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Urban Economic Growth in Europe Between 2001 and 2008 – Gravitation or Dispersion?

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Uwe Neumann, Rüdiger Budde, and Christoph Ehlert[1]

Urban Economic Growth in Europe Between 2001 and 2008 – Gravitation or Dispersion?

Abstract

This paper examines what regional characteristics drove urban economic growth in Europe during the past decade. Possible impacts on the new member states in Central Europe due to expansion of the European Union are accounted for by comparison between two periods, before and after 2004. With a focus on cities, a more precise view of Europe-wide regional disparities and their development can be provided than by research based on larger territories, which prevails in the empirical literature on regional convergence. After 2004, economic growth accelerated considerably in the least developed peripheral regions and in the wealthier capital cities of Central European countries. In the medium term, however, no equalisation of disparities within Europe can be exptected. The analysis suggests that economic prosperity in Central Europe and in other parts of Europe depends on the performance of urban "growth poles" favouring regional innovation. This implies that it is a task of regional policy to support provision of a high-quality infrastructure for education and innovation in cities and to encourage utilisation of these facilities within wider regions.

JEL Classification: R11, R12, C21, C23

Keywords: Spatial economics; urban economics; EU enlargement

November 2012

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1. Introduction

Urbanisation is the most visible expression of the forces of gravitation. Still, it is quite difficult to explain why people and firms locate in close proximity to one another instead of choosing to disperse across space and why disparities of regional income levels persist over very long periods of time. Many empirical studies have found that poor economies tend to grow faster than rich ones and regional disparities are likely to diminish. On the other hand, a strand of the literature, which is known as the "new economic geography", expects further regional agglomeration rather than dispersion of wealth, because people and firms tend to concentrate in a single location and close to a large market.

In Europe, economic activity is highly concentrated in a macro-region between the cities of Hamburg, London, Milan, Munich, and Paris, also referred to as the "European pentagon" (BBSR 2011). The following analysis will examine if (and to what extent) the less developed regions began to catch up during the past decade, in which ten Central European countries became members of the European Union. In order to gain a precise view of regional dynamics, the analysis focuses on urban regions. Continental urban comparisons so far have used mainly North American cities as case studies. For lack of comparative urban data, most European studies have referred to larger administrative entities (e.g. NUTS 1 or NUTS 2 regions[1]), which may comprise very heterogeneous regions.

[1] The "Nomenclature des unités territoriales statistiques" (NUTS) is the standard for the subdivision of countries for statistical purposes in the European Union. For each EU member country, a hierarchy of NUTS levels has been defined by Eurostat, the statistical office of the European Union. NUTS 1 is the largest sub-national district level. The second sub-national level (NUTS 2) comprised regions with an average population of 1.9 million inhabitants in 2010 (cf. Eurostat web page, (http://ec.europa.eu/eurostat), accessed 26 September 2012).

This paper adds to the literature by examining urban economic dynamics across Europe. The main issues are:

(i) Are poor regions catching up to such an extent that in the medium term, equalisation of regional disparities can be expected?

(ii) Has economic growth accelerated in the countries joining the EU in 2004 and 2007 in general or are there considerable regional differences?

(iii) Are there other city-specific growth determinants apart from regional wealth?

The analysis shows that growth in the poorest regions accelerated considerably after 2004, but in the medium term equalisation of disparities is unlikely. Following a brief review of the literature in section 2, the third section presents the data base and empirical strategy. Section four shows the analysis and the final section discusses the findings.

2. Literature Review

Barro/Sala-i-Martin (1991: 108-109) develop a growth equation that derives from the neoclassical growth model for closed economies (Solow 1956, Swan 1956). In their analysis economic growth over a long period of time (using data from 1880 to 1988 for U.S. states and 1950-1985 for European countries) is thought to depend mainly on initial per capita income. The convergence coefficient ß measures the rate at which regional income approaches its long-term steady-state. This may be region-specific or common to all regions. As an empirical regularity, an estimated value of ß at around 2% per year has been found by many studies comprising different regional samples (U.S. states, European countries, Japanese regions

and Australian states, cf. Magrini 2004). In other words, given that all regions develop towards a common income level, half of the distance between a poor and a rich region can be exptected to diminish after about 35 years.

While the neoclassical approach leads to plausible results, manifold identification problems arise for its adaptation to the analysis of convergence between smaller spatial units (e.g. urban regions) and over relatively short periods (Maurer 1995). Magrini et al. (2011) point out that failing to account for the cyclical fluctuations of national and regional economies may lead to an overestimation of the tendency towards convergence or divergence. Furthermore, recent studies show that when controlling for spatial interaction between regions, the rate of ß-convergence may differ from that measured by studies without spatial controls. As a whole, however, a convergence trend is confirmed by studies controlling for spatial interdependence (Magrini 2004).

Other strands of the regional science literature take a skeptical view towards regional convergence. Predominantly, they suggest that long-term prevalence of disparities is a more likely scenario. Most importantly, the polarisation hypotheses from the 1950s (e.g. Perroux 1950) assumed that growth is based on specific core sectors of economic activity, which tend to agglomerate at particular locations and continue to concentrate. In the latter part of the 20th century, key arguments of the polarisation hypotheses were integrated into the formalised framework of economic theory by the “new growth theory” (Mankiw et al. 1992) and, as mentioned before, the “new economic geography” (Krugman 1991, Fingleton/Fischer 2010). This research has provided strong evidence for a long-term concentration of economic activity in the most accessible regions (cf. Redding 2009).

The economic output of any city or "central place" will represent the income level of its surrounding region (Christaller 1933; Fujita et al. 1999). With regard to the determinants of regional wealth, the more recent literature has emphasised that human capital and knowledge transfer assume a particularly prominent role (Porter 2003, Ellison et al. 2007, Florida et al. 2008). Urban economic competitiveness therefore can be expected to depend on regional innovation and, considering that European countries face considerable demographic change (European Commission 2011a: 62-67), attraction of qualified migrants. A further issue in this context refers to urban labour markets. It has been described as an "urban paradox" that in many cities there is a great concentration of wealth while unemployment among the residential population is high (OECD 2006: 76). In spite of this urban paradox, local unemployment levels and regional per capita income can be assumed to be interrelated.

The following analysis will elaborate on the concept of regional convergence by relating growth to a variety of urban characteristics and by controlling for spatial interdependence at different geographical scales.

3. Data and empirical framework

The analysis draws on regional statistics (NUTS 3 level) provided by Eurostat and on city-level data from the Urban Audit, which is a unique source of European city data. It is coordinated by the European Commission (Directorate-General for Regional Policy and Eurostat, the statistical office of the European Union) and conducted in cooperation with national statistical offices and cities (European Communities 2004). For the purposes of this paper selected indicators were ex-

tracted from the most recent and comprehensive Urban Audit data collections, referring to the years 2001, 2004 and 2008. The data base thus compiled comprises information about 329 cities from the current EU member states, Norway and Switzerland. Of these, 265 cities represent more than half of all cities with over 100,000 inhabitants in the European Union.

In the analysis, growth dynamics before and after the most recent EU enlargements of 2004 and 2007 will be compared. For many reasons, this before and after comparison will provide no causal evidence on the effects of EU enlargement[2]. However, by analysing growth over two separate periods it can be examined if the underlying dynamics changed in this early phase of closer economic integration. In the Euro Area, apart from two phases of slow growth in 2001 and 2003, the study period from 2001 to 2008 was part of an economic expansion phase lasting from 1993 until a recession marked the beginning of the financial and economic crisis in January 2008 (CEPR 2009). In the new member states, most regions accounted for above-average growth rates compared to the EU 27 as a whole during the period from 2000-2008, the capital city regions being particularly dynamic (European Commission 2011b). It can therefore be assumed that no particular business cycle phases will be overrepresented in the study period.

Since it is one of the goals of the analysis to examine the role of time invariant regional characteristics, a cross-sectional regression model is chosen (cf. section

[2] Causal evaluation would require isolation of the effects of EU enlargement from other determinants of regional economic growth. An appropriate research design cannot be developed on the basis of the information available for this analysis. In particular, a causal evaluation would need to consider that accession to the EU in 2004 and 2007 was no administratively homogeneous process across the new member states, e.g. membership did not coincide with an opening of the EU labour market for all acceding countries to the same extent and at the same time. Furthermore, this evaluation would have to take into account that the EU already began to provide substantial financial assistance to the Central European countries applying for EU membership in order to adjust living conditions to EU standards long before the enlargement came into effect, e.g. via the PHARE programme.

4.1). Apart from controls for a range of city types and macro-regions, a set of observable growth determinants as suggested by the recent literature (market size, accessibility, innovation, cultural diversity, migration) will be included. Due to the methodical fallacies connected with cross-sectional analysis, robustness checks will be carried out using panel regressions (section 4.2).

The cross-sectional analysis employs a measure of city types, assuming that "club convergence" (Quah 1996) may apply to cities, which are similar in basic characteristics such as size, wealth and regional economic specialisation, but need not be located in close proximity. The city typology allows for both spatial effects across borders and regional disparities within countries. In addition, controls for the macro-region (comprising groups of countries) and a spatially lagged measure of regional economic wealth will be accounted for.

The growth equation, in which the growth rate of per capita output over the observation period is thought to depend on the initial output level, is defined as

$$(1) \qquad (1/T)\log(y_{i,t+T}/y_{it}) = a + b\log(y_{it}) + c\, y_{Nit}/y_{it} + d\, X_{it} + e\, C_i + f\, R_i + u_{it}$$

with i = 1, 2,...., 329 cities, in which y_{it} is per capita output in city-region i at time t (2001, 2004), y_{Nit} is per capita output in regions adjacent to city-region i, X_{it} is a set of additional characteristics of city i at time t, C is a city type dummy[3], R_i a macro-regional dummy, T is the observation interval (2001-2004, 2004-2008) and

[3] Since city type proxies were derived from a wider set of variables, which will not be controlled for in the analysis, it can be assumed that they will neither affect economic growth nor the other regressors independently from these omitted variables. We can also assume that unobserved regional heterogeneity due to the omission of variables, will be, by and large, accounted for by city type proxies and additional controls for macro-regions.

u_{it} is disturbance[4]. The base years 2001 and 2004 are separated in the estimates by full interaction of all variables with year dummies and an additional control for the base year 2004. While labour productivity would be preferable as measure of economic development, information on productivity could not be made available at the required territorial level. Therefore, y is approximated by regional GDP per head. Data on regional GDP has been extracted from Eurostat statistics for the NUTS 3 regions, in which Urban Audit cities are located[5]. Since the income levels of regions in close proximity can be expected to affect the economic growth of city-regions, the spatial lag y_{Nit} accounts for per capita GDP in neighbouring NUTS 3 regions sharing a common border with Urban Audit city-regions[6]. The macro-regional setting is represented by broad categories of European countries (Centre, North, South, West)[7].

The Urban Audit also provides information about so-called "Larger Urban Zones" (LUZ). They correspond to a concept known in the regional science literature as "functional urban regions", comprising large cities and surrounding municipalities, from which many residents commute into the city. In this analysis, additional city characteristics need to refer to the territorial level of cities within their administrative boundaries (Core Cities), because not all of the relevant indicators have been made available for LUZs (Table 1). The city typology applied in the analysis was derived for the purposes of the Second State of European Cities Report,

[4] OLS estimation of $(1/T)\log(y_{it,t+T}/y_{it}) = a - [(1-e^{-\beta T})/T]\log(y_{it}) +$ 'other variables' (Barro/Sala-i-Martin 1991)

[5] Extraction from Eurostat web page, 11 May 2011 (http://ec.europa.eu/eurostat)

[6] The relation y_{Nit}/y_{it} is represented by a dummy variable. It is set to 1 if y_{Nit}/y_{it} is at least 0.9, assuming that urban economic growth will only be affected considerably by the adjacent regions if they represent fairly similar levels of economic wealth. The median value of y_{Nit}/y_{it} is 0.9068 in 2001 and 0.9063 in 2004.

[7] Centre: Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, Slovenia; North: Denmark, Finland, Norway, Sweden; South: Cyprus, Greece, Italy, Malta, Portugal, Spain); West: Austria, Belgium, France, Germany, Ireland, Luxembourg, Netherlands, Switzerland, UK

which was prepared for the European Commission on the basis of the 2004 collection of the Urban Audit (European Commission (ed.) 2010) (Map 1).

Table 1
Descriptive statistics
2001

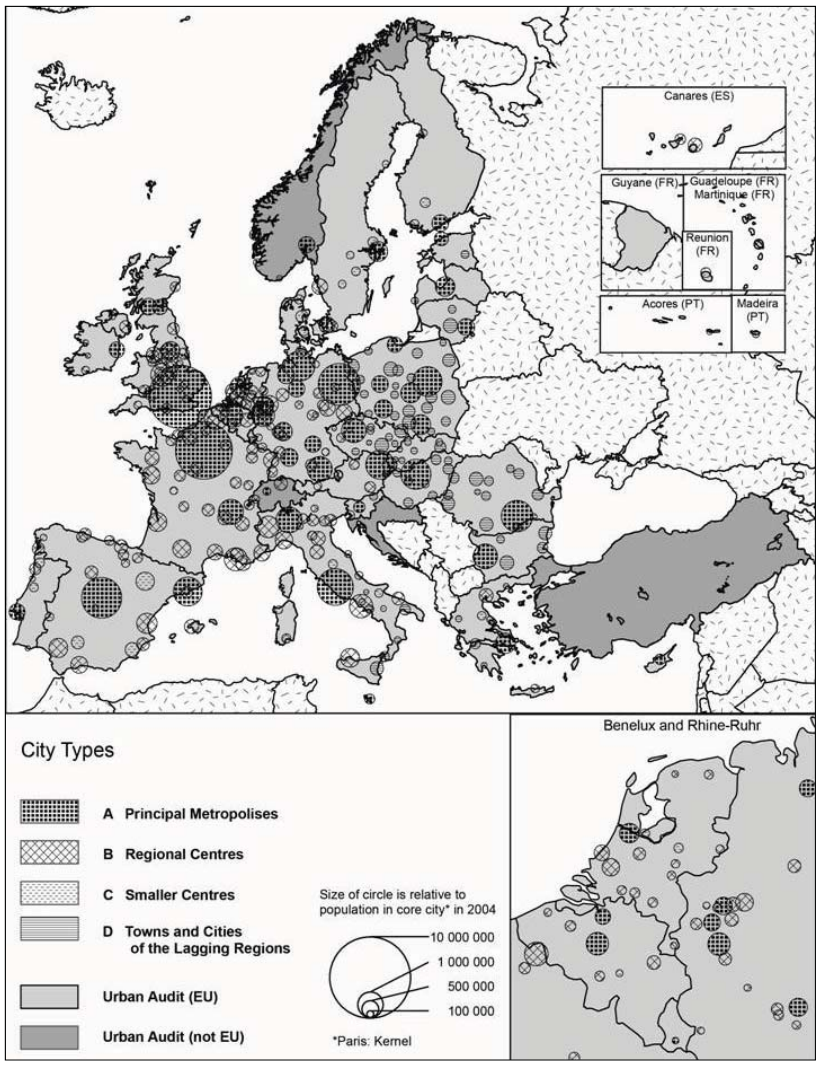
	Core City			Larger Urban Zone		
	Obs	Mean	Std.	Obs	Mean	Std. Dev.
2001-2004 (in %)						
annual growth in real GDP/head (NUTS 3)[1]	314	1.2	3.3	291	1.2	3.5
annual population growth	327	0.3	1.0	290	0.2	2.2
annual population growth in outer zone of LUZ	274	0.8	1.3	274	0.8	1.3
2001						
real GDP/head (in €, NUTS 3)[1]	314	21,706	14,787	291	21,499	15,199
total population	329	352,878	552,545	303	725,483	1,146,574
population < 25 (in %)	294	30.1	4.8	235	30.5	4.2
population > 55 (in %)	294	25.4	4.9	235	25.4	4.2
unemployment rate (in %)	324	11.0	6.3	236	11.0	6.9
multi-modal accessibility (EU27 = 100)[2]	252	96.2	36.1	0		
firms in ICT services sector (per 1,000 firms)	194	0.8	2.2	0		
tourist overnight stays per resident population	254	3.8	5.9	0		

Table 1 continued
Descriptive statistics
2004

	Core City			Larger Urban Zone		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
2004-2008 (in %)						
annual growth in real GDP/head (NUTS 3)[1]	302	3.8	6.3	271	3.95	6.5
annual population growth	311	0.3	0.9	199	0.5	1.2
annual population growth in outer zone of LUZ	194	1.0	1.5	194	1.0	1.5
2004						
real GDP/head (in €, NUTS 3)[1]	315	21,851	14,638	281	22,504	15,155
total population	329	357,603	566,397	293	757,752	1,214,169
population < 25 (in %)	268	28.5	4.5	251	29.1	3.8
population > 55 (in %)	267	26.8	4.7	249	26.7	4.0
unemployment rate (in %)	304	9.7	5.1	157	9.3	4.8
multi-modal accessibility (EU27 = 100)[2]	252	96.2	36.1	2	91.5	2.1
firms in ICT services sector (per 1,000 firms)	253	3.4	3.6	34	5.0	2.0
tourist overnight stays per resident population	281	3.5	4.4	0		

Own calculation based on the Urban Audit and regional statistics from Eurostat (NUTS 3), [1]prices from 2005, [2]potential accessibility of NUTS 3 regions by road, rail and air, as operationalised by Baptiste et al. (2003: 163-173)

Map 1
Basic Types of European Cities
2004



Own calculation based on the Urban Audit and regional statistics provided by Eurostat. *The "Kernel" is a spatial unit provided by the Urban Audit for comparison between selected capital cities. In Paris, the Kernel population is more suitable for comparative purposes than that of the core city.

Table 2
Descriptive statistics by city type
2001

	Type A Principal Metropolises		Type B Regional Centres		Type C Smaller Centres		Type D Lagging Regions	
	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
2001-2004 (in %)								
annual growth in real GDP/head (NUTS 3)[1]	49	1.4	145	0.9	38	1.6	82	1.5
annual population growth	51	0.2	150	0.5	44	0.8	82	-0.4
annual pop. growth in outer zone of LUZ	46	0.8	125	0.8	34	1.1	69	0.5
2001								
real GDP/head (in €)[1] in NUTS 3 region	49	31,326	145	27,829	38	19,617	82	6099
total population	52	1,039,227	151	283,538	44	139,767	82	159671
population < 25 (in %)	51	27.5	133	29.2	39	31.8	71	32.7
population > 55 (in %)	51	27.1	133	26.9	39	24.3	71	22.0
unemployment rate (in %)	51	8.9	150	9.7	43	10.6	80	14.9
multi-modal accessibility (EU27 = 100)[2]	49	125.0	118	107.3	26	69.6	59	62.0
firms in ICT services sector (per 1,000 firms)	39	1.4	79	0.9	22	0.2	54	0.6
tourist overnight stays/resident population	46	4.8	109	5.1	33	3.6	66	1.0
countries joining the EU in 2004 or later	17		1		1		73	

Table 2 continued
Descriptive statistics by city type
2004

	Type A Principal Metropolises		Type B Regional Centres		Type C Smaller Centres		Type D Lagging Regions	
	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
2004-2008 (in %)								
annual growth in real GDP/head (NUTS 3)[1]	48	4.6	141	0.4	35	1.0	78	10.5
annual population growth	49	0.6	144	0.4	41	0.7	77	-0.03
annual pop. growth in outer zone of LUZ	33	1.0	91	0.9	30	1.1	40	1.3
2004								
real GDP per head (in €)[1] in NUTS 3 region	49	31,470	146	27,873	38	20,071	82	6,204
total population	52	1,048,778	151	290,371	44	143,627	82	157,918
population < 25 (in %)	47	26.7	119	27.6	39	30.2	63	30.6
population > 55 (in %)	47	27.7	119	28.4	39	25.5	62	23.7
unemployment rate (in %)	52	9.4	149	9.0	38	10.4	65	11.0
multi-modal accessibility (EU27 = 100)[2]	49	125.0	118	107.3	26	69.6	59	62.0
firms in ICT services sector (per 1,000 firms)	45	3.7	109	3.7	39	3.0	60	2.8
tourist overnight stays/resident population	44	5.2	123	4.1	40	3.4	74	1.5
countries joining the EU in 2004 or later	17		1		1		73	

Own calculation based on the Urban Audit and regional statistics from Eurostat (NUTS 3), [1]prices from 2005, [2]cf. Table 1

This report identifies four basic groups of European cities (Table 2)[8]. The first (type A) comprises very large and capital cities from all parts of Europe, described as "Principal Metropolises". These cities also account for the most dynam-

[8] For details on the classification process that was carried out in four steps using regional factor, cluster and discriminant analysis, cf. European Commission (ed.) 2010.

ic innovation activity and concentrate private and public administrative functions[9]. The second group (Regional Centres, type B) contains cities from all parts of Northern, Southern and Western Europe, which are considerably smaller than the Principal Metropolises, but where economic output and entrepreneurial activity are still high above national averages. Type C (Smaller Centres) represents cities in more peripheral locations of Northern and Western Europe. The fourth group (Towns and Cities of the Lagging Regions, type D) consists of smaller cities from economically lagging regions in Central and Southern Europe (Map 1).

4. Analysis

4.1 Growth characteristics 2001-2004 and 2004-2008

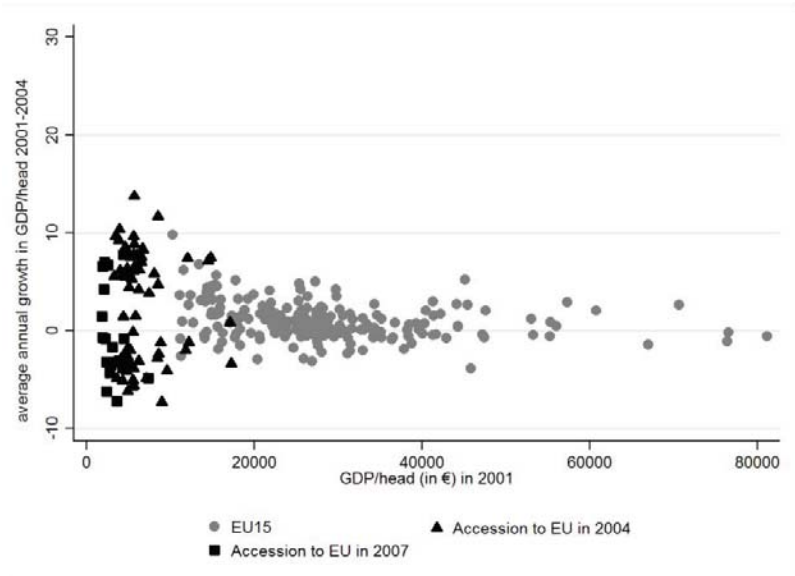
As expected, in both periods (2001-2004 and 2004-2008) particularly poor regions accounted for high growth rates (Figure 1). During the second period, most cities located in the Central European countries that joined the EU in 2004 (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia and Slovenia) and 2007 (Bulgaria and Romania) grew at relatively high rates.

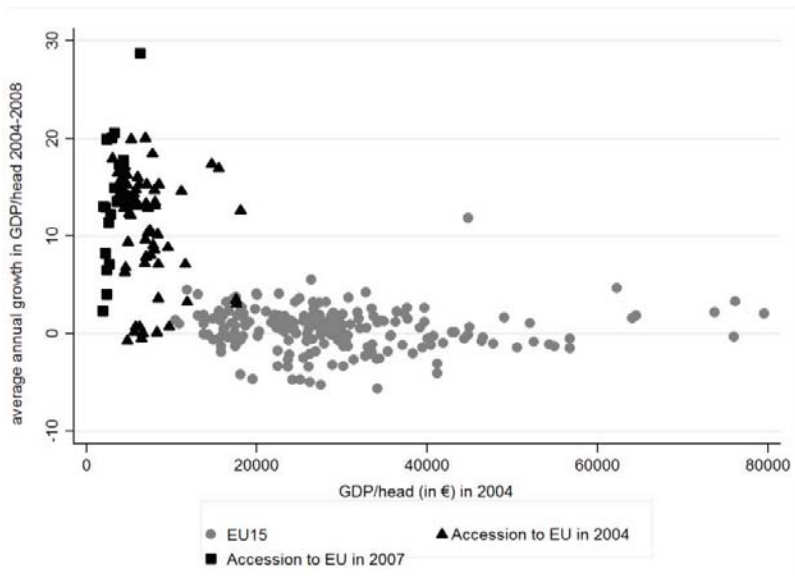
In the analysis of urban growth characteristics, different specifications elaborate on the relation between initial GDP per capita and growth (Table 3) across European city-regions as a whole (estimations 1 to 4), among city types (estimations 5 to 7) and within macro-regions (estimations 8 to 10)[10].

[9] Capital cities were classified as "Principal Metropolis", because even if they are relatively small, concentration of administrative functions is likely to combine with a particular economic "weight" within national urban hierarchies.

[10] Due to a relatively small number of observations, no separate analyses are carried out for sub-samples comprising Type C or macro-region "North" only.

Figure 1
GDP per head in 2001 and 2004 and subsequent growth in real GDP per head*
NUTS 3 regions





Own calculation based on the Urban Audit and regional statistics provided by Eurostat

Table 3

Cross-sectional regressions (OLS): Average annual growth in real GDP per head 2001-2004/2004-2008

	all cities	all cities	all cities	all cities
	(1)	(2)	(3)	(4)
2001				
real GDP per head (log)	-0.00233	0.00542	-0.00519	0.00479
	(0.00300)	(0.00612)	(0.00939)	(0.0122)
real GDP per head	0.00562	0.00778	0.00667	0.00770
(spatial lag)	(0.00391)	(0.00665)	(0.00659)	(0.00658)
total population (log)		-0.00798	-0.0120	-0.0125*
		(0.00563)	(0.00729)	(0.00715)
Δ pop. 01-04 (in %)		-0.00290	-0.00193	-0.00241
		(0.00337)	(0.00368)	(0.00387)
Δ pop. 01-04 (outer zone)		-0.00518*	-0.00596*	-0.00563*
(in %)		(0.00312)	(0.00313)	(0.00329)
unemployment rate		-0.00127*	-0.00106	-0.00118
		(0.000704)	(0.000719)	(0.000770)
multi-modal accessibility		0.000194	0.000198	0.000236
		(0.000148)	(0.000151)	(0.000179)
firms in ICT sector		0.00618	0.00736	0.00541
		(0.00541)	(0.00557)	(0.00536)
tourist overnight stays		0.00131	0.00127	0.00165
		(0.00122)	(0.00114)	(0.00126)
city types (base: C Smaller Centres)				
A Principal Metropolises			0.00429	-0.0170
			(0.0196)	(0.0187)
B Regional Centres			-0.0000527	-0.00787
			(0.0129)	(0.0112)
D Lagging Regions			-0.0266	-0.0463**
			(0.0166)	(0.0187)
macro-regions (base: Southern)				
North				0.0257*
				(0.0145)
Centre				0.0432**
				(0.0194)
West				0.0106
				(0.0147)
2004				
real GDP per head (log)	-0.0461***	-0.0518***	-0.0536***	-0.0418***
	(0.00300)	(0.00576)	(0.00875)	(0.0110)
real GDP per head	-0.0156***	-0.0226***	-0.0192***	-0.0165**
(spatial lag)	(0.00416)	(0.00574)	(0.00613)	(0.00767)
total population (log)		0.00305	-0.00377	-0.00293
		(0.00422)	(0.00473)	(0.00452)
Δ pop. 04-08 (in %)		0.0108***	0.0119***	0.00981**
		(0.00357)	(0.00342)	(0.00406)
Δ pop. 04-08 (outer zone)		-0.000624	-0.000437	-0.000919
(in %)		(0.00236)	(0.00247)	(0.00280)
unemployment rate		-0.00127**	-0.00115**	-0.000730
		(0.000564)	(0.000499)	(0.000629)
multi-modal accessibility		0.0000574	-0.0000217	0.00000409
		(0.000114)	(0.000101)	(0.0000892)
firms in ICT sector (in %)		0.00622	0.00419	0.000259
		(0.00566)	(0.00507)	(0.00796)
tourist overnight stays		-0.0000170	-0.000335	-0.000144
		(0.000356)	(0.000424)	(0.000375)
city types (base: C Smaller Centres)				
A Principal Metropolises			0.0366**	0.0255
			(0.0153)	(0.0155)
B Regional Centres			0.0165	0.0138
			(0.0104)	(0.00911)
D Lagging Regions			0.00413	-0.00420
			(0.0116)	(0.0113)
macro-regions (base: Southern)				
North				0.0197**
				(0.00970)
Centre				0.0335**
				(0.0165)
West				-0.00240
				(0.0106)
year 2004	0.459***	0.470***	0.407**	0.375**
	(0.0437)	(0.108)	(0.161)	(0.188)
constant	0.0296	0.0391	0.196	0.0930
	(0.0314)	(0.0907)	(0.129)	(0.146)
R^2	0.44	0.55	0.58	0.61
observations	616	222	222	222

Table 3 continued

Cross-sectional regressions (OLS): Average annual growth in real GDP per head 2001-2004/2004-2008

	City Types			Macro-Regions		
	Type A	Type B	Type D	North/West	Central	South
	(5)	(6)	(7)	(8)	(9)	(10)
2001						
real GDP/head (log)	-0.0124	-0.0283*	-0.0145	-0.000731	0.00667	-0.0105
	(0.0243)	(0.0165)	(0.0181)	(0.00943)	(0.0181)	(0.00834)
real GDP/head	0.00121	0.00641	-0.0152	0.00360	-0.00822	.
(spatial lag)	(0.0288)	(0.00519)	(0.0137)	(0.00456)	(0.0136)	.
total population (log)	-0.0164	0.000625	-0.0369***	-0.00158	-0.0207**	-0.00757***
	(0.0230)	(0.00700)	(0.0125)	(0.00308)	(0.00884)	(0.00232)
Δ pop. 01-04 (in %)	-0.00829	0.00214	0.00582	-0.00535*	-0.0203	0.00339***
	(0.0160)	(0.00533)	(0.0116)	(0.00320)	(0.0130)	(0.000850)
Δ pop. 01-04 (outer zone)	0.0119	-0.00461	-0.0106***	0.000553	-0.00836**	-0.0139***
(in %)	(0.0149)	(0.00315)	(0.00338)	(0.00238)	(0.00344)	(0.00277)
unemployment rate	-0.00264	0.0000803	-0.00230*	0.000314	-0.00249**	-0.00185
	(0.00209)	(0.000551)	(0.00124)	(0.000415)	(0.00116)	(0.00130)
multi-modal accessibility	0.000399	0.0000461	0.0000694	-0.0000169	0.000274	-0.000239**
	(0.000506)	(0.000116)	(0.000555)	(0.0000740)	(0.000449)	(0.000103)
firms in ICT sector	-0.000810	0.00172	0.0335**	-0.00177**	0.0156*	.
	(0.00755)	(0.00236)	(0.0128)	(0.000797)	(0.00903)	.
tourist overnight stays	0.000431	0.000359	0.0103	0.0000514	0.0128	0.00825***
	(0.00349)	(0.000745)	(0.0206)	(0.000656)	(0.00929)	(0.000930)
2004						
real GDP/head (log)	-0.0929***	-0.0150	-0.0637***	0.0107	-0.0456**	-0.0157
	(0.0225)	(0.0153)	(0.00608)	(0.0102)	(0.0205)	(0.0115)
real GDP/head	-0.0249	-0.00675	-0.0243**	0.00644	-0.0115	-0.0144***
(spatial lag)	(0.0147)	(0.00559)	(0.0109)	(0.00824)	(0.0122)	(0.00448)
total population (log)	-0.0131*	-0.00807**	0.0326***	-0.00527*	0.0298***	-0.00324
	(0.00678)	(0.00347)	(0.0110)	(0.00310)	(0.00820)	(0.00259)
Δ pop. 04-08 (in %)	0.0145***	0.000482	0.0401**	-0.00779	0.0499***	0.00589**
	(0.00464)	(0.00396)	(0.0165)	(0.00477)	(0.0128)	(0.00290)
Δ pop. 04-08 (outer zone)	0.000778	0.00328	-0.00946***	0.00984***	-0.00719***	0.00195
(in %)	(0.00658)	(0.00218)	(0.00246)	(0.00280)	(0.00237)	(0.00150)
unemployment rate	-0.00306*	-0.0000848	-0.00200	0.000654	0.000431	-0.000262
	(0.00158)	(0.000530)	(0.00230)	(0.000705)	(0.00179)	(0.000736)
multi-modal accessibility	0.000787**	-0.0000521	-0.0000305	0.0000116	-0.000143	-0.0000134
	(0.000349)	(0.000104)	(0.000327)	(0.0000790)	(0.000356)	(0.000106)
firms in ICT sector	-0.0414	0.00283	0.00255	-0.00120	-0.0299	0.00481
	(0.0264)	(0.00266)	(0.0321)	(0.00357)	(0.0565)	(0.0167)
tourist overnight stays	-0.000263	-0.000174	0.0278**	-0.000106	-0.0109*	0.000313
	(0.000813)	(0.000279)	(0.0126)	(0.000476)	(0.00605)	(0.000390)
year 2004	0.777*	-0.0184	-0.297	-0.0888	-0.00795	.
	(0.445)	(0.258)	(0.238)	(0.135)	(0.245)	.
constant	0.320	0.281	0.569***	0.0370	0.183	0.210*
	(0.393)	(0.189)	(0.187)	(0.0894)	(0.173)	(0.110)
R^2	0.61	0.42	0.84	0.39	0.78	0.55
observations	49	91	61	95	75	52

Authors´ calculation based on the Urban Audit and regional statistics from Eurostat. Robust standard errors in parentheses; */**/*** = significant at 10/5/1%-level; real GDP per head (spatial lag): dummy variable (1 if average real GDP in adjacent regions > 0.9, 0 otherwise); Δ pop. 01-04 (04-08): average annual population change 2001-2004 (2004-2008); Δ pop. 01-04 (outer zone): average annual population change in non-core-city part of larger urban zone

The key result is that according to the approximation of the neoclassical model applied in this analysis (see above) growth during the period from 2004 to 2008 related strongly to the initial level of economic development, which confirms ß-convergence. No such relation was identified for the first period (2001-2004). The

influence of y_{it} (and its spatial lag) in 2004 on subsequent growth (estimation 1 in Table 3) remains stable even when controlling for additional city characteristics (estimation 2), city type (estimation 3), or macro-regional proximity (estimation 4). The estimation representing equation (1), which controls for city characteristics, city type and macro-region (estimation 4), suggests an annual ß-convergence rate of 4.6%[11]. Perhaps due to its focus on urban areas and the relatively short period, the analysis measures a somewhat faster convergence rate than those studies based on data about long-term growth in large regions (2%, see above).

However, while the lagging regions (type D) were beginning to catch up, the Central European capital cities also continued to grow at high rates, which is why convergence was particularly rapid among the Principal Metropolises (column 5). Among the Regional Centres, no statistically significant effect of intitial per capita output on growth was measured in the post-accession period, but for 2001-2004 the data suggest ß-convergence (column 6). One could argue, therefore, that convergence to a common level of economic wealth before the EU enlargement of 2004 was more characteristic of cities in the old EU member states than across Europe as a whole. In the post-enlargement period, however, within the lagging regions the convergence rate was even higher than among all cities, i.e. in the poorest regions the very poorest cities began to catch up (estimations 4, 7, 9). While the analysis emphasises that growth relates to regional wealth, the precise role of some of the economic and demographic determinants adopted from the more recent literature remains ambiguous.

[11] ß convergence is approximated due to the equality $b = - (1-e^{-ßT})/T$ (cf. Sala-i-Martin 1996: 1334)

4.2 Robustness check

In this analysis, a cross-sectional approach was applied to examine the way in which the regional context affects urban economic growth. The available information about cities and regions will not allow the construction of a research design allowing causal inference on the relationship between wealth and growth. However, the general validity of regional GDP per capita and further explanatory variables as growth predictors can be assessed by panel methods which eliminate all unobserved, time invariant heterogeneity (fixed effects).

For this purpose, two different robustness checks will be implemented. The first uses variation between the first and second period examined by cross-sectional regressions in section 4.1, according to equation (2).

$$(2) \qquad \log(y_{it+T}/y_{it}) - \overline{\log (y_{it+T}/y_{it})} = b\,(\log y_{it} - \overline{\log y_i}) + c\,(X_{it} - \overline{X_i}) + u_{it} - \overline{u_i}$$

The second robustness check incorporates a different data base. It draws on a yearly time-series from 2001 to 2008, comprising a restricted set of indicators for NUTS 3 districts representing Urban Audit city-regions. In this analysis (cf. equation (3)) growth over a one-year period (2001-2002, 2002-2003…..2007-2008) is regressed on per capita output and other indicators in each base year (2001, 2002, …, 2007).

$$(3) \qquad \log(y_{it+1}/y_{it}) - \overline{\log (y_{it+1}/y_{it})} = b\,(\log y_{it} - \overline{\log y_i}) + c\,(X_{it} - \overline{X_i}) + u_{it} - \overline{u_i}$$

Table 4
Fixed effects regressions: (Average) annual growth in real GDP per head

	two periods (2001-2004, 2004-2008), base years 2001, 2004	annual time series for base years…	
		2001-2003	2004-2007
	(1)	(2)	(3)
real GDP/head (log)	-0.525***	-0.886***	-0.427***
	(0.101)	(0.0843)	(0.0753)
total population (log)	-0.459*	0.459*	-1.607***
	(0.260)	(0.234)	(0.299)
unemployment rate	-0.00551*	-0.00703***	-0.00788**
	(0.00284)	(0.00219)	(0.00301)
firms in ICT sector	-0.00204		
	(0.00161)		
patent intensity		0.00000347	0.000153*
		(0.0000941)	(0.0000784)
tourist overnight stays	0.00225		
	(0.00477)		
R^2	0.46	0.51	0.30
observations (balanced panel)	146	330	440
data source	NUTS 3 (GDP)/ Urban Audit	NUTS 3	

Authors´ calculation based on the Urban Audit and regional statistics from Eurostat. Robust standard errors in parentheses; */**/*** = significant at 10/5/1%-level; patent intensity: patent applications per 1 million inhabitants; countries represented in balanced panel (1): Belgium, Germany, Estonia, Spain, Finland, Hungary, Italy, Latvia, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovenia, Slovakia, UK; (2)-(3): Cyprus France, Germany, Lithuania, Luxembourg, Poland, Portugal, Romania, Sweden, UK

Since data on firms in the ICT sector was not available for NUTS 3 regions, patent intensity is employed as a proxy for technical development instead. Two subperiods corresponding to those of the cross-sectional growth regressions (comprising the base years 2001-2003 and 2004-2007 to account for growth 2001-2004 and 2004-2008) were separated.

These estimations corroborate the outstanding role of per capita output as a growth determinant (Table 4). Among the other indicators included in these analyses, population change, change in unemployment rates and (only after 2004, cf. estimations 2 and 3 in Table 4) in patent intensity have a significant influence. Quite obviously, the fast-growing city-regions in Central Europe accounted for a below-average growth in population. Apparently, in the fastest-growing low-income regions unemployment did not increase and in general, unemployment

slows growth. These findings correspond to the results of the cross-sectional analysis.

In addition, the panel regressions highlight the role of patent intensity as a growth determinant in the post-2004 period, while the share of firms in ICT was not identified as a significant influence by the cross-sectional regressions. Quite obviously, the precise regional innovation characteristics measured by these indicators differs. It remains difficult to measure innovation, knowledge-spillover or creativity by aggregate statistics at the regional level. The analysis corroborates that these regional characteristics do play a role, even though it cannot provide an in-depth view of the way in which they affect growth.

5. Conclusion

This Europe-wide analysis has modified the "regression approach" common to the study of regional economic growth by

- focusing on cities, which are likely to reflect inter-regional disparities more precisely than more heterogeneous spatial entites,
- controlling for spatial interaction within macro-regions, between cities with similar basic characteristics and among neighbouring regions, and
- controlling for city-specific characteristics likely to affect growth independently from the macro-regional and national setting, as suggested by the literature on urban competition.

The results corroborate the findings of previous research on regional convergence insofar as the income level in urban regions is shown to relate to growth. Growth characteristics in two periods, before and after 2004 (when the Central European countries except for Bulgaria and Romania became EU members), were com-

pared. The new member states as a whole accounted for high growth rates throughout both periods. Yet, before 2004, within Central European countries, growth was distributed highly unevenly, concentrating mainly on the relatively well-off capital city regions.

After 2004, the poorest regions grew at the fastest rate. Closer economic integration of less developed regions obviously favours growth in these regions since after 2004, they were truly catching up. However, since the most prosperous cities also continued to grow, albeit at moderate rates, it is unlikely that income disparities between the different parts of Europe and within countries will diminish completely in the medium term.

The role of other city characteristics suggested to be influential on growth by the recent literature on urban competitiveness, remains difficult to measure. Accounting for unobserved time invariant heterogeneity which may affect cross-sectional results by using fixed effects supports our findings. While the analysis shows to what extent growth accelerated in different parts of Europe and among different types of cities, it would have gone beyond the scope of this study to isolate the precise effect of EU accession on growth and prosperity in the new member states. Within Central Europe, an adjustment of living conditions to (Western) European standards may need to focus on the relative concentrations of wealth in and around capital and other large cities before it can disperse to more remote regions.

It will remain one of the most difficult tasks of regional policy to find the right balance between measures fostering economic growth and those supporting regional cohesion, both between and within countries. Obviously, economic pros-

perity in all parts of Europe depends on the performance of urban "growth poles". The consequences of the recent financial and economic crisis suggest that in the medium term, on the path towards greater convergence, Europe as a whole will depend on the strength and competitiveness of its economic core zone. Within Central European countries, a policy focusing on the support of regional innovation networks, which connect the research, education and business service infrastructure of capital cities with economic activities from the more remote regions, may help to strengthen the economies of these lagging regions.

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