanatory variables (Nordic, Anglo-saxon and Continental countries). 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 $s = u, g$ and $E\left[\varepsilon_j^u \varepsilon_j^g\right] = 0$[7]. Finally, the growth rate of the Solow residual is denoted by $\mathcal{S}R_j$.

1.3.2 Empirical strategy

The estimation of models (1) and (2) 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.

[7]Under these assumptions we can estimate (1) and (2) equation by equation.

1.3.3 Results

Estimations from the specification in (1) are reported in table 1, whereas those from the specification in (2) are reported in table 2. In both cases, 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).

Table 1: First specification.

	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	–

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).

First specification. 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. Finally, the positive link between the growth rate of the regional TFP and the growth rate of GDP per capita, suggested by figure 4, 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).

Table 2: Second Specification.

	Growth		**Unemployment**	
	β	p-value	β	p-value
$\mathcal{K}_j$	0.4487	0.0000	-1.1516	0.0001
$\mathcal{E}_j^{e\&m}$	-0.0015	0.9138	-0.1278	0.0685
TW	-1.2368	0.0002	2.7331	0.0996
BRR	-0.1379	0.0320	2.6579	0.0000
PE	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).

Second specification. In the growth equation, the point estimates significantly differs from zero at a 5%, and have the expected sign for the following variables: the regional capital share, the tax wedge (TW), the replacement rate (BRR), and the coordination on the wage bargaining (CO). Finally, the positive link between the growth rate of the regional capital stock 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 at 5% or 10% level.

Summary:

- 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.
- Either the growth rate of the regional capital share, or the growth rate of the TFP, increase (decrease) the GDP per capita growth (the unemployment).
- The bargaining power increases the unemployment in the second specification.

Finally, for the growth and unemployment equations, in the first specification the R^2 are 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. Likewise, in the second specification these values 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.

1.3.4 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:

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

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

- 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:

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

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

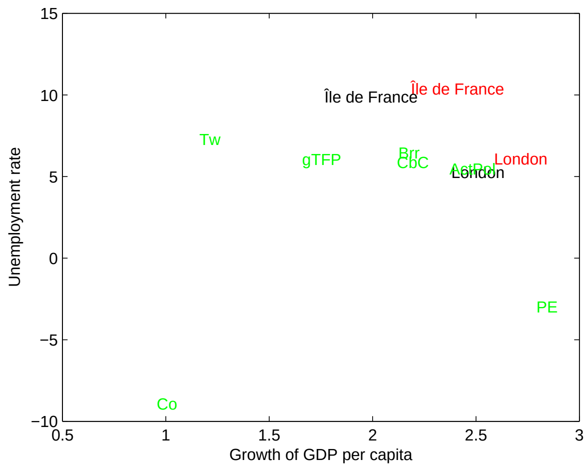
The gap between $\widehat{g}_{j',FR}$ and $\widetilde{g}^{TW}_{j',FR}$ gives a measure of the marginal effect of the French fiscal policy.

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 6 and 7 present the results for the French economy. First in figure 6, we show that

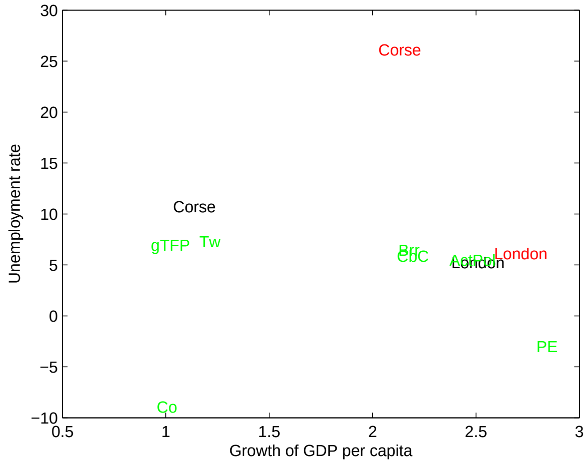
Figure 6: The French case (I): London versus Paris (Ile de France).



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.*..).

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

Figure 7: The French case (II): London versus Corse



gives a measure of the marginal impact of the French tax[8]. 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 7, 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 8 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.

What do we learn from the Spanish cases? Figures 9 and 10 show that these higher unemployment rates are mainly due to the low level of TFP growth. If the growth rate of

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

Figure 8: The Nordic case: London versus Stockholm

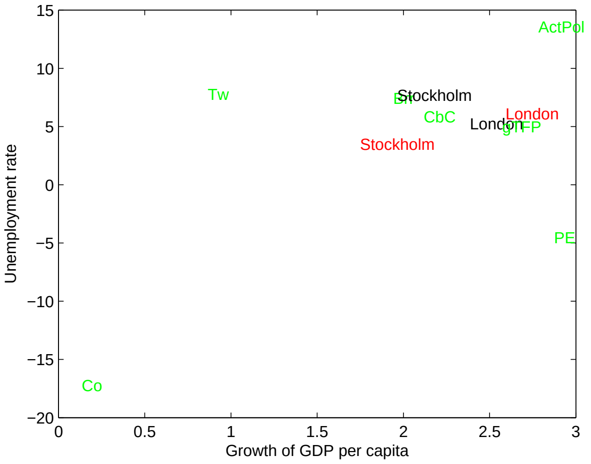


Figure 9: The Spanish case (I): London versus Madrid

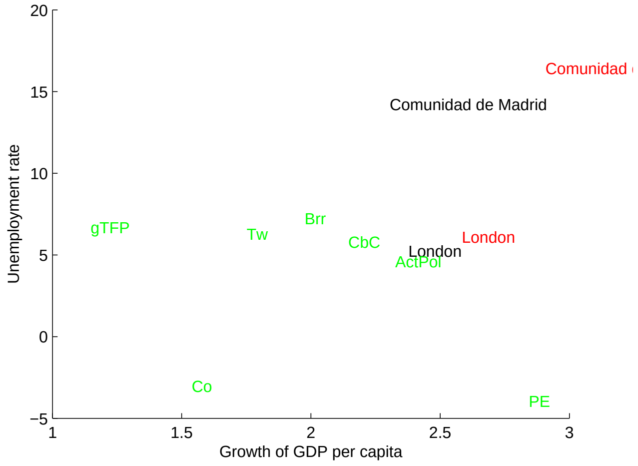
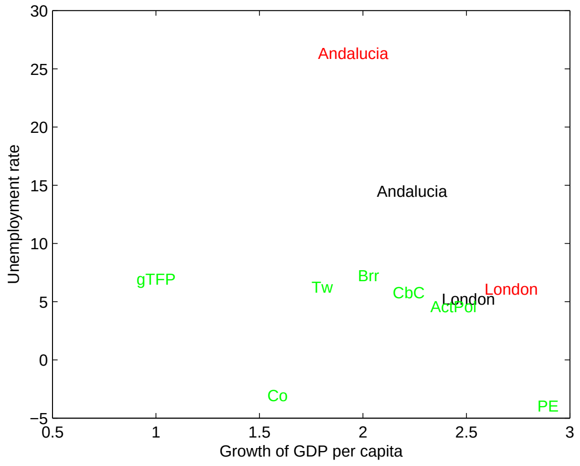


Figure 10: The Spanish case (II): London versus Andalucia



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.

2 The model

At the light of the empirical results, we develop the next theoretical model.

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): $L = x + n + u$. When employed, workers pay a tax τ^w on their labor income. When unemployed, they receive the unemployment benefits B.

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

$$U(C_t) = E_0 \int_0^\infty C_t e^{-\rho t} dt \tag{3}$$

where $\rho > 0$ 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 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. This assumption allows us to analyze the impact of the unemployment benefit system.

2.2 Goods sector

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

$$C_t = \int_0^1 A_{j,t} x_{j,t}^\alpha dj, \quad 0 < \alpha < 1, \quad j \in [0, 1] \tag{4}$$

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 $q > 1$ ($A_{t+1} = qA_t$).

In turn, intermediate goods are produced by monopolistic firms. Production of one unit of intermediate good requires one unit of labor as input. Since the final-good sector is perfectly competitive, the price of each intermediate good, $p(x_j)$, is equal to the value of its marginal product:

$$p(x_{j,t}) = \frac{\partial C}{\partial x_{j,t}} = \alpha A_{j,t} x_{j,t}^{\alpha-1} \quad \forall j \tag{5}$$

2.3 R&D sector

Technology improvements lead to good-specific public knowledge allowing to start improvement efforts upon the current vintage v. 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]

$$\frac{(1-\tau^w)W_{j',v}}{h} \leq \min_j V_{j,v+1} \quad \forall j, j' \in [0,1] \tag{6}$$

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

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

$$V_{j,v+1} = \frac{\Pi_{j,v+1} - hn_{j,v+1}E_{v+1}}{r + hn_{j,v+1}} \tag{7}$$

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

$$\Pi_{j,v+1} = p(x_{j,v+1})x_{j,v+1} - W_{j,v+1}(1+\tau)x_{j,v+1} \tag{8}$$

Normalizing the lasts expressions by the productivity level associated to the $(v+1)^{th}$ innovation, and using equation (5) we obtain:

$$\pi_{j,v+1} = \alpha x_{j,v+1}^{\alpha} - w_j(1+\tau)x_{j,v+1} \tag{9}$$

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

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

hence the free entry (25) condition becomes:

$$\begin{aligned}(1-\tau^w)w_{j',v} &\leq qh\nu_{j,v+1} \\ &= qh\left(\frac{\pi_{j,v+1}-hn_{j,v+1}e}{r+hn_{j,v+1}}\right)\end{aligned} \tag{10}$$

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:

$$Bu + T = (\tau + \tau^w)\int_0^1 w_j x_j dj + Eh\int_0^1 n_j dj \tag{11}$$

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 β. If they don't agree, workers get the unemployment benefits and the monopolist pays the firing costs E. Given the bargained wages, the firm chooses the level of employment that maximizes her profit flow. That is,

$$W_{j,v+1} = \arg\max\left\{[((1-\tau^w)W_{j,v+1} - B_{j,v+1})x(W_{j,v+1})]^{\beta}(\Pi_{j,v+1} - hn_{j,v+1}E - \bar{\pi}_{j,v+1})^{1-\beta}\right\} \tag{12}$$

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

2.6 Equilibrium

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

(i) **Wage rule:**

$$w = \frac{\beta_1 b}{1-t}, \quad \beta_1 \equiv 1 + \frac{\beta(1-\alpha)}{\alpha} \tag{13}$$

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

(ii) **Labor demand:**

$$x = \left(\frac{\alpha^2(1-\tau^w)}{(1+\tau)\beta_1 b}\right)^{\frac{1}{1-\alpha}} \tag{14}$$

(iii) **R&D**

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

$$n = \left(\frac{1}{h}\right)\left(\frac{qh\pi - r\beta_1 b}{\beta_1 b + qhe}\right) \tag{15}$$

where

$$\pi = \frac{(1-\alpha)(1+\tau)\beta_1 b}{\alpha(1-\tau^w)} x \tag{16}$$

(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:

$$u = L - x - n \tag{17}$$

(v) **Government:**

The balanced budget of government is:

$$bu + \top = (\tau + \tau^w)wx + ehn \tag{18}$$

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: $C_{v+1} = qC_v$. 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 ($n_t = n$):

$$g = hn \ln(q) \tag{19}$$

3 The impact of labor market institutions on growth and unemployment

3.1 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 (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 (13)) and so a decline in the labor demand (equation (14)). This contracts the monopolistic profits and reduces the expected value of an innovation. Moreover, the higher wages make production more attractive than R&D. As the size of R&D decline, the growth rate falls. Since neither the wage rates nor the labor demands change, the only effect is a contraction of profits. This reduces the workers' incentives to engage in R&D. Then the growth rate falls and the unemployment raises.

3.2 The wage bargaining processes

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

3.2.1 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 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.

3.2.2 Inefficient v.s. efficient bargain

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

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

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

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

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

$$w_E = \frac{\beta_1 b}{1-\tau^w} \quad (20)$$

$$x_E = \left(\frac{(1-\tau^w)\alpha^2}{(1+\tau)b}\right)^{\frac{1}{1-\alpha}} \quad (21)$$

$$n_E = \left(\frac{1}{h}\right)\left(\frac{qh\pi_E - r\beta_1 b}{\beta_1 b + qhe}\right) \quad (22)$$

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

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.*

The gain in employment is due to the coordination in the setting of wages and the 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).

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

- Converse to the empirical model, the theoretical model predicts an ambiguous link between unemployment and coordination.
- Even if the link 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.

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 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. Finally, the empirical results concerning the active labor market policies (ActPol) suggest to include them into the theoretical model because they have positive impact on the unemployment rate.

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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,

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

In a similar way, we deduce: **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 $\beta_1 \geq 1$, then $x \leq x_E$. On the other hand, $\pi_E \leq \pi$. This is due to the decreasing returns of the technology. Then, $n_E \leq n \Rightarrow g_E \leq g$. Because there are less researchers but more employed in production the total effect on u is ambiguous.

B Reaching the Optimal Growth: Which is the role of the Labor Market Institutions?

In this part, we make a social welfare exercise using a simplified version of our endogenous growth model. We show that the optimal growth rate can be reached by compensating the distortions on the goods-sector due to the growth process with the distortions induced by the labor market rigidities.

Creative destruction in the economic growth process could lead either to insufficient or excessive economic growth (Aghion and Howitt (1994) and (1998)). This is mainly explained by the distortions on the goods-sector induced by the monopolistic rents generated by R&D. However, we show that when the institutions and rigidities present in the labor market of many developed economies are acknowledged by the model, the optimal growth rate could be reached. Specifically, when the economic growth is excessive, the labor market rigidities are desirable because its negative impact on growth reduce the gap to the optimal rate. Conversely, when the economic growth is suboptimal, the fiscal policy gives the solution: the optimal rate can be reached by subsidizing labor.

B.1 The model

The basics of the model are: *(i)* Innovations are the engine of growth. *(ii)* Agents have the choice of being employed or doing research and development activities (R&D). *(iii)* Unemployment is caused both by the wage-setting behavior of the unions representing the workers' interests, and by the labor costs associated to taxes and unemployment compensation.

B.1.1 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): $L = x + n + u$. When employed, workers pay a tax τ^w on their labor income.

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

$$U(C) = E_0 \int_0^\infty C(t)e^{-\rho t} dt \tag{23}$$

$\rho > 0$ is the subjective rate of time preference and C_t is the individual's consumption of the final good at time t.

B.1.2 Goods sector

The final good is produced by perfectly competitive firms that use the latest vintage v of intermediate input x,[11]

$$C(t) = A_{v,t} x_{v,t}^{\alpha}, \quad 0 < \alpha < 1 \tag{24}$$

A_v represents the productivity of the intermediate good 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 $q > 1$ ($A_{v+1} = qA_v$). Production of one unit of intermediate good requires one unit of labor as input. Since the final-good sector is perfectly competitive, the price of the intermediate good, $p(x)$, is equal to the value of its marginal product.

B.1.3 R&D sector

Technology improvements lead to good-specific public knowledge allowing to start improvement efforts upon the current vintage. Innovations arrive randomly at a Poisson rate hn, where n 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:

$$\frac{(1-\tau^w)W_v}{h} = V_{v+1} \tag{25}$$

[11] Matter of simplicity, we assume just one homogeneous intermediate input. However, results are qualitatively the same if we assume instead a continuum of perfectly substitute intermediate inputs.

That is, the opportunity cost of $R\&D$ is the hourly net wage prevailing in the production sector, $(1-\tau)W_v$, times the expected duration of the innovation process, $1/h$.[12] On the other hand, the expected payoff of next innovation, V_{v+1}, is equal to the net discounted value of an asset yielding Π_{v+1} per period until the arrival of next innovation, at the arrival rate hn_{v+1}. Assuming that Firms pay a proportional payroll tax τ over employment, the instantaneous monopolistic profits earned by the successful innovator are: $\Pi_{v+1} = p_{v+1}x_{v+1} - W_{v+1}(1+\tau)x_{v+1}$.

B.1.4 Government

The government faces the following budget constraint:

$$B_v u + T_v = (\tau + \tau^w)W_v x_v \tag{26}$$

B are the unemployment benefits, and any change in the revenue caused by changes in taxes and subsidies is rebated to household through the lump-sum transfer T.

B.1.5 Wage bargaining and labor demand

The wage rate is the solution to the bargaining problem between the monopolistic producer 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 β. If they don't agree, workers get the unemployment benefits and the monopolist makes zero profits. Given the bargained wages, the firm chooses the level of employment that maximizes her profit flow. That is,

$$W_{v+1} = \arg\max\left\{[((1-\tau^w)W_{v+1} - B_{v+1})x(W_{v+1})]^{\beta}\Pi_{v+1}^{1-\beta}\right\} \tag{27}$$

B.1.6 Equilibrium

Given $r > 0$, for all "state of the art" v the equilibrium is defined as follows. The the wage rule, the labor demand and the research level satisfy the system of equations:

[12]Equivalently, we can assume that the opportunity cost amounts to the unemployment benefits, or even to a linear combination of both, the earnings of employed and those of unemployed workers.

$$w = \frac{\beta_1 b}{1-t}, \quad \beta_1 \equiv 1 + \frac{\beta(1-\alpha)}{\alpha} \tag{28}$$

$$x = \left(\frac{\alpha^2(1-\tau^w)}{(1+\tau)\beta_1 b}\right)^{\frac{1}{1-\alpha}} \tag{29}$$

$$n = \frac{q(1-\alpha)(1+\tau)x}{\alpha(1-\tau^w)} - \frac{r}{h} \tag{30}$$

$$u = L - x - n \tag{31}$$

Finally, the average rate of growth in aggregate consumption is given by: $g = hn\ln(q)$. Remark that we have normalized lasts expressions by the productivity level associated to the $(v+1)^{th}$ innovation (i.e. $\pi \equiv \frac{\Pi}{A}$, $w \equiv \frac{W}{A}$ and $b = \frac{B}{A}$).

B.1.7 The optimal economic growth

The optimal growth rate g^* is determined by the optimal level of research n^* that would be chosen by a social planner whose objective was to maximize the expected welfare $E(U)$. Since consumption is a random variable that takes the values $\{A_0x^\alpha, A_0qx^\alpha, A_0q^2x^\alpha, \ldots, A_0q^kx^\alpha, \ldots\}_{k\in N}$, the expected welfare $E(U)$ is:

$$E(U) = \int_0^\infty e^{-rt}E(C_t)dt = \frac{A_0x^\alpha}{r - hn(q-1)} \tag{32}$$

Hence the social planner will choose (x, n) to maximize the expected present value of lifetime consumption, subject to the labor constraint $L = x + n$.[13] Then,

$$n^* = \arg\max\left\{\frac{A_0(L-n)^\alpha}{r - hn(q-1)}\right\} = \frac{1}{1-\alpha}\left(L - \frac{\alpha r}{h(q-1)}\right) \tag{33}$$

Given this level of research the optimal growth rate is $g^* = hn^*\ln(q)$.

B.1.8 Equilibrium growth *v.s.* optimal growth

Given that the average growth rate is proportional to the number of researchers, it is sufficient to compare the optimal level of research with the equilibrium level of our economy. In order to simplify the comparison between n^* and n we rewrite (33) and (30) respectively as:

$$1 = \frac{(q-1)h\left(\frac{1}{a}\right)(L-n^*)}{r - hn^*(q-1)} \tag{34}$$

$$1 = \frac{qh\left(\frac{1-\alpha}{\alpha}\right)(1+\top)(L-n-u)}{r+hn} \tag{35}$$

where $1 + \top \equiv \frac{1+\tau}{1-\tau^w}$ can be thought as a proxy of the *Tax Wedge*. As in the **?**)'s model, we find the following basic differences between n^* and n:

[13] Obviously, in an optimal setting there is no unemployment.

D1 The social discount rate $r - hn^*(q-1)$ is less than the private discount rate $r + hn$ ("intertemporal-spillover effect").

D2 The private monopolist in unable to appropriate the whole output flow, but just a fraction $(1-\alpha)$.

D3 The factor $(q-1)$ corresponds to the so-called "business-stealing"effect, whereby the successful monopolist destroys the surplus attributable to the previous generation of intermediate good by making it obsolete.

Whereas distortions $D1$ and $D2$ tend to make the average growth rate less than optimal, $D3$ tends to make it greater. Due to the offsetting nature of these effects, the market average growth rate may be more or less than optimal. These three distortions summarize the main welfare implications of introducing creative destruction in the process of economic growth: *laissez-faire* growth may be either insufficient or excessive. Additionally, we have two other differences due to the rigidities on the labor market, say:

D4 The optimal employment $L - n^*$ is bigger that the equilibrium employment $L - n - u$. This is directly due to the bargaining power of unions.

D7 The equilibrium level of research is affected by the taxes on labor.

Clearly, $D4$ tends to make the average growth rate less than optimal. In contrast, $D5$ is growth enhancing only when $1 + \top > 1$, *i.e., when* $\top > 0$. Nevertheless, the stark difference between distortions due to $D1 - D3$ and those due to $D4 - D5$, is that the two lasts depend on labor-market policy variables that, at least theoretically, can be controlled by the policy deciders. This naturally suggest the question of whether variations in the policy variables, already present in the labor market, can reduce the gap between the optimal and the equilibrium growth rates caused by distortions $D1$ to $D3$. In other words, we are interested on issues as the following:

$n > n^*$**:** If the negative externality that new innovators exert upon incumbent firms ($D3$) dominates, which kind of policy adjustments could be done to converge to the optimum?

$n < n^*$**:** Conversely, if the intertemporal-spillover and the appropriability effects dominate ($D1$ and $D2$), which policy could foster growth?

To answer these questions, we look to the impact of the policy variables on the research level. Since $\frac{\partial x}{\partial \Omega}|_{\Omega} = \{b, \beta, \tau^w, \tau\} < 0$, then $\frac{\partial n}{\partial \Omega}|_{\Omega} = \{b, \beta, \tau^w, \tau\} < 0$. This suggest that when growth is excessive the labor market rigidities are desirable because they can help to reduce the gap between the equilibrium rate of growth and the optimal one. Moreover, when the economic growth is suboptimal the optimal rate can be reached by subsidizing labor.