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The Fading Attraction of Central Regions: an Empirical Note on Core–Periphery Gradients in Western Europe

MARIUS BRÜLHART

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ABSTRACT *This paper describes sectoral core–periphery gradients across Western European regions over the period 1975–2000, and it estimates the impact of EU membership on countries' internal geography. Overall, it is found that the centrality of European regions has been losing importance as a determinant for the location of employment. Central regions have gained employment share in none of the eight broad sectors analysed, whereas peripheral regions have significantly gained employment share in four of these sectors. Accession to the EU has favoured countries' peripheral regions in terms of manufacturing employment and their central regions in terms of service employment.*

L'attirance des régions centrales en déclin: une note empirique sur les inclinaisons de périphérie du cœur en Europe occidentale

RÉSUMÉ *Cet article décrit les inclinaisons de périphérie du cœur à travers les régions de l'Europe occidentale sur la période de 1975 à 2000 et l'impact des adhésions à l'UE sur la géographie interne des pays concernés. Il s'avère dans l'ensemble que l'aspect central des régions européennes a perdu de l'importance comme élément déterminant pour l'emplacement d'un emploi. Les régions centrales n'ont acquis aucune part d'emploi dans les huit larges secteurs analysés, alors que les régions périphériques ont considérablement gagné de part du marché de l'emploi dans quatre de ces mêmes secteurs. L'accession à l'UE a favorisé les régions périphériques des pays au niveau de l'emploi industriel et leurs régions centrales au niveau de l'emploi dans les services.*

La atracción en declive de las regiones centrales: una nota empírica sobre gradientes de periferia central en Europa occidental.

RESUMEN *Este trabajo describe los gradientes sectoriales de periferia central en regiones de Europa occidental entre los años 1975 a 2000, y evalúa el impacto de la pertenencia a la UE en la geografía interna de los países. Sobretodo, se revela que la centralidad de las regiones europeas ha ido perdiendo importancia como factor determinante en la localización de empleo. Las regiones centrales no han ganado participación laboral en ninguno de los amplios ocho sectores analizados, mientras que las regiones periféricas han aumentado significativamente su participación laboral en cuatro de estos sectores.*

Département d'économétrie et économie politique, Ecole des HEC, Université de Lausanne, CH-1015 Lausanne, Switzerland. Email: Marius.Brulhart@unil.ch; http://www.hec.unil.ch/mbrulhar/. Also affiliated with the Centre for Economic Policy Research, London. The author would like to thank Carsten Schürmann for the generous provision of data, and Harry Garretsen for his helpful comments. Financial support from the Swiss National Science Foundation (grant 612-65970) is gratefully acknowledged.

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El ingreso a la UE ha favorecido a las regiones periféricas de los países en lo que se refiere a trabajos de manufactura y a sus regiones centrales en lo referente a empleos del área servicios.

KEYWORDS: *Geographic concentration; EU regions; core–periphery gradients*

JEL CLASSIFICATION: F15; R12; R14

1. Introduction

Since the early 1990s, the economic geography of Western Europe has become an object of intense scrutiny. Academic interest has been kindled primarily through the advent of a new generation of spatial general-equilibrium models, the 'new economic geography', that provide a formal treatment of locational forces affecting imperfectly competitive industries over a priori featureless space. These models appear particularly well suited to the analysis of locational forces in industrialized and relatively homogeneous world regions such as Western Europe. Policy-oriented economists have taken note of these models primarily because they identify cumulative forces that create or reinforce polarized economic landscapes featuring agglomerated core locations and hollowed-out peripheries, and because these forces may be strengthened by the reduction of spatial transaction costs. The relevance for Western Europe is obvious: if economic integration strengthens agglomeration forces and exacerbates core–periphery gradients, important distributional (and, possibly, efficiency-related) issues arise.[1]

The purpose of this note is to offer some relevant stylized facts. It describes (a) the degree to which sectoral location patterns in Western Europe are influenced by the centrality and peripherality of regions, and (b) whether and how accession to the EU has been associated with changes in within-country location patterns. The analysis draws on a balanced panel of sectoral employment across 222 Western European regions over the period 1975–2000. Eight sectors are distinguished, covering the full range of economic activities.

Related studies abound.[2] This literature has mainly described the extent to which particular sectors are geographically concentrated, and—the flipside of this coin—the extent to which regions (or countries) are specialized in particular sectors. These are important issues in their own right, but they do not address what are arguably two of the most pressing questions that arise in the context of modern location theory and of European integration: how are sectors (re-)locating relative to the regional core–periphery structure of aggregate economic activity? And: how does economic integration affect these location patterns?[3]

The paper is organized as follows. Section 2 briefly describes the data. Section 3 reports regression estimates of locational core–periphery gradients. Estimates of the impact of EU accession on countries' internal location patterns are reported in Section 4. Section 5 concludes.

2. Data

The data set, compiled by Cambridge Econometrics, provides a balanced panel of sectoral employment for 17 Western European countries, the 15 pre-2004 EU Member States plus Norway and Switzerland (referred to collectively as 'WE17'). Except for Luxembourg, all country data are disaggregated into NUTS-2 or

NUTS-3 regions, yielding a total of 222 region-level observations per sector and year. The number of regions within countries ranges from 2 (Ireland) to 37 (UK). Employment is reported for eight sectors, covering the full range of economic activities, over the period 1975–2000.[4]

In addition, the exercise draws on a regional estimates of Harris's (1954) well-known market-potential measure:

$$M_r = \sum_{s=1}^{S} \frac{Y_s}{d_{rs}}, \tag{1}$$

where $r \in R$ and $s \in S$ ($R \subset S$) denote regions; Y stands for 1998 regional GDP in terms of purchasing power parity, as computed by Eurostat; and d_{rs} stands for the economic distance between regions r and s. Drawing on the data set of Schürmann & Talaat (2000), economic distances are represented by estimated road-freight travel times between regional capitals. These estimates take account of road quality, border delays and legal constraints that affect the speed of road transport. Intra-regional distances are defined as one-third of the radius of a circle whose area represents that of the region, and d_{rr} is defined as twice the intra-regional distance, which implies that the intra-regional travel speed is 30 km/h on average.[5] The set of partner regions S includes WE17 as well as all other countries on the European Continent.[6] The estimated market potentials vary considerably: that of the most central region in our data set (London) is 12.5 times larger than that of the most peripheral region (northern Norway).

3. Core–Periphery Gradients in Western Europe

One of the principal insights of modern geography models is that a location's market access can be a powerful attractor for increasing-returns activities.[7] The policy relevance of this issue is obvious.

3.1. The Regression Model

Based on the market potential measure M_r, we compute core–periphery gradients of the eight sample sectors by estimating the following simple specification separately for each sector and year:

$$\ln\left(\frac{\frac{\gamma_{rit}}{\sum_i \gamma_{rit}}}{\frac{\sum_r \gamma_{rit}}{\sum_i \sum_r \gamma_{rit}}}\right) = \alpha_{it} + \beta_{it}\ln(M_r) + \varepsilon_{rit}, \tag{2}$$

where y is employment, i denotes sectors, t denotes years, α and β are regression coefficients, and ε is a stochastic error. The dependent variable is commonly referred to as a Balassa index or location quotient.[8] We take logs in order to make

the Balassa index symmetric around zero, and so as to be able to interpret $\hat{\beta}_{it}$ as an elasticity.

Since there is evidence of between-country heteroskedasticity, inference is based on White-adjusted t-statistics. To assess the statistical significance of changes in $\hat{\beta}_{it}$ between sample years, F tests are computed on the hypothesis that $\hat{\beta}_{it} - \hat{\beta}_{i,t-x} = 0$, using seemingly unrelated regression estimates of the disturbance covariances in order to account for cross-equation error correlation (Greene, 2000, p. 620).

3.2. Results

Table 1 reports the results, based on sector-level regressions for 1975, 1987 and 2000. The estimations broadly conform with expectations based on casual observation. Agriculture is the only sector that exhibits a consistently positive and statistically significance locational bias towards peripheral regions. Conversely, four sectors are statistically significantly concentrated in central regions for all three sample years: manufacturing and energy, transport and communication, banking and insurance, and 'other market services'.

Looking at changes over time, it turns out that no sector exhibits a significant increase over the sample period in its tendency to concentrate at the core. However, four sectors have relocated significantly towards peripheral regions: manufacturing,

Table 1. Core–periphery gradients, 1975–2000[a] (222 regions)

				$(F\|H_0:\hat{\beta}_t - \hat{\beta}_{t-x} = 0)$[b]	
Sector	Year	$\hat{\beta}$	R^2	$x \in \{12, 13\}$	$x = 25$
Agriculture	1975	−1.38**	0.33		
	1987	−1.31**	0.33	3.9*	
	2000	−1.29**	0.29	0.04	0.7
Manufacturing, energy	1975	0.38**	0.23		
	1987	0.28**	0.14	14.7**	
	2000	0.14**	0.03	47.9**	39.2**
Construction	1975	0.10	0.03		
	1987	−0.04	0.01	16.4**	
	2000	−0.18**	0.08	18.4**	37.9**
Distribution	1975	0.14**	0.07		
	1987	0.06	0.01	12.3**	
	2000	0.07	0.01	0.5	4.2*
Transport, communication	1975	0.12*	0.02		
	1987	0.09*	0.03	1.2	
	2000	0.13**	0.07	6.2*	0.2
Banking, insurance	1975	0.39**	0.22		
	1987	0.39**	0.27	0.0	
	2000	0.36**	0.18	0.8	0.5
Other market services	1975	0.26**	0.16		
	1987	0.28**	0.24	0.4	
	2000	0.31**	0.29	2.3	1.7
Non–market services	1975	0.18**	0.04		
	1987	0.12**	0.03	5.4*	
	2000	−0.02	0.001	88.8**	41.7**

[a] See equation (2); ** and * denote statistical significance at 99% and 95%, respectively, White-corrected.
[b] F-statistic on Wald test of equality of $\hat{\beta}$ across years, taking account of cross-equation error covariance.

construction, distribution, and non-market services. Hence, centrality seems to have lost some importance as a determinant of sectoral location in Europe.

It may be thought particularly striking that manufacturing employment has been relocating away from central regions. We illustrate this pattern in Table 2, which lists the 12 regions with strongest specialization *into* manufacturing, and the 12 regions with strongest specialization *out of* manufacturing, where specialization changes are defined as differences in log Balassa indices between 1975 and 2000.[9] The average market potential of the regions specializing out of manufacturing (13,181) is considerably larger than that of the regions specializing into manufacturing (7,518). In view of the varied composition of the 24 regions with most pronounced changes in manufacturing specialization, we can observe furthermore that the diagnosed locational shift away from central regions is a phenomenon that applies across European countries and is not driven by the relative performance of a certain country (or subset of countries) alone.

4. EU Accession and Intra-country Core–Periphery Gradients

While it is interesting in itself to describe the evolution of the European space economy, such descriptions inevitably raise the question as to whether and how such trends are affected by policy decisions. We therefore seek a way of identifying the effect of Western Europe's most prominent recent policy experiment, EU integration. Our data do not allow us to examine the impact of integration on Continent-wide location patterns. However, we can offer a simple assessment of how EU integration has impacted on countries' internal core–periphery gradients. Exploiting the richness of the data set in terms of time coverage and intra-country information, we can explore whether past accessions to the EU were associated with systematic changes in the time profile of sectoral location patterns within Member States.

4.1. The Regression Model

In order to isolate EU effects, we need to control for the myriad of unobserved factors that shape sector- and country-specific inter-temporal location patterns. Hence, we estimate a separate intercept and linear time trend for each country sector over the full sample period, attributing to these intercepts and time trends all the forces that shape sectoral location patterns except for EU membership. Then, we estimate the deviation from this baseline time trend of a time trend starting in the year of the relevant country's accession to the EU. Any deviation of the post-EU trend from the full-period trend is then interpreted as a membership effect. In order to obtain sufficient degrees of freedom for meaningful statistical analysis, and assuming that similar spatial forces were triggered when successive countries joined the EU, we force those deviation terms to be identical across countries and therefore estimate a unique membership effect per sector.

Specifically, we estimate the following regression model separately for each sector:

$$\mathbf{Z} = \mathbf{I}\boldsymbol{\alpha} + \mathbf{T}\boldsymbol{\beta} + \mathbf{E}\gamma + \boldsymbol{\varepsilon}, \tag{3}$$

where we let K denote the number of sample countries and T the number of sample years; $\mathbf{Z}$ is a $KT \times 1$ vector of estimated within-country core–periphery gradients

Table 2. Regions with largest changes in manufacturing specialization

Region	Market potential	Manuf. empl.		Balassa index	
		1975	2000	1975	2000
12 regions with largest *decrease* in manufacturing specialization:					
Scottish Highlands (UK)	4,924	49	11	0.17	−0.86
Trier (DE)	13,885	59	17	0.13	−0.63
Oslo (NO)	4,795	57	23	−0.22	−0.89
London (UK)	31,307	441	158	−0.35	−0.96
North Aegean (GR)	2,523	20	7	−0.12	−0.62
Liège (BE)	15,888	124	44	0.08	−0.42
Aosta Valley (IT)	9,811	11	5	−0.34	−0.80
Luxembourg (LU)	14,740	52	35	0.09	−0.37
Merseyside (UK)	12,606	212	69	0.07	−0.40
Brabant (BE)	16,911	106	71	0.00	−0.46
Namur (BE)	15,334	28	13	−0.34	−0.79
Bedfords./Hertfords. (UK)	15,451	223	119	0.14	−0.29
Average	13,181	115	48	−0.06	−0.62
12 regions with largest *increase* in manufacturing specialization:					
Ionian Islands (GR)	3,103	2	5	−2.28	−1.10
Epirus (GR)	3,363	12	15	−1.30	0.74
Gotland (SE)	5,423	3	6	−0.92	0.16
Molise (IT)	6,950	13	18	−1.03	−0.82
Ireland Centre/West (IE)	5,127	57	95	−0.46	0.39
Braunschweig (DE)	12,484	200	247	0.05	0.69
Niederbayern (DE)	11,135	144	208	0.11	0.64
Kassel (DE)	13,417	90	173	−0.18	0.18
Western Greece (GR)	3,659	31	21	−1.38	−0.25
Abruzzi (IT)	7,878	84	104	−0.37	0.03
Oberfranken (DE)	12,365	160	229	0.22	−0.33
Galicia (ES)	5,308	184	183	−0.60	−1.10
Average	7,518	82	109	−0.68	0.02
Overall average (WE17)	9,967	173	131	−0.12	−0.10

$\hat{\beta}_{ct}$, with c denoting countries, from country-by-country regressions of equation (2); $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ are $K \times 1$ vectors of regression coefficients; $\mathbf{I}$ is a $KT \times K$ matrix that consists of K diagonally stacked $T \times 1$ vectors of 1s, and zeros elsewhere; $\mathbf{T}$ is a $KT \times K$ vector consisting of K diagonally stacked $T \times 1$ vectors of sample years in ascending order ([1975, 1976, ..., 2000]), and zeros elsewhere; $\mathbf{E}$ is a $KT \times 1$ vector whose values are equal to the number of years either since the relevant country's accession to the EU or since 1975, whichever of the two is more recent, and zero for non-EU country-years;[10] γ is a regression coefficient (1×1); and $\boldsymbol{\varepsilon}$ is a $KT \times 1$ vector of stochastic disturbances.

This is a piecewise linear spline function. The main object of interest is the membership effect γ, a slope shifter contingent on accession to the EU.

Inspection of the data reveals significant intra-country autocorrelation and cross-country error correlation. Since the number of panels is relatively small ($K = 17$), we follow Beck & Katz (1995) and estimate the coefficients with feasible generalized least squares accounting for the intra-country autocorrelation (Prais–Winsten method) whilst taking account of the cross-country correlation and implied heteroskedasticity by basing inference on panel-corrected standard errors.

4.2. Results

Estimated $\hat{\gamma}$s and the corresponding inferential statistics are reported in Table 3. The regression model accounts for a large share of the sample variation in the dependent variable, ranging between 55% and 99%. The coefficient on the slope-shifting EU-accession variable is statistically significant in all sectors except for agriculture. For manufacturing and for construction, accession to the EU is associated with an increasing tendency for employment to locate in countries' peripheral regions (where 'peripherality' is again defined relative to the whole of Europe, and not just relative to the country's domestic markets). The opposite holds for the service sectors, where EU accession is associated with an increasing tendency towards location in central regions. EU accession therefore appears to have reinforced the general trend towards dispersion of manufacturing employment away from central regions, whereas it has to some extent counterbalanced such dispersion forces with respect to service employment.[11]

Table 3. EU membership and intra-country C-P gradients

	Dependent variable = $\hat{\beta}_{ft}$ (employment, 16 countries)		
Sector	EU accession effect	*P*-value	R^2
Agriculture	0.005	0.78	0.99
Manufacturing, energy	−0.047	0.00	0.98
Construction	−0.041	0.03	0.86
Distribution	0.122	0.00	0.77
Transport, communication	0.125	0.00	0.79
Banking, insurance	0.123	0.00	0.84
Other market services	0.120	0.00	0.78
Non-market services	0.052	0.02	0.55

Notes: Prais–Winsten GLS regressions with panel-corrected standard errors (see Beck & Katz, 1995); country fixed effects and interactions of country fixed effects with year variable included but not reported; 390 observations.

5. Conclusion

This note reports core–periphery gradients of sectoral location patterns and estimates the impact of countries' accession to the EU on changes in their internal economic geography.

Overall, the centrality of regions has over time become a less important determinant of sectoral location patterns. None of the eight broad economic sectors became significantly more concentrated in core regions, whereas in four of them the employment share of peripheral regions increased significantly. Countries' accession to the EU appears to have reinforced the general trend towards peripheral regions for the manufacturing and construction sectors, but not for the service sectors, where the effect of EU accession was to strengthen the locational attractiveness of central regions.

It is perhaps striking that the manufacturing sector, which is frequently seen as the most geographically mobile part of the economy and subject to potential agglomeration economies, while on average still concentrated in central regions, was in fact relocating towards the periphery, both across all Western European regions and (even more so) within individual countries subsequent to EU accession.

Two caveats should be mentioned. First, it might be tempting to interpret the observed locational changes as bad news for the new economic geography, which mainly stresses centripetal agglomeration forces that are triggered by integration. Such a reading of our results would be overly simplistic, both because many new economic geography models can accommodate integration-induced locational dispersion and because our data are highly sectorally aggregated (the price to pay for disaggregation in the regional dimension). For instance, while we find that manufacturing overall was relocating towards the periphery, some manufacturing subsectors might of course have exhibited opposite tendencies. Second, we measure location through employment. This is the variable that most concerns European policy makers, but it would be interesting to investigate whether relative employment gains by peripheral regions were reinforced or offset by unequal changes in labour productivity. We leave this issue for future research.

Notes

1. For a thorough analysis of the policy implications of new economic geography models, see Baldwin *et al*. (2003).
2. For a survey of this literature, see Combes & Overman (2004).
3. Accounts of sectoral core–periphery patterns across European regions have previously been provided by Hallet (2002) and Brülhart (1998). These analyses are based on shorter data sets with fewer regions, and they do not attempt to gauge the impact of EU integration explicitly.
4. For a detailed description of this data set, see Brülhart & Traeger (2005).
5. The appropriate measurement of distance, particularly at the intra-region level, remains a moot issue (see, for example, Head & Mayer, 2002). It could be interesting for future research to test the sensitivity of estimated centre–periphery gradients to alternative underlying distance measures, as well as to the inclusion of time-varying measures of market potential.
6. The following non-WE17 countries were *not* disaggregated into regions: Albania, Belarus, Bosnia-Herzegovina, Croatia, Cyprus, Estonia, Iceland, Latvia, Lithuania, Macedonia, Malta, Moldova, Russia, Serbia-Montenegro, Slovenia, Turkey, and Ukraine.
7. In those models, the arrival of increasing-returns firms in a location is typically of sufficient magnitude that it increases the market potential of that location significantly and thereby triggers further arrivals of firms in a process of cumulative causation. Market access therefore becomes an endogenous variable. This analysis abstracts from such processes by taking the market potential of regions as exogenous and time invariant.
8. Since the denominator of the index does not vary across regions, its inclusion only affects $\hat{\alpha}_{it}$.

9. Owing to the slow-moving nature of sectoral employment shares, recomputing these numbers for 3-year averages makes no difference to the rankings in Table 2.
10. We have experimented with alternative definitions of this variable, by starting the counter 1 or 2 years ahead of countries' accession dates, in order to take account of anticipatory relocation decisions. The results (available upon request) are qualitatively equivalent.
11. The similarity of estimated coefficients for the four market service sectors raises suspicion about the accuracy of those individual data series—it would appear that they were generated to some extent by imputing employment in market services to individual subsectors using common disaggregation weights.

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