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Nation Size and Unemployment

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Abstract

Throughout the world, strong dispersions of both regional and national unemployment rates can be observed. The economic theory has developed various explanations on how this differences occur. Corresponding models mainly aim at institutional and political framework, insider effects, efficiency wages, collective bargaining and cyclical effects. However, the size of economies has received little attention in this discussion.

In this paper, we will show that there is indeed a strong link between size and unemployment. Using data from 37 countries, 15 continents and trade areas as well as 496 federal states, we will demonstrate that larger economic regions tend to have higher unemployment rates.

Subsequently, we show that this correlation is strongly determined by the degree of centralization of countries. Based on these findings, we develop a model that explains regional and national unemployment using size and centralization. We will point out that centralization parabolas can be derived for each country. These curves are strongly influenced by the size of economies in a way that different sizes lead to a shift of the parabolas. As we will demonstrate, country-specific parabolas explain the strong dispersion of unemployment rates quite accurately.

Keywords: Unemployment, Size, Centralization
JEL No.: J64, J08, R10, F00

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1 Introduction

In most developed countries, strong dispersions of regional unemployment rates can be stated. The standard deviation of regional unemployment rates in Germany was 3.3%-points in 2010. This effect can be observed in many industrialized countries like the United States (1.3 %-points), Japan (4.3 %-points), France (2.0 %-points), the United Kingdom (1.3 %-points) and Canada (3.2 %-points). However, this phenomenon does not only hold for intra-national levels. Intra-continental views reveal even stronger differences, particularly in Africa (standard deviation: 8.8 %-points), Asia (3.1 %-points) and North America (4.1 %-points). With some 2.3 %-points, the EU-15 show the lowest diffusion on the continental scale.

Since the early 1970s when European unemployment rates rose sharply, the determinants of unemployment led to an intense discussion among economists. It is indisputable that exogenous shocks leading to a decline in aggregate demand have strong impacts on the level of employment. In addition, economists agree that wages above the equilibrium level will cause unemployment. Furthermore, the influence of collective bargaining, insider effects and both institutional and political framework is widely accepted.[1]

However, the influence of the size of nations has received little attention in this discussion. Based on the EU-15 states, *Neumann* (2006) showed that there is a significant correlation between the surface area of European countries and their unemployment rates. A similar presumption has been expressed by *Krugmann* (2011) who discovered a strong link between the population of the American federal states and the state specific level of unemployment in December 2010. Nevertheless, to date, this effect has solely been studied on the basis of few observations. Thus, no statements concerning the general interdependencies between size and unemployment are possible so far.

In this paper, we will examine that link on a broad basis. Chapter 2 first explains our empirical and methodological approaches and presents the data used. In chapter 3, we derive the theoretical link between size and unemployment using a Cobb-Douglas production function and demonstrate that this correlation basically has to be positive. Chapter 4 provides an overview of the status quo of the synchronization between size and unemployment on the international as well as the intra-national level. Furthermore, we will identify the need to derive long-term cyclically-adjusted unemployment rates, since cyclical effects

[1] A detailed overview on the state of research is provided by *Blanchard, O.* (2006).

took huge impacts on the correlation. Using this smoothed rates, we calculate equilibrium coefficients for 35 countries as well as for 15 trade areas and continents. As we will show, the correlation between size and unemployment is indeed positive in most cases, albeit some countries deviate from this general rule.

In chapter 5, we wish to answer why some of the countries in the sample reveal negative correlation coefficients. Our findings indicate that the relationship between size and unemployment is largely influenced by the agregate degree of centralization, defined as the product of tariff and fiscal centralization. Concretely, size influences unemployment rates negatively whenever nations are strongly decentralized.

In chapter 6, we show how regional and national unemployment can be modeled using the aggregate level of centralization and our derived relationship between size and unemployment rates. We will demonstrate that each country has its own centralization parabola which has strong similarities to the proposed hypothesis of *Calmfors* and *Driffill* (1988). However, these parabolas are influenced by the size of the underlying economies, since different sizes lead to shifts of the parabolas. In consequence, the influence of size may add one missing piece to the hypothesis of Calmfors and Driffill, since their hump-shape assumption can hitherto not explain one phenomenon that we can empirically observe quite often: that countries with the same degree of centralization in several cases have significantly different unemployment rates.

2 Data and methodological approach

In chapter 4, we will examine the linear synchronization between size and unemployment on both the *intra*national and the *inter*national level. We will therefore split up various economic regions into subgroups and measure the linear correlation within these groups. At the *intra*national level, country j will be divided into its federal states $i = 1, ..., n$. At the *inter*national level, we will split up continents and trade areas k into $j = 1, \ldots, m$ countries.

In order to define comparable federal states for each country, the NUTS classification of Eurostat will be used. The NUTS code divides all EU member states, candidate countries and EFTA states into homogeneous and internationally contrastable administrative districts. In addition, due to NUTS being based on the internationally accepted standard ISO-3166, international comparisons

with countries outside Europe are possible.[2]

NUTS structures national states on six different levels (NUTS 0-3 and LAU 1-2). In this paper, we mainly use the NUTS 1 and NUTS 2 codes which reflect lager regions with 3-7 million (NUTS 1) respectively 800.000-3 million (NUTS 2) inhabitants. For most countries, n is sufficiently large enough to allow cautious statements about the correlation of size and unemployment by using NUTS 1 and NUTS 2. Yet, in some cases n falls below the critical level of $n = 5$. In this situation, we deviate to NUTS 3. Due to the heterogeneity of the size of European countries, a consideration on a consistent NUTS level does not seem to be operational. Owing to the small number of cases, Iceland, Liechtenstein, Luxembourg, Malta, Macedonia and Cyprus could not be included into the study.

For states outside Europe, we use the TL-2 classification of the OECD, which coincides largely with the NUTS codes. TL-2 codes are available for Australia, Canada, Japan, Mexico, New Zealand, South Korea, Turkey and the United States. Countries outside the NUTS and the TL-2 categorization, such as China, Russia or India, will be disposed by using the classification of the particular census bureaus. Table A1 in the appendix shows the classifications used and the respective number of cases for each country.

We define the size of the region i by both its area in square kilometers (SQ_i) and its population (L_i). The unemployment rate will be denoted by ω_i and reflects the unemployment of people over 15 as measured by Eurostat (data code Y_GE15). For countries that are not covered by Eurostat, we use data from the International Labor Organization (ILO).

In order to determine the synchronization of size and unemployment, we use the correlation coefficient according to *Pearson* and *Bravais*. Since the classification of subregions employing NUTS and TL-2 leads to a relatively small sample sizes for the particular countries j, we use the correlation coefficient instead of regression analysis to get a general idea of the coherence between size and unemployment in j. As a matter of course, these coefficients must be interpreted with caution, owing to the low degrees of freedom.

Let $SQ_j = (SQ_1, ..., SQ_i, ..., SQ_n)$ be the vector of the area of all subregions i in j and $\omega_j = (\omega_1, ..., \omega_i, ..., \omega_n)$ be the vector of regional unemployment with the same sequence, the correlation coefficient ρ_j is given by

[2]For a detailed illustration of the NUTS code see *Eurostat* (2008).

$$\rho_j(SQ_j, \omega_j) = \frac{COV(SQ_j, \omega_j)}{\sqrt{VAR(SQ_j)}\sqrt{VAR(\omega_j)}} \in [-1,\, 1]$$

with covariance $COV(SQ_j, \omega_j) = E[(SQ_j - \mu_{SQ_j})(\omega_j - \mu_{\omega_j})]$ and variance $VAR(SQ_j) = E[(SQ_j - \mu_{SQ_j})^2]$ where μ describes the mean of the particular random variable.[3]

Similarly, $\rho_j(L, \omega_j)$ denotes the correlation of population and unemployment on the international level. In this case, the corresponding coefficients are marked with the subscript k instead of j. Note that ρ only measures the linear coherence of SQ_j and ω_j. For $\rho \to -1$, SQ_j and ω_j are perfectly negative correlated, whilst $\rho \to 1$ displays a completely positive relationship between SQ_j and ω_j.

Bearing in mind that the approach of chapter 4 is rather inadequate to derive a general statement on the relationship between size and unemployment, we will apply *OLS* models in order to evaluate the influence of size on the *aggregate* level. This analysis will include *all* subregions i of the countries surveyed as well as *all* countries j of our sample. We will therefore attain one regional as well as one international estimation. Thus, the degrees of freedom are high enough to allow a general statement on the influence of size using OLS.

We will demonstrate that ρ_j relies heavily on the aggregated national degree of centralization, defined as the multiplicative combination between the fiscal and the tariff centralization level. Hence, we will include this link in our OLS analysis. For the degree of centralization, the tariff data from the *ICTWSS* Database of the Amsterdam Institute for Advanced Labour Studies (AIAS) (2011) will be used. The series WCOORD in the database prescinds the dominant centralization level for each country. We will use three general levels of centralization: wage coordination on company level (1), industry level (2) and central level (3). The tariff degree of centralization will therefore be a trinary variable. For the fiscal centralization degree, we use data of the *OECD* (2011b) that reflect the ratio of tax payments collected by the central government in contrast to the general tax amount. To eliminate short-term fluctuations, we adopt the arithmetic mean between 2000 and 2010. Table A2 in the appendix shows the characteristics of both centralization levels for the observation period between 1995 and 2010.

[3] For a detailed review of the correlation coefficient of Pearson and Bravais see *Rodgers* and *Nicewander (1988)*.

3 The theoretical link between unemployment and size

The theoretical link between size and unemployment can be derived by using an adjusted Cobb-Douglas production function. Let Y^P be the Cobb-Douglas function in its original form

$$Y^P = AK^\alpha L^{1-\alpha} \tag{1}$$

where $\alpha \in (0,\ 1)$ denotes the elasticity of production, K entitles capital, L denominates labor and A labels total factor productivity. Equation (1) has positive and decreasing marginal productivities $\frac{\partial Y^P}{\partial K} > 0$ and $\frac{\partial^2 Y^P}{\partial K^2} < 0\ \forall K > 0, L > 0$ and furthermore has constant returns to scale with respect to positive scalars θ, that is $Y^P(\theta K, \theta L) = \theta Y^P(K, L) \forall \theta > 0$.

In addition, (1) has its limits at $\lim_{K\to 0}\left(\frac{\partial Y^P}{\partial K}\right) = \lim_{L\to 0}\left(\frac{\partial Y^P}{\partial L}\right) = \infty$ respectively at $\lim_{K\to\infty}\left(\frac{\partial Y^P}{\partial K}\right) = \lim_{L\to\infty}\left(\frac{\partial Y^P}{\partial L}\right) = 0$, satisfying the INADA conditions.

By redefining L in (1) as population in place of labor, we can differentiate between labor force N and work-seeker U, that sum up to the total population L. Note that people in non-working-age and voluntarily unemployed persons are not taken into account. By using N in (1) we get

$$Y = AK^\alpha N^{1-\alpha} \tag{2}$$

At any time, a ratio of the total population is employed. Thus, the equation above now pictures the actual production at a fictive point in time instead of the production potential, where $N \in (0, L)$ acts as a cyclical component. The unemployment rate $\omega = \frac{U}{L} = 1 - \frac{N}{L}$ is the quotient of work-seekers and total population. By rearranging this relationship, we get

$$N = L(1 - \omega)$$

.

using this equation in (2) we get

$$Y = K^\alpha \left[L(1-\omega)\right]^{1-\alpha} A$$

taking logs and rearranging gives

$$\omega = 1 - \exp\left\{\frac{\ln(Y) - \alpha\ln(K) - \ln(A)}{1-\alpha}\right\}/L$$

This expression equals

$$\omega = 1 - \left[\exp\left\{\frac{\ln Y}{1-\alpha}\right\}\left(\exp\left\{-\frac{\alpha\ln K}{1-\alpha}\right\}\right)\left(\exp\left\{-\frac{\ln A}{1-\alpha}\right\}\right)\right]/L$$

$$\omega = 1 - \left[\exp\left\{\frac{1}{1-\alpha}\ln Y\right\}\left(\exp\left\{-\frac{\alpha}{1-\alpha}\ln K\right\}\right)\left(\exp\left\{-\frac{1}{1-\alpha}\ln A\right\}\right)\right]/L$$

$$\omega = 1 - \frac{Y^{\frac{1}{1-\alpha}}K^{-\frac{\alpha}{1-\alpha}}A^{-\frac{1}{1-\alpha}}}{L} := 1 - \frac{\Phi}{L}$$

We mentioned before that $\alpha > 0$. Thus, Φ always has to be positive. It is therefore immediatley apparent that an increase in population L leads to a rise of the unemployment rate ω. However, as the unemployment rate is determined by a variety of factors, deviations of this rule are easily possible. Nevertheless, in general, we can assume a positive relationship between size and unemployment if defining size as population.

4 Empirical findings

In this chapter, we will evaluate the prediction of the previous section concerning the relationship between size and unemployment. As described in chapter 2, we will use the correlation coefficient of *Bravais* and *Pearson*, owing to the small amount of subregions in j respectively k. Tables 1 and 2 show the correlation coefficients $\rho_j(SQ_j, \omega_j)$ and $\rho_j(L_j, \omega_j)$ for several industrialized nations between 1999 and 2009. Significant coherences between size and unemployment can be found in nearly every examined country. These correlations are particularly strong in Germany, the UK, Turkey, South Korea and partly in the United States and Mexico.

Table 1: $\rho_{j,t}(SQ_{j,t}, \omega_{j,t})$ for selected industrialized nations between 1999 and 2009

j	*1999*	*2001*	*2003*	*2005*	*2007*	*2009*
Germany	-.38	-.33	-.32	-.39	-.41	-.47
France	-.24	-.03	-.29	-.28	-.34	-.09
United Kingdom	-.57	-.59	-.77	-.84	-.56	-.51
Italy	.23	.26	.23	.28	.26	.35
Turkey	n.A.	.15	.27	.31	.14	n.A.
Mexico	-.26	-.31	-.21	-.09	-.27	-.13
Japan	-.29	-.28	-.27	-.24	-.24	-.20
South Korea	-.28	-.67	-.50	-.42	-.44	-.52
United States	.25	.41	.32	.33	.23	.21

Data source: *Eurostat* (2011).

Table 2: $\rho_{j,t}(L_{j,t}, \omega_{j,t})$ for selected industrialized nations between 1999 and 2009

j	*1999*	*2001*	*2003*	*2005*	*2007*	*2009*
Germany	-.52	-.49	-.49	-.51	-.50	-.50
France	-.11	-.03	.07	.12	-.01	.08
United Kingdom	-.50	-.44	-.15	-.03	-.19	n.A.
Italy	.11	.12	.10	.12	.12	.11
Turkey	n.A.	.66	.47	.52	.71	n.A.
Mexico	.44	.34	.32	.19	.22	n.A.
Japan	-.22	-.29	-.30	-.28	-.30	n.A.
South Korea	.79	.71	.81	.88	.85	n.A.
United States	.13	.24	.36	.19	.29	.39

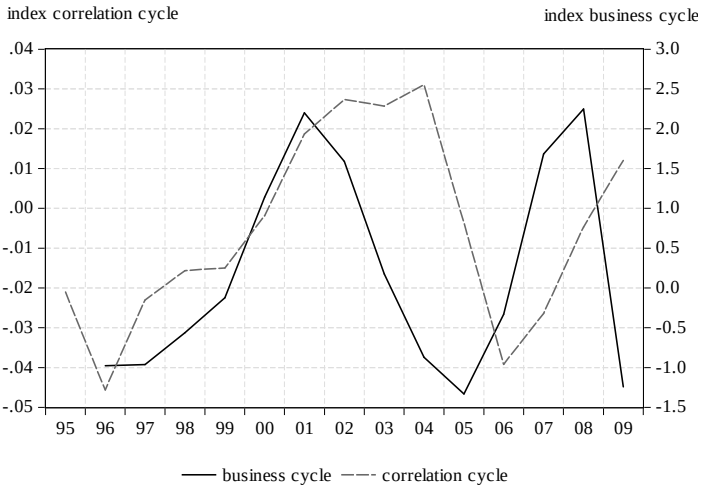
Data source: *Eurostat* (2011).

Given the results above, three basic conclusions can be drawn: first, whilst the correlation is high in most cases, we still find significant differences in the strength of the co-movement. Second, our general assumption on the theoretical direction of the synchronization shows some empirical evidence, since most numbers in table 2 are positive. Nevertheless, there are some deviations from that rule (e.g. Japan and Germany). Third, the coefficients tend to strongly falter over time. In some cases, these fluctuations can be neglected (e.g. in

Japan), but mostly, they distort the picture significantly.

Since $SQ_{j,t}$ and $L_{j,t}$ are virtually constant in the course of time, the fluctuations are triggered by the unemployment rate which is strongly sensitive to cyclical developments. This can easily be shown using the example of Germany: let $Y_{G,t}$ be the price-adjusted chain-linked index of the German gross domestic product at t, we can derive the economic cycle $\dot{Y}_{G,t}$ by eliminating the trend in $Y_{G,t}$. Similarly, we can derive the correlation cycle $\dot{\rho}_{G,t}$ by detrending $\rho_{G,t}$. Figure 1 plots both cycles over the period from 1995-2009.[4]

Figure 1: economic cycle and correlation cycle from 1995-2009



Data source: *Statistisches Bundesamt* (2011) and *table 2*.

The graph shows that the correlation cycle follows the economic cycle with some delay. Aside from the time-lag, the course of both curves is strikingly identical. Table 3 shows the results of estimating $\dot{\rho}_{G,t}$ using lagged values of $Y_{G,t}$. The findings indicate that the business cycle indeed has a strong impact on the correlation coefficient. As the columns $(i)-(iii)$ demonstrate, the determination is particularly strong for a delay of three years. Model (ii) explains 98 percent of the variance of the correlation cycle, whilst the marginal impact of the business cycle is strongly significant.

[4] We eliminated the trends in $Y_{G,t}$ and $\rho_{G,t}$ by using the polynomial $P_Y = 86,1 + 1,3t$ and $P_\rho = -0,61 + 0,05t - 0,003t^2$, where t^n represents the n-th degree trend variable. We get $p_t = .0000$ and $R^2 = .91$ for P_Y as well as $p_t = .0000 \forall t^n$ and $R^2 = .84$ for P_ρ.

Table 3: regressions for $\dot{\rho}_{G,t}$, 1995-2009, Germany

	(i)	(ii)	(iii)
c	.0010+	-.0001+	.0061+
	[.13]	[-.85]	[.76]
$\dot{Y}_{G,t}$	.0032+	.0156***	.0058+
	[.53]	[13.10]	[.78]
$\dot{Y}_{G,t-2}$	.0132*		
	[2.01]		
$\dot{Y}_{G,t-3}$		.0306***	
		[22.47]	
$\dot{Y}_{G,t-4}$			.0155
			[1.82]
N	14	14	14
R^2	.31	.98	.33
SEE	.024	.004	.023
$F-Stat$	2	254***	2+

Data source: *Statistisches Bundesamt* (2011) and *table 2*. *Notes*: Table reports OLS-Regression, t values are shown in parantheses, *p<.10, **p<.05, ***p<.001, +p>.20, SEE = standard error of regression.

It is obvious that the strong economic impact on the correlation coefficient must be eliminated in order to identify the stable relationship of size and unemployment. Thus, we calculate cyclically adjusted unemployment rates $\widetilde{\omega}_i$ and $\tilde{\omega}_j$ for all sub-regions $i = 1, \ldots, n$ respectively $j = 1, ..., m$. To extract the cyclically component from the time series ω_i and ω_j, we use the proposed filter from *Hodrick* and *Prescott* (1980). The cyclically adjusted time series $\tilde{\omega}$ will show the long-term trend around which the unemployment rates fluctuate.[5] It therefore has strong similarities with the 'natural' rate of unemployment, if the trend owns a slight slope.[6]

[5] Let $\log(\omega_{i,t})$ be the logarithm of the unemployment rate at t, the desired trend component τ_j solves the minimization problem

$$\arg\min_{\tau_i} \sum_{t=1}^{T} (log(\omega_{i,t}) - \tau_{i,t})^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{i,t+1} - \tau_{i,t}) - (\tau_{i,t} - \tau_{i,t-1})]^2$$

at a given smoothing parameter λ. The first term of the equation above ensures the best possible fit to the data, whereas the second term penalizes the variation of the trend component. Thus, the time series is accretively smoothed for increasing values of λ. In order to obtain a low grade, we set $\lambda = 5000$.

[6] A gradient $\to$ 0 would lead to an approximation to the arithmetic mean. However,

Table 4: cyclically adjusted international equilibrium correlation coefficients

Continent or trade area	$\widetilde{\rho}_k(SQ_k, \widetilde{\omega}_k)$	$\widetilde{\rho}_k(L_k, \widetilde{\omega}_k)$	N
Africa	.27	.43	45
COMESA	.42	-.26	17
COMESSA	.30	-.22	26
Asia	.16	-.22	42
ASEAN	.47	-.30	8
GAFTA	.60	.37	16
Europe	-.09	.22	38
EU27	.35	.25	27
EU15	.70	.50	15
EURO-17	.56	.36	17
South America	.21	.29	12
MERCOSUR	.44	.57	10
North America	-.25	-.31	20
NAFTA	.88	-.36	3
Oceania	-.23	-.24	18

Data source: *Eurostat* (2011), *OECD* (2011), *World Bank* (2011), *ILO* (2011), and national census bureaus.

Since the variables SQ and L are only marginally affected by cyclical fluctuations, the adjusted correlation coefficients $\tilde{\rho}(SQ, \tilde{\omega})$ and $\tilde{\rho}(L, \tilde{\omega})$ using $\tilde{\omega}$ rather than ω can be interpreted as the long-term equilibrium relationship between size and unemployment. Tables 4 and 5 illustrate this correlation coefficients on the intra-national respectively the international level.

Based on the time-independent coefficients, strong correlations for almost all countries, continents and trading areas can be indentified. The results pictured in table 4 also provide the recognition that in most cases, trade areas have a particularly higher correlation than continents. For example, $\widetilde{\rho}_k(SQ, \widetilde{\omega})$ of South America is .21, while the coefficient for MERCOSUR assumes a particularly higher level (.44). The same coherences can be measured in Asia (.16 vs. .47 (ASEAN) and .60 (GAFTA)), Africa (.27 vs. .42 (COMESA) and .30

the slope is significantly different from zero in most cases. Calculating $\tilde{\omega}$ on the basis of $T^{-1}\sum_{t=1}^{T}\omega_t$ would hence distort the results. Nevertheless, owing to the trend component $\tau_i \neq 0$, the long term equilibrium rates can change over long periods. Yet, since we use data between 1999 and 2009, the equilibrium rates are quite stable in the medium time.

Table 5: cyclically adjusted intra-national equilibrium correlation coefficients

Nation	$\widetilde{\rho}_j(SQ_j, \widetilde{\omega}_j)$	$\widetilde{\rho}_j(L_j, \widetilde{\omega}_j)$
Belgium	-.69	-.99
Bulgaria	-.90	-.88
Denmark	.95	.94
Germany	-.34	-.51
Estonia	-.48	.09
Finland	.58	.58
France	-.27	.01
Greek	.60	.48
United Kingdom	-.70	-.20
Ireland	.44	.08
Italy	.27	.12
Croatia	-.99	-.99
Latvia	.32	.15
Lithuana	.47	.22
Netherlands	.40	-.59
Norway	.69	-.34
Austria	.50	.50
Poland	-.96	-.97
Portugal	.44	.44
Romania	.20	.20
Sweden	.64	-.56
Slovakia	.64	.66
Slovenia	.32	.17
Spain	.39	.35
Switzerland	.46	.49
Czech Republic	-.83	-.25
Hungary	.93	.98
Australia	-.57	-.15
China	.25	.10
India	-.38	.21
Japan	-.26	-.27
Canada	-.29	-.28
Mexico	-.11	.34
New Zealand	-.99	.99
Russia	.77	-.61
Turkey	.22	.62

Data source: *Eurostat* (2011), *OECD* (2011), *World Bank* (2011), *ILO* (2011), and national census bureaus.

(COMESSA)) as well as in Europe (≈ 0 vs. .35 (EU27), .70 (EU15) and .56 (EURO-17)).

Evaluating our hypothesis from chapter 3, we perceive that the correlation indeed is positive in most cases: 22 of the 36 countries surveyed offer a positive coefficient $\widetilde{\rho}_j(L, \widetilde{\omega})$. This also holds for the international comparison: 5 out of 8 trade areas possess a positive coherence of size and unemployment. However, this proposal does not hold on the continental level. One possible explanation of this deviation is the relationship that we derived above: trade areas tend to exhibit weaker correlations than continents. Apparently, the correlation is higher, the more homogeneous the examined economic region is. Since countries in continents like Ozeania ($n = 18$) and North America ($n = 20$) are strongly heterogeneous, the correlation can easiliy be distorted in a way that the direction of the coherence reverses.

5 The relationship between $\tilde{\rho}$, the fiscal and the tariff degree of centralization

We learned from chapter 4 that we can indeed state a significant link between size and unemployment for most countries and trade areas. As theoretically derived, this correlation is positive in most cases. In other words, smaller economies have to struggle with unemployment in a much lesser extent. However, we could not yet explain why some countries have negative coefficients. Obviously, there are determinants that reverse the basically positive relationship between size and unemployment.

Economists largely agree that institutions strongly affect the level of unemployment.[7] Probably the most important determinant in terms of the institutional framework of labor markets is the degree of centralization.[8] At this juncture, we have to distinguish between the *fiscal* degree of centralization and the level of centralization of *collective bargaining*. The fiscal degree of centralization shows to what extent fiscal resources are used on the central government level, whilst the level of collective bargainig indicates on which level bargaining talks are held. *Calmfors* and *Driffill* (1988) demonstrated that the tariff level has a significant impact on the level of real wages and unemployment. This

[7] See inter alia *Berthold* (2001), *Blanchard* and *Wolfers* (1999), *Flaig* and *Rottmann* (2011) as well as *Caballero* and *Hammour* (2000) for this argument.

[8] See inter alia *Traxler* (2003) and *Haltiwanger et al.* (2006).

assumption known as the *'Calmfors-Driffill hypothesis'* or *'hump-shape hypothesis'* is based on an inverse parabolic relationship between the two variables, with the maximum real wage and the highest rate of unemployment reached at the medium degree of centralization.

But why do particularly high respectively low degrees of centralization lead to lower unemployment rates? The *corporatist hypothesis* of *Bruno* and *Sachs* (1985) says that the more comprehensive an interest group is, the less can it succeed to gain special advantages to the detriment of other social groups. Central wage bargaining therefore reflect the overall economic consequences to a much higher extent, what leads to the interest group acting as a general welfare-maximizing actor. On the other side, the *liberal-pluralist thesis* of inter alia *Lindbeck* (1993) stresses the importance of market forces. Leaving wage negotiations to markets leads to more flexibile structures and a reduction of classical unemployment.[9]

The hump-shape hypothesis can be interpreted as a combination of both approaches: countries with high levels of decentralization succeed because of the flexibility gained by the market forces. On the other hand, strongly centralized nations succeed due to the bargaining partners acting as a general welfare-maximizing actor. However, countries whose degrees of centralization stuck in the middle could neither benefit from the positive effects described by the corporatist hypothesis nor from those postulated by the liberal-pluralist thesis. As a matter of fact, moderately centralized nations have to suffer higher unemployment rates.

Hereinafter, we aim to explain the relationship between $\widetilde{\rho}_j$, the fiscal and the collective degree of centralization. For the *tariff* level of centralization (θ_j), we use data from the *ICTWSS* database of the *AIAS* (2011). We distinguish between three degrees of collective bargaining (CB). The trinary variable is defined as follows:

$$\theta_j = \begin{cases} 1 & CB\ on\ company\ level \\ 2 & CB\ on\ industry\ level \\ 3 & CB\ on\ central\ level \end{cases}$$

In addition, we define the *fiscal* level of centralization $\eta_j \in (0, 1]$ as the ratio of the amount of taxes flowing directly to the central government and the total

[9] See *Fehn, R.* (2002) for a more detailed explanation of the corporatist and the liberal-pluralist thesis.

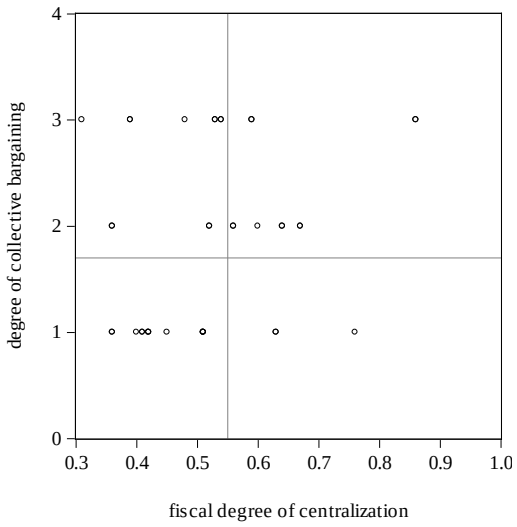
tax revenues. To calculate this quotient, we use data from *OECD* (2011b). To eliminate short-term fluctuations as well as cyclical effects, we apply the arithmetic mean $\eta_j = T^{-1}\sum_{t=1}^{T}\eta_{j,t}$ between 2000 and 2010. Table A2 in the appendix shows the specification of θ_j and η_j for all countries surveyed.

First, we have to clarify how these two factors interact. The economic intuition would be that economies choose a combination of θ and η that minimizes the adjustment costs. If bargaining talks are held on the central level, the fiscal degree of centralization has to be high in order to enable the state to cope with the unemployment caused by the collective agreement. In this case, there are some strong incentives for the state to act as a general welfare-maximizing actor. On the other hand, if barganing talks are held on the company level, this necessity does not exist. Recapitulatory, a positive correlation between the two variables can be expected.

Figure 2 shows the relationship between the fiscal and the collective degree of centralization. The lines picture the respective mean values of the sample. Apparently, the synchronization of the variables is rather weak, albeit a faint positive correlation (15 percent) can be measured. According to our theory, most observations have to be located in the first or the third quadrant. As figure 2 shows, 12 out of 21 observations follow this rule. However, a strong concentration in the second quadrant can be stated, whereas only two countries are located in the fourth quadrant. Whilst the position of countries in the fourth quadrant remains inexplicably, the high accumulation in the second quadrant can be explained by the dynamics of the variables: as the fiscal degree of centralization in most cases is (implicitly or explicitly) enshrined in the Constitution of the countries, it is very difficult to be changed. The degree of collective bargaining, however, reveals some variation over the course of time. Figure 2 therefore shows the snapshot of an adjustment process that is still not finished. Nonetheless, the correlation between the fiscal degree of centralization and the centralization of collective bargaining is currently rather weak. As a consequence, estimating the effects on unemployment or $\tilde{\rho}$ solely on the basis of one degree of centralization might distort the results significantly.

We therefore use the multiplicative combination of the two centralization levels $\theta_j\eta_j$ to estimate the correlation $\tilde{\rho}(SQ,\tilde{\omega})$. This multiplicative composition can be interpreted as the aggregate degree of centralization of an economy. Theoretically, the domain is $Dom(\theta\eta) = \{\theta\eta \in \mathbb{R}^+ | 0 \leq \theta\eta \leq 3\}$. However, the

Figure 2: relationship between the fiscal and the collective degree of centralization (2010)



Data source: *AIAS* (2011), *OECD* (2011b).

empirical interval of all nations surveyed is $\theta\eta \in [0.36, 2.58]$. Table 6 shows the results of the OLS estimation for the years 2000 and 2010. To investigate whether the product $\theta_j\eta_j$ is a reasonable explanation feature, we also test for the factors θ_j and η_j separately.

One might argue that our estimation using a simple linear regression can be biased due to the omitted variable problem. Though, as the sample size is $N = 21$, conclusions must be drawn very cautiously, even in the univariate case. Including further variables λ_q would significantly intensify this problem owing to the loss of additional degrees of freedom. Yet, the omitted bias will be negligible if $\lim Cov(\theta\eta, \lambda_q) \to 0$. Another problem might be the logical inconsistency since $\tilde{\rho} \in [-1, 1]$ owns a bounded domain $Dom(\tilde{\rho}) \neq \infty$. However, this is an inherent problem of economic research, since the domains of the unemployment rate $Dom(\omega) = \{\omega \in \mathbb{R}^+ | \omega \leq 1\}$ or the Gini coefficient $Dom(G) = \{G \in \mathbb{R}^+ | G \leq 1\}$ are similarly bounded.

Table 6 shows that the aggregate degree of centralization $\theta\eta$ strongly influences $\widetilde{\rho}_j(SQ, \widetilde{\omega})$. Low degrees of centralization lead to negative coefficients, while increasing values of $\theta_j\eta_j$ lead to steadily rising expressions of $\widetilde{\rho}_j(SQ, \widetilde{\omega})$. Moreover, $\theta\eta$ has a significantly higher ability to explain $\tilde{\rho}$ in comparison to the individual degrees of centralization θ and η. This finding is crucial, since the

Table 6: regressions for $\tilde{\rho}(SQ, \tilde{\omega})$, 2000-2010, international level

	2000			2010		
	$\theta\eta$	θ	η	$\theta\eta$	θ	η
c	-.70**	-.46	-.05+	-.63**	-.36	-.05+
	[-2.93]	[-1.75]	[-.11]	[-2.66]	[-1.41]	[-.11]
degree of centralization	.67**	.27	.17+	.58**	.21	.17+
	[3.32]	[1.95]	[.23]	[2.96]	[1.61]	[.23]
N	21	21	21	21	21	21
R^2	.37	.13	.01	.33	.09	.01
SEE	.48	.57	.62	.49	.58	.62
$F - Stat$	10.4***	3.8	.05+	8.8***	2.6	.05+

Data source: *AIAS* (2011), *OECD* (2011b) and *table 5*. *Notes*: Table reports OLS-Regression, t values are shown in parantheses, *p<.05, **p<.01, ***p<.001, +p>.20, SEE = standard error of regression.

model using $\theta\eta$ apparently works best in approximating $\tilde{\rho}$. The intercept of the estimated equation is -.63 in 2010, the marginal impact of centralization is .59. Overall, the model describes the data relatively well: 37 percent of the variance of $\tilde{\rho}$ in 2000 (respectively 33 percent in 2010) can be explained by using the aggregate degree of centralization. The probability of the model beeing insignificant is lower than one percent. As table 6 shows, the effect of centralization is quite stable over time, although a slightly decreasing trend can be observed.

From a centralization level $\theta_j\eta_j \approx 1$, $\tilde{\rho}$ tends to be positive. Our findings in this chapter can therefore be summarized as follows: size and unemployment are essentially positive correlated. Exceptions to this rule are nations with a low degree of centralization ($\theta_j\eta_j < 1$).

6 Explaining unemployment using size and degree of centralization

The previous chapter showed that the strength of the link between size and unemployment rises with increasing degrees of centralization. Yet, this finding could as well be a hint that multi-colinearity between the degree of centralization and size is high. In this chapter, we develop a model that accounts for both the size effect as well as the centralization effect. So far, we only measured the influence of size in j. The degrees of freedom have thus not been sufficiently large enough to allow OLS estimations. In the following, we wish to investigate the influence of size on a broader level. The model derived in this chapter shall therefore answer two crucial questions: (1) how exactly works the interplay between size and centralization and (2) how does size influence unemployment on a broad country-unspecific level?

To display the degree of centralization, we again use $\theta_j\eta_j$. The concrete specification of our model is based upon an adjusted Calmfors-Driffill hypothesis. Calmfors and Driffill examined a sample of 17 countries in the period between 1962 and 1985 and came to the conclusion that strongly centralized as well as highly decentralized nations have to struggle with a lower rate of unemployment in comparision to those having a mediocre degree of centralization.

The findings of Calmfors and Driffill have been discussed intensely during the last two decades. Recent studies could in fact confirm the hump-shape

hypothesis with some restrictions.[10] Nevertheless, the hump-shape hypothesis fails for several countries when being evaluated empirically.

We adjust the Calmfors-Driffill hypothesis by using the aggregate level of centralization $\theta_j \eta_j$ rather than θ_j. In addition, we use the above derived positive relationship between unemployment and size by adding the size parameter $\sqrt{LSQ}$ to our model. The parameter represents the square root of the product of area and population. Therefore, the analysis will account for both correlation between surface area and unemployment as well as coherences amongst population and unemployment.

In order to obtain a preferably extensive sample, we include all federal states s of the nations for which we can find reliable data on $(\theta\eta)_{j,t}$ and $\omega_{s,t}$ between 1999 and 2009 and achieve the set M_s with $|M_s| = 496$. Table A3 in the appendix lists the countries whose federal states are included in the analysis. In order to maximize comparability, we exclusively use NUTS-2 regions for European nations as well as TL-3 regions for countries outside Europe. Every federal state $s \in M_s$ has a degree of centralization $\theta\eta_j$ that refers to the country j to which the federal state belongs.[11] To get an idea about the long-term equilibrium relationship, we again use the smoothed unemployment rates $\tilde{\omega}_s$. The higher amount of observations using regions leads to a fairly robust model.

We can summarize the above-described assumptions as follows

$$\tilde{\omega}_s = \beta_0 + \beta_1 (\theta\eta)_s + \beta_2 (\theta\eta)_s^2 + \phi\sqrt{LSQ_s} + \epsilon_s \tag{3}$$

where the first two terms after the intercept picture the Calmfor-Driffill hypothesis and the second term accounts for the derived relationship between size and unemployment. In order to contrast the size effect from the hump-shape impact, we name the size coefficient ϕ. Tables 7 and 8 show the results of the OLS estimation of (3) on both the intra-national level as previously described as well as on the international level. Due to the strong heterogeneity of the size of the countries surveyed, we use $\log(LSQ_j)$ in our country model.[12] The results

[10] See inter alia *Forni* (2004). Forni added, that highly centralized nations in fact have lower unemployment rates than moderately centralized economies. However, in contrast to strongly decentralized countries, this result could only be achieved by above-average government spendings.

[11] We use the subscript s in order to delimit the federal states included in the estimations of this chapter from those of the previous chapters (i). Since we solely use NUTS-2 respectively TL-3 regions, s and i are not identical.

[12] Each data transformation changes the relative distance between the individual observations. However, this smoothing effect is stronger using logs instead of the square root. See *Osborne* (2002) for a more detailed discussion of this matter. Since we mainly use NUTS-2

in tables 7 and 8 distinguish between the whole sample and a restricted sample that only includes countries inside Europe. Owing to the structural differences between European countries and nations outside Europe, we include the dummy variable EUR when applying (3) on the whole sample. EUR takes a value of 1 if the country is inside Europe, and 0 otherwise.

The results of estimating the model on the whole sample of regional data are shown in column (ii) of table 7. They are surprisingly good, given the large variety of regions in the sample. All the variables have the expected sign and are furthermore significant in nearly every case. In particular, ϕ reveals a positive expression in each of the four models and is highly significant, as predicted in the preceding chapters. The positive sign of $(\theta\eta)_s$ as well as the negative sign of $(\theta\eta)_s^2$ confirm the inverse parabolic coherence between unemployment and aggregate centralization. In general, the model explains almost one third of the variance of regional unemployment, whilst the probability of the model being insignificant is lower than .01 percent. Column (i) reports the results of estimation (3) on the restricted sample that includes solely European regions. The results are similar to those from column (ii), althoug the significance of the model is slightly smaller. As our European dummy EUR indicates, there are some major structural disparities between European and non-European states. Nevertheless, our modeled relationship holds in both cases.

Table 8 indicates an even better fit of our model on the international level. Again, all the variables have the expected sign, they are highly significant most of the time, and they explain 70 percent of the variance of international unemployment rates. Just as on the regional level, size influences unemployment positively. The coefficient ϕ is profoundly significant for all sample periods. Furthermore, the hump-shape proposal can again be approved. The null hypothesis of model-insignificance must be rejected at least at the 0.5 percent-level for all sample periods. The comparison between the sample periods shows that the results are fairly robust over time.

We can summarize our findings as follows: first, size influences unemployment rates positively. Second, this positive correlation is highly significant on both the regional as well as the international level. Third, the adjusted hump-shape hypothesis holds in each case and is significant most of the time. Overall, both size and centralization have a crucial influence on regional and national un-

and TL-3 regions, the dispersion of $\sqrt{LSQ}$ on the regional level (coefficient of variation: .73) is significantly lower than on the national level (.91), where a strong heterogeneity of size can be stated. Thus, we use the logarithmic transformation in our country model.

Table 7: regressions for $\tilde{\omega}$, 2000 and 2010, regional level

	2000		2010	
	(i) Europe	(ii) Whole sample	(i) Europe	(ii) Whole sample
c	4.25***	3.68***	5.71***	4.18***
	[3.04]	[5.95]	[5.49]	[8.50]
$(\theta\eta)_s$	6.25**	2.91**	2.43	1.38
	[2.37]	[2.00]	[1.48]	[1.29]
$(\theta\eta)_s^2$	-3.56***	-2.26***	-1.59***	-1.02**
	[-3.08]	[-3.38]	[-2.52]	[-2.20]
$\sqrt{LSQ_s}$	8.38E-06***	1.28E-06**	8.94E-06***	1.30E-06**
	[4.08]	[2.20]	[-2.52]	[2.19]
EUR		3.38***		2.97***
		[11.76]		[10.56]
N	239	496	239	496
R^2	.16	.27	.15	.24
SEE	3.32	2.52	3.34	2.57
$F-Stat$	14.4***	46.4***	13.2***	39.7***

Data source: *AIAS* (2011), *OECD* (2011b), *Eurostat* (2011), and national census bureaus. *Notes*: Table reports OLS-Regression, t values are shown in parantheses, SEE = standard error of regression, *p<.10, **p<.05, ***p<.01, +p>.20.

Table 8: regressions for $\tilde{\omega}$, 1995-2010, international level

	1995 Whole sample	2000 Whole sample	2005 Whole sample	2010 Whole sample	2010 Europe
c	-13.21** [-2.64]	-10.26* [-1.87]	-14.06** [-2.82]	-13.56** [-2.81]	-11.74** [-2.27]
$(\theta\eta)_j$	3.03* [1.89]	5.08* [1.87]	3.47** [2.13]	3.24** [2.04]	2.92 [1.62]
$(\theta\eta)_j^2$	-1.61** [-2.73]	-2.78** [-2.29]	-1.70** [-2.79]	-1.66** [-2.81]	-1.54** [-2.36]
$\log(LSQ_j)$	.53*** [3.72]	.42** [2.58]	.55*** [3.81]	.54*** [3.87]	.62*** [.3.61]
EUR	3.91*** [4.95]	3.57*** [4.11]	3.91*** [4.80]	3.91*** [4.96]	
N	21	21	21	21	17
R^2	.71	.64	.68	.71	.68
SEE	1.11	1.22	1.14	1.10	1.159
$F-Stat$	9.84***	7.29***	8.83***	9.79***	9.16***

Data source: *AIAS* (2011), *OECD* (2011b), *Eurostat* (2011), and national census bureaus. *Notes*: Table reports OLS-Regression, t values are shown in parantheses, SEE = standard error of regression, *p<.10, **p<.05, ***p<.01, +p>.20.

employment. However, it is essential to quantify this influence more in detail. As shown in tables 7 and 8, $(\theta\eta)_j$ has an inverse parabolic impact on the unemployment rate. Nations that have an aggregate degree of centralization equal to the global maximum of the parabola will ceteris paribus have to struggle with higher unemployment. The global maximum of $\tilde{\omega}_j$ with respect to $(\theta\eta)_j$ can be calculated solving $\arg\max_{(\theta\eta)_j}[-11.68 + 6.74(\theta\eta)_j - 3.54(\theta\eta)_j^2 + .057\log(LSQ_j)]$.[13] It appears that unemployment is at its maximum in $\theta\eta = 1$. With increasing distance from that point, unemployment rates decrease in both directions due to the parabolic curve of the hump-shape hypothesis. In the following, we will call this derived parabola the 'centralization parabola' $\Omega(LSQ_j)$.

However, this parabola is relying heavily on the size of the underlying economy. For smaller economies, the parabola is shifted downwards, whereas the parabola lies on a higher level regarding larger economies. The size of economies therefore influences its unemployment rates in a way that it leads to a shift of $\Omega(LSQ_j)$. In consequence, each economy has its individual centralization parabola $\Omega(LSQ_j)$. The position of a *nation* on its parabola is determined by its degree of centralization. In contrast, the position of the *parabola* $\Omega(LSQ_j)$ itself is influenced by the size of the economy. That means, even if two economies have the same degree of centralization, unemployment rates could differ due to the difference in population or surface. On the other hand, two countries with a comparable population can have strongly different unemployment rates due to their individual position on $\Omega(LSQ_j)$. Our parabolas therefore deviate from the Calmfors-Driffill hypothesis in its original form, where two countries with identical degrees of centralization can only have an *identical* level of unemployment.

If correct, our hypothesis leads to direct implications on economic policy: to a certain extent, large nations with a particularly high respectively low degree of centralization can compensate for the size effect. A supoptimal centralization level harms small countries to a much lesser extent than large nations. However, even small states have the potential to reduce unemployment by moving towards the two optima at the edges of $\Omega(LSQ_j)$. Figures 3-5 picture the positions of several European states on their individual centralization parabola and the resulting amount of unemployment.

[13] This can easily be done by calculating the necessary $\left(\frac{\partial\tilde{\omega}_j}{\partial(\theta\eta)_j} = 0 \Leftrightarrow (\theta\eta)_j \approx 1\right)$ and sufficient $\left(\frac{\partial^2\tilde{\omega}_j}{\partial(\theta\eta)_j^2} = -7.08 < 0\right)$ condition.

We can state significant improvement potentials for some of the countries shown. Figure 3 illustrates the centralization parabolas for small European countries. Although Switzerland and the Czech Republic operate on a more elevated parabola, both countries are able to realize a lower unemployment rate than Denmark, owing to their lower level of aggregate centralization (Switzerland: 0.40, Czech Republic: 0.41, Denmark: 1.3).

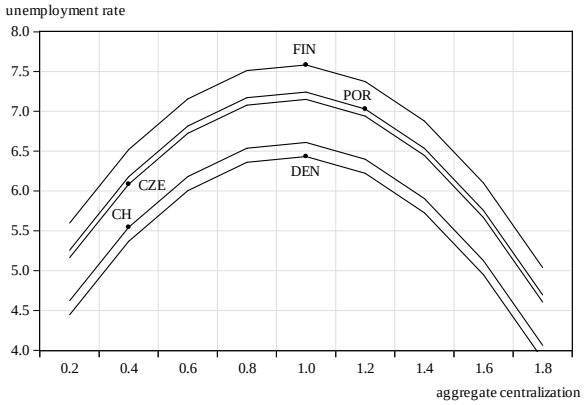
In addition, Denmark is almost precisely on the global maximum of $\Omega(LSQ_j)$, that is at $(\theta\eta)_j = 1$, while Portugal has a slightly more desirable degree of centralization at 1.20, striving for the optimal point at the right edge of $\Omega(LSQ_j)$. However, the equilibrium unemployment rate in Denmark is significantly lower than in Portugal, since Denmark (5.4 million inhabitants; 43,000 square kilometers) is particularly smaller than Portugal (10.6; 92,000). But the comparision with Switzerland offers the potential for Denmark to reduce its unemployment: although Switzerland and Denmark are almost equal in size, the decentralization in Switzerland (0.40) leads to a much lower equilibrium unemployment rate. Denmark therefore could realize the potential to reduce unemployment by centralizing or decentralizing wage negotiations. However, decentralizing would be the better alternative: *Forni* (2004) showed that the positive effects on unemployment gained by a high degree of centralization can only be achieved by above-average government spendings.

Similar conclusions can be made regarding figure 4 that shows centralization parabolas for large European nations. Although France is larger than Germany or the United Kingdom, its equilibrium unemployment rate is lower. Again, the high degree of aggregate centralization in Germany and the United Kingdom affects employment negatively. This example also provides some interesting insights on the characteristics of $\theta\eta_j$: even though the fiscal degree of centralization in France is higher than in Germany ($\eta_{FRA} = .40$ vs. $\eta_{GER} = .31$), collective bargaining is much more decentralized. Consequently, the aggregate level of centralization in France is significantly lower than in Germany ($\theta\eta_{FRA} = .40$ vs. $\theta\eta_{GER} = .93$).[14]

Figure 5 illustrates the remarkableness of the size effect on the position of $\Omega(LSQ_j)$. Compared with small European countries like Switzerland, Germany and France are more or less similar in size. Differences in equilibrium unemployment rates between these two countries are mainly triggered by the level of

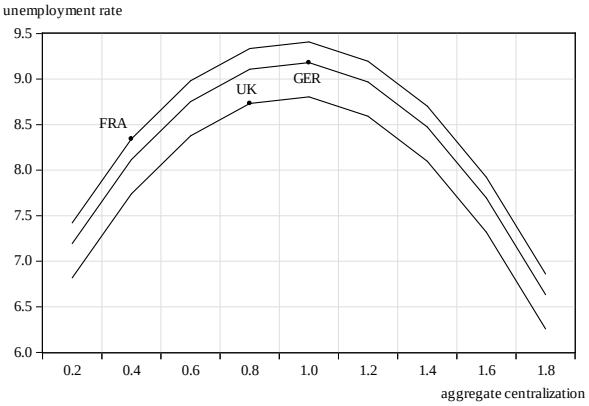
[14] Although France has historically been highly centralized, it has imposed a form of integrated decision making on lower levels of government during the past century. See *Ashford* (1977) for a detailed discussion of the French political system.

Figure 3: centralization parabolas $\Omega(LSQ_j)$ for small European countries



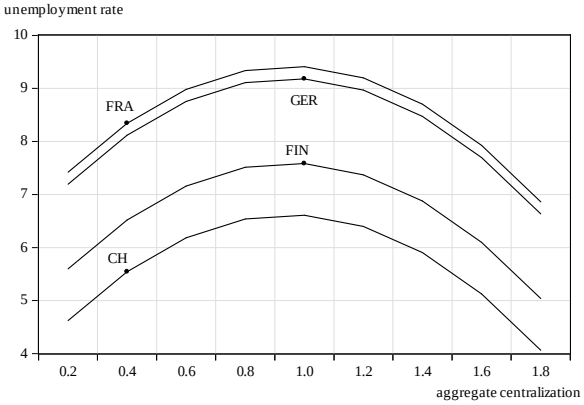
Data source: *table* 8, restricted sample of European countries.

Figure 4: centralization parabolas $\Omega(LSQ_j)$ for large European countries



Data source: *table 8*, restricted sample of European countries.

Figure 5: size differences of centralization parabolas $\Omega(LSQ_j)$ between small and large European countries



Data source: *table 8*, restricted sample of European countries.

centralization rather than by size effects. However, the impact of size becomes strongly significant when comparing Germany or France with small countries. Even if Germany reaches the optimal centralization level at the left edge of $\Omega(LSQ_j)$, its unemployment rate would not be smaller than the Finnish or the Swiss.

7 Conclusions

We showed that there is a significant link between size and unemployment. It became clear that this correlation is positive in most cases, i.e. larger states are struggling with higher average unemployment. Exceptions to this rule are states with a very low degree of centralization. However, with increasing centralization levels, the probability of a positive co-movement continues to grow. Looking at both the degree of centralization and the size of economies, individual centralization parabolas can be derived, which document the interaction between centralization, size and unemployment for each state.

Based on these parabolas, implications for national economic policies can be obtained. For Germany, the centralization parabola reveals some potential for improvement: the degree of centralization is close to the global maximum $(\theta\eta)_j = 1$. The fiscal centralization level is .32 and ranks in the lower middle of all countries surveyed. Still, Germany owns a high level of centralization in terms of collective bargaining. According to our hypothesis illustrated in figure 3, decentralizing collective bargaining would lead to a reduction in German unemployment. This necessity becomes apparent considering the size of Germany: since Germany ranks at the 14th position of the world largest countries in terms of population[15], the centralization parabola lies on an elevated level. Germany therefore has to struggle with a generally higher level of unemployment. But according to the results in this paper, decentralizing can be considered a preferable measure to antagonize the negative effects emanating from the size of nations.

[15] This ranking was established based on data from *World Bank* (2011).

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Appendix

Table A1: Classifications and numbers of cases

1. NUTS-Countries

country	*classification*	*n*
Austria	NUTS 2	9
Belgium	NUTS 2	10
Bulgaria	NUTS 2	6
Croatia	NUTS 3	21
Czech	NUTS 2	8
Denmark	NUTS 2	5
Estonia	NUTS 3	5
Finland	NUTS 2	5
France	NUTS 2	26
Germany	NUTS 1	16
Greece	NUTS 2	13
Hungary	NUTS 2	7
Ireland	NUTS 3	8
Latvia	NUTS 3	6
Lithuana	NUTS 3	10
Netherlands	NUTS 2	12
Norway	NUTS 2	7
Poland	NUTS 2	16
Portugal	NUTS 2	7
Romania	NUTS 2	8
Sweden	NUTS 2	8
Slovakia	NUTS 3	8
Slovenia	NUTS 3	12
Spain	NUTS 2	19
Switzerland	NUTS 2	7
Turkey	NUTS 1	12
United Kingdom	NUTS 1	12

2. TL2-Countries

country	*classification*	*n*
Australia	TL2	8
Canada	TL2	12
Japan	TL2	10
Mexico	TL2	31
New Zealand*	TL2	2
South Korea	TL2	7
United States	TL2	51

*Note that New Zealand has not been included in the international-level estimations of this paper since the correlation coefficient by definition has to be either 1 or -1 for $n = 2$. Nevertheless, New Zealand is included in the tables of this paper in order to show the general direction of the correlation.

3. Others

country	*classification*	*n*
China	National Census Bureau	28
India	National Census Bureau	27
Russia	National Census Bureau	8

Table A2: Specification of θ_j and η_j

country	θ_j *1995*	θ_j *2000*	θ_j *2005*	θ_j *2010*	η_j *2000-2010*
Australia	1	1	1	1	.42
Austria	3	3	3	3	.53
Belgium	3	3	3	3	.48
Canada	1	1	1	1	.45
Denmark	2	3	2	2	.67
Finland	2	2	3	2	.52
France	1	1	1	1	.40
Germany	3	3	3	3	.31
Italy	3	3	3	3	.54
Japan	3	2	2	2	.36
Netherlands	3	3	3	3	.59
Norway	3	2	3	3	.86
Portugal	2	2	2	2	.60
Sweden	2	2	2	2	.56
Spain	2	2	3	3	.39
United Kingdom	1	1	1	1	.76
United States	1	1	1	1	.42

Source: *OECD* (2011b), *AIAS* (2011).

Table A3: Nations and regions used in the estimations of tables 7 and 8

country	*classification*	*number of regions*	*used in regional estimation*
Australia	TL-3	60	no
Austria	NUTS-2	9	yes
Belgium	NUTS-2	11	yes
Canada	TL-3	288	no
Czech Republic	NUTS-2	8	yes
Denmark	NUTS-2	5	yes
Finland	NUTS-2	5	yes
France	NUTS-2	26	yes
Germany	NUTS-2	39	yes
Hungary	NUTS-2	7	yes
Italy	NUTS-2	21	yes
Japan	TL-3	64	yes
Netherlands	NUTS-2	12	yes
New Zealand	TL-3	14	yes
Norway	NUTS-2	7	yes
Poland	NUTS-2	16	yes
Portugal	NUTS-2	7	yes
South Korea	TL-3	16	no
Sweden	NUTS-2	8	yes
Switzerland	NUTS-2	7	yes
Spain	NUTS-2	19	yes
United Kingdom	NUTS-2	37	yes
United States	TL-3	179	yes

Source: OECD (2011b), AIAS (2011)

Notes: We use regional data of all countries shown in table above whenever we could find sufficient time series on regional unemployment rates on TL-3 respectively NUTS-2 level. Norway is excluded from the restricted sample estimation in column 5 of table 9, due to its exceptionally high degree of centralization in comparison to other European nations (Norway: 2.54; second highest degree of centralization: Netherlands: 1.77). We also excluded island regions and regions that are overseas territories such as French-Guyana (France) or the Canaries (Spain). Excluded regions are not included in the number of regions as shown in Table A3.