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Regional growth and national development: transition in Central and Eastern Europe and the regional Kuznets curve in the east and the west

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Abstract
Regional disparities in Central and Eastern Europe rose substantially after 1990. Still, prima facie evidence of beta-convergence is often found in the CEE data. To reconcile this apparent paradox, we sketch out and test empirically a hybrid model of regional growth that draws on the regional Kuznets curve and incorporates aspects of cumulative causation and neoclassical convergence. In both CEE and the 'old' EU15, regional convergence is strongly linked to the level of national development, non-linearly. But while in the EU15 convergence speeds-up at intermediate/high levels of development, in CEE we find divergence at intermediate levels of national development and no significant return to convergence thereafter. Although this may show that overall development levels are not sufficient yet to mobilise regional convergence, it is also possible that non-convergence is attributable to centripetal forces instigated by the process of transition.

Keywords: regional growth; convergence; regional Kuznets curve; Central and Eastern Europe
JEL Codes: O11, O18, R11, R15

1. Introduction

Regional disparities in the countries of Central and Eastern Europe (CEE) have risen sharply over the last two decades. With them, strong patterns of polarisation emerged, as increasing openness and economic-political integration, stimulated by the process of transition, have not been equally beneficial across space. Besides their policy relevance, these developments are particularly important for academic inquiry, as they challenge simple concepts of convergence and instantaneous equilibration (Monastiriotis and Petrakos, 2010), bringing to the fore some fundamental theoretical questions. Is the process of development inherently uneven? Is, inversely, convergence an automatic process driven by the properties of the

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production technology (diminishing returns)? Or is growth an endogenously-driven cumulative process, whereby leading economies, boosted by their past performance, are able to maintain and enhance their advantages over less developed ones? And are processes of convergence and divergence conditioned on the level of national development and the national political-economic context?

In recent decades, the study of these questions has been dominated by the so-called 'convergence hypothesis'. Based on the Solow one-sector growth model under the assumptions of a common technology, diminishing returns and no systematic external shocks (Barro and Sala-i-Martin, 1991), the convergence hypothesis asserts that economies starting from higher development levels experience slower growth rates, so that less developed economies eventually catch-up. Although more recent contributions have sought to move beyond the simplicity of this hypothesis (e.g., by examining distributional dynamics, club-formation and spatial dependence – Rey and Janikas, 2005, Dall'erba et al, 2008 – or by looking at the role of local-specific variables such as entrepreneurship and cultural diversity – Audretsch and Keilbach, 2005, Bellini et al, 2009), the macroeconomic analysis of regional growth, with few exceptions, is still very much rooted in the convergence hypothesis.

Following, much of the empirical analysis of regional disparities in CEE has also been within this framework, typically finding evidence of neoclassical convergence either in absolute terms or in parallel with the formation of convergence clubs (Dall'erba et al, 2008; Artelaris et al, 2010; Smetkowski and Wójcik, 2012). Curiously, studies adopting alternative analytical frameworks, such as the Kaldor-Verdoorn model of cumulative causation under the presence of increasing returns (Kaldor, 1970; McCombie and de Ridder, 1984), find evidence pointing to the opposite direction, towards cumulative divergence.

It is of course very difficult to subscribe simultaneously to both analytical processes. Neoclassical convergence implies the presence of constant returns to scale, resulting in catching-up by lagging regions as the growth rates of more advanced regions slow down. In turn, the cumulative causation thesis contents that more advanced regions maintain higher rates of growth as they capitalise on their productivity advantages and increasing returns to scale. Simple inspection of the evolution of regional incomes and productivities in the CEE countries confirms the presence of such divergence tendencies. It is thus puzzling that the 'convergence hypothesis' is still empirically validated by the data.

Against this background, this paper sets out to examine in a comparative way the process of regional growth in CEE linking it to the process of national development in a fashion more akin to the so-called 'regional Kuznets curve', developed by Williamson (1965). Our aim is not to provide a causal explanation of regional growth but rather a description of the regional growth process that moves beyond the polarity of the convergence-divergence debate and frames it within the context of national development.

Our empirical analysis supports this analytical departure. Consistent with previous findings, we find evidence of both convergence and cumulative causation, in both the east (CEE) and the west (EU15). We show that convergence-divergence tendencies exist in parallel with a process of polarisation, especially in the CEE, whereby "convergence at the bottom" (amongst low-to-medium productivity regions) takes place in conjunction with a "separation from the top" (for the more advanced regions). We subsequently examine the interaction between regional growth and national development, through an adapted formulation of the regional Kuznets curve, and find the process of convergence to follow a non-linear path along levels of national development in both samples, but to be weaker and qualitatively different in the CEE, where levels of development are generally lower and where the national context is influenced uniquely by the process of post-communist transition and European integration.

The reminder of the paper is structured as follows. In the next section we offer a brief review of the literature on regional convergence and the evolution of regional disparities in CEE and in Europe more broadly. Section 3 examines the evidence concerning the patterns of regional growth in CEE (and, comparatively in the EU15) through both a descriptive and an exploratory regression analysis, with emphasis on processes of convergence, divergence and polarisation. Drawing on the notion of the regional Kuznets curve and linking it to the process of transition, in section 4 we move on to propose an alternative theoretical description of the growth process and investigate it empirically. We discuss the implications of our results in the concluding section.

2. Regional growth in CEE and the wider national-development context

Descriptive studies examining the extent and evolution of regional disparities in the CEE countries have found consistently that these have grown significantly over the last two decades. The rise in inequalities has been evident from the early stages of transition (Petrakos 1996; Römisch, 2003), but it continued throughout the period and in some cases intensified (Ezcurra et al, 2007; Kallioras and Petrakos, 2010). There is broad consensus in the literature, largely attributing these developments to the significant geographical and sectoral reallocation that has taken place in CEE over the last two decades. On the one hand, there is a notable shift of industrial activity towards metropolitan regions and regions bordering the EU (Petrakos and Economou, 2002; Iara and Traistaru, 2003), stimulated partly by the self-selected inflow of foreign investments in these areas (Altomonte and Resmini, 2002; Tondl and Vuskic, 2003). Trade integration also played a role in this, by favouring regions with significant specialisations and agglomeration economies, relative concentration of skilled labour and vibrant product demand (Traistaru et al, 2003; Resmini, 2007). On the other hand, the literature identifies a process of structural change across sectoral lines, both in terms of internal structures (sectoral compositions) and external competitiveness (trade specialisations) (Resmini, 2003; Niebuhr and Schlitte, 2009; Kallioras and Petrakos, 2010). Analyses along these lines confirm the inherent link between spatial and structural restructuring, finding that regions which have successfully restructured and thus benefited most from integration are those located closer to the EU borders and to metropolitan areas or large agglomerations.

Despite this general trend, econometric studies following the convergence approach often find evidence of convergence, at least in cross-country – cross-regional analyses (indicating regional convergence across the CEE space but not necessarily within each CEE country). Herz and Vogel (2003) use data for 31 regions across the CEECs and find evidence of divergence in the early transition period and of conditional convergence more recently. Using Eurostat data and examining cross-national and cross-regional convergence across the CEE, Niebuhr and Schlitte (2009; at the NUTS2 level for the period 1995-2000) and Paas et al (2007; at the NUTS3 level for 1995-2002) find evidence of regional divergence or stability within countries but of fast cross-national convergence, resulting in an overall slow convergence of regional incomes at the supra-national level. Using the same database in a simple neoclassical framework, Petrakos et al (2005a) also find evidence of convergence. Similar are the results obtained by Del Bo et al (2010), who use NUTS2-level Cambridge Econometrics data in a spatial econometrics framework and find evidence of both conditional and (marginally) unconditional convergence across the CEE regions. Evidence of

convergence is also obtained in country-specific studies (e.g., Totev, 2008, for Bulgaria; Banerjee and Jarmuzek, 2010, for Slovakia).

In an analysis that departs somewhat from the neoclassical approach, Petrakos et al (2005b) find simultaneous evidence of short-run divergence and long-run convergence, with the level of disparities moving pro-cyclically along an overall convergent trend. Kallioras (2010) shows that convergence trends are conditioned on the size of the regional economies, pointing to the possibility of club convergence. Direct evidence for this, with strong regional convergence within, and persistent divergence across clubs, has been offered recently by Artelaris et al (2010; for within-country clubs) and earlier by Fischer and Stirböck (2006; for cross-country clubs). In a detailed study along these lines, which also examines the stability of convergence clubs across the CEE countries, Smetkowski and Wójcik (2012) find club-membership to be rather persistent and within-club convergence to exist together with spatial polarisation at wider scales.

Similar results are found more generally in the literature on regional growth in Europe. Evidence of club convergence in the 'old' EU member states has been obtained widely (see, inter alia, Canova, 2004; Corrado et al, 2005; Fischer and Stirbock, 2006; Dall'erba et al, 2008), while more recent contributions highlight the role of spatial processes (proximity, concentration), both for club-formation (spatial heterogeneity) and for the overall speed of convergence (see, for example, Lopez-Bazo et al, 2004; Ertur et al, 2006; Egger and Pfaffermayr, 2006; Arbia et al, 2008; Rey and Le Gallo, 2009; Arbia et al, 2010 – see also the discussion in Fingleton and Lopez-Bazo, 2006). The importance of spatial processes has been also analysed in empirical studies employing the Verdoorn Law equation. Using this, Fingleton and McCombie (1998), Dall'erba et al (2008), Angeriz et al (2008), and others find evidence of increasing returns – and thus of a tendency for regional divergence and/or club convergence – across EU regions.

Despite the important advances made in this literature, the analysis of processes of club-formation and convergence is largely separated from the national (and supra-national) context of the regional economies. Indeed, if we are to put aside the studies that look at questions of regional restructuring within the context of transition, there is only a handful of studies that examine the issue of convergence-divergence in relation to the national-development context. In his historical study of regional convergence in Europe, Tondl (1997) found that this was speedier in the 1950s and 1960s, slowed down during the 1970s, and recovered somewhat in the 1980s – suggesting that the speed of convergence may well be

pro-cyclical (in relation to national growth). In turn, Geppert and Stephan (2008) examine regional convergence in relation to the process of economic integration in Europe and find integration to be associated to cross-regional convergence across countries, albeit with increasing spatial concentration and regional disparities within countries. More specifically on the issue of development, Gennaioli et al (2013) develop a theoretical model where the speed of convergence is an inverse function of factor mobility frictions. The authors claim that such frictions are higher in less developed economies, thus predicting higher rates of regional convergence as national economic development progresses. Employing a different methodological approach that looks at the issue of polarisation rather than disparity/convergence per se, Ezcurra and Pascual (2007) find that the distribution of regional incomes becomes less polarised (along a non-linear path) as levels of national GDP per capita increase. A similar effect (an inverted-J path) has been found in the study of Petrakos et al (2011), albeit for the case of regional levels of development and in the context of a neoclassical convergence model.

3. Regional growth through the prism of convergence and divergence

3.1. Patterns of inequality and polarisation

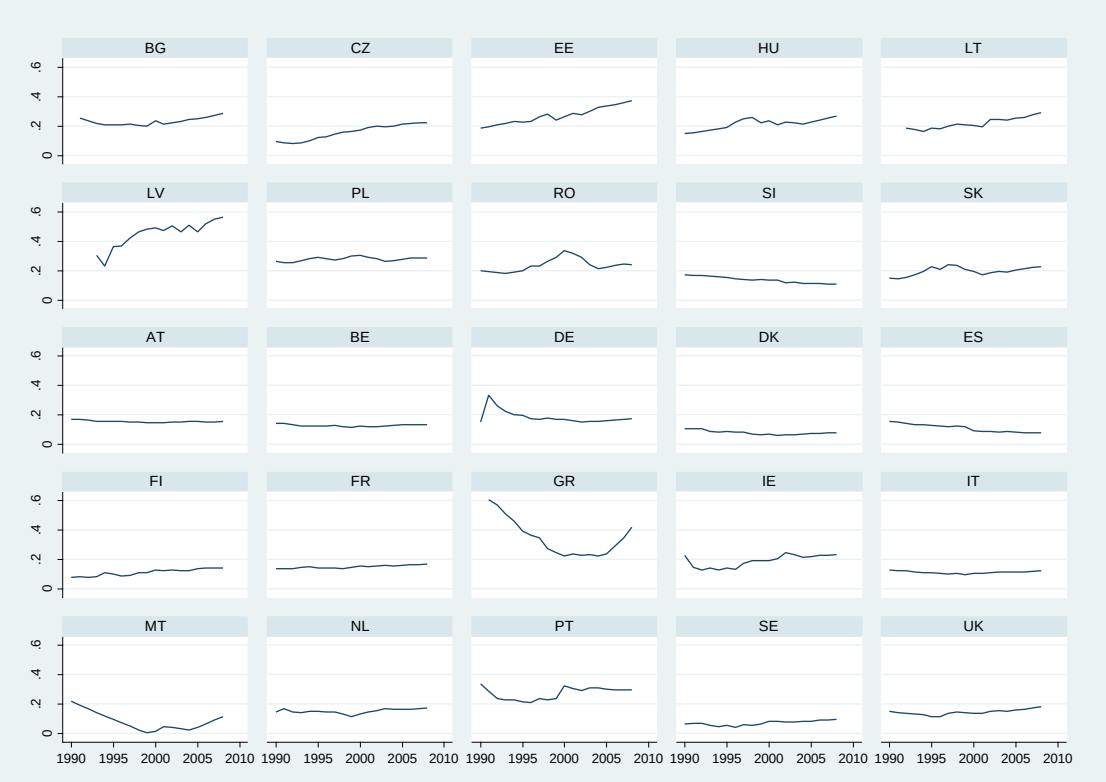
Our empirical investigation uses data on regional labour productivity, defined as gross value-added per employee, covering the period 1990-2008. In parts of the analysis we also use data on regional GDP (GVA plus net transfers) and GDP per capita (resident population). We use regional data at the NUTS3 level, covering 1,276 regions across Europe, 190 of which are located in the CEE.[1] Our focus is with the analysis of regional productivity, as this is the relevant variable for the two main theoretical approaches on the issue of regional growth (neoclassical convergence and the Kaldor-Verdoorn Law).

We start our analysis by examining the evolution of regional disparities in labour productivity at the country level and for each of the two groups of countries (CEE and EU15). Figure 1 plots the coefficient of variation of regional labour productivity across the 25

[1] The CEE countries in our sample are the 10 post-communist New Member States of the EU that acceded in the 2004 and 2007 enlargements. Cyprus and Luxemburg are excluded from our analysis. Nominal data have been deflated and expressed in constant 2000 euros. All data are from the Cambridge Econometrics European Regional Database (http://www.camecon.org).

countries of our sample (summary measures of disparity and polarisation are presented in the Appendix). As can be seen, regional disparities have increased in the majority of the CEE countries. Among the countries in this group, only one (Slovenia) shows a clear and lasting trend of declining disparities (sigma-convergence). Disparities in Poland have been rather stable and in Romania and Bulgaria they have alternated trends, but all other CEE countries have experienced almost continuously rising regional disparities. The picture is generally different in the EU15 sample, were disparities have remained rather stable throughout the period and in many cases have declined over time. Thus, whereas in the EU15 there is some mild evidence of sigma-convergence, in the CEE sample the evidence rather strongly suggests a widening of disparities at least at the national level – with the coefficient of variation almost doubling in some cases (Czech Republic, Estonia).

Figure 1. Evolution of regional disparities in labour productivity across EU countries

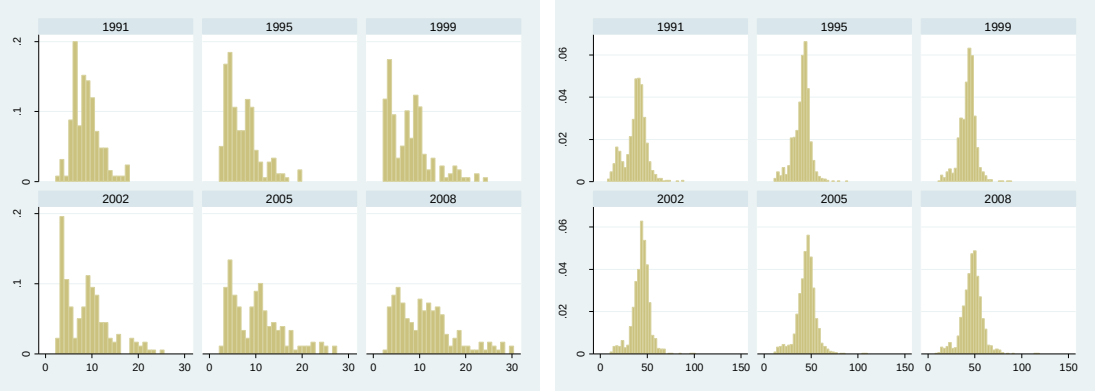


Note: Coefficients of variation of the within-country distribution of labour productivity; author's calculations.

This picture is reproduced when examining regional disparities not within countries but within each of the two groups (CEE and EU15). In the CEE, disparities in regional labour productivity rose sharply during the 1990s with the coefficient of variation across the sample

rising from around 0.33 in 1990 to 0.58 in 1999 and stabilising somewhat thereafter but remaining at very high levels (0.55 in 2004-08 – see Appendix). In contrast, disparities in the EU15 group were declining in the 1990s and rose only modestly in the 2000s (from 0.21 to 0.23). More interestingly, the evolution of the distribution of regional labour productivities was also very different across the two groups. As is shown in Figure 2, the distribution is strictly uni-modal and very leptokurtic in the EU15 sample, at least since the mid-1990s, and has remained so up to 2008, despite some widening of the distribution in more recent years. In contrast, the CEE distribution saw a significant widening over time, becoming bi-modal at least since the late-1990s and increasingly skewed to the right. Undoubtedly, this evolution shows a tendency of polarisation in the CEE sample, with values around the median (10.6) having very low densities, and a significant number of regions having values over twice the median.

Figure 2. Evolution of the cross-national distribution of regional labour productivity



(a) CEE (b) EU15

Notes: author's calculations.

It thus seems evident that the evolution of regional disparities in both the CEECs and the CEE region at large has been notably different from that of the EU15, as the CEE sample is characterised not only by widening disparities (sigma-divergence) but also by a relative polarisation in the distribution of labour productivities across regions; while, in contrast, regional disparities in the EU15 are much lower, generally non-rising and distributed around a single mode. Next we examine how these patterns are captured in an econometric analysis that draws on the two dominant models of neoclassical convergence and cumulative causation typically employed in the literature.

3.2. Testing convergence and cumulative divergence

As is well known, the empirical formulation of the convergence hypothesis makes regional growth a function of initial regional incomes, as follows:

$$\Delta(y-l)_{i,t} = b_0 + b_1(y-l)_{i,t=0} \quad (1)$$

where *y* is the log of output, *l* is log employment, *i* and *t* index regions and time, respectively, and b_1<0, reflecting catch-up convergence. In turn, the cumulative causation hypothesis is typically examined using the Kaldor-Verdoorn equation (Kaldor, 1970), which makes productivity growth (typically, in manufacturing) a function of total output growth:

$$\Delta(y-l)_{i,t} = c_0 + c_1\Delta(q)_{i,t} \quad (2)$$

where *q* stands for total output in the economy. The coefficient c_1 in eq.2 is supposed to capture the presence of increasing returns to scale and thus of tendencies for (cumulative) divergence. Although there is no direct relation between equations 1 and 2, empirically c_1>0 in eq.2 implies that b_1>0 in eq.1 (see Cibuskiene and Butkus, 2007 for relevant discussion). We examine this in Table 1.

As can be seen in cols.1-2, the convergence hypothesis is well validated by the data as we find strong evidence of convergence in both the CEE and the EU15.[2] Convergence is slower in the CEE and statistically much weaker, resulting in a differential in the so-called 'half-life condition' of just over two years (8.3 versus 10.4), although the overall fit of the regression is lower in the much-bigger EU15 sample suggesting a greater differentiation in regional growth trajectories in this sample.

Table 1. Neoclassical convergence and the Kaldor-Verdoorn law

	Neoclassical convergence		Kaldor-Verdoorn model		Nested model		Nested model with group effects	
	EU15	CEE	EU15	CEE	EU15	CEE	EU15	CEE
Productivity	-0.084*	-0.067*			-0.058*	-0.074*	-0.068*	-0.087*
(t-1)	(0.003)	(0.006)			(0.002)	(0.006)	(0.003)	(0.007)
Output			0.712*	0.551*	0.658*	0.568*	0.649*	0.565*
growth			(0.014)	(0.037)	(0.012)	(0.033)	(0.012)	(0.033)
High-p/y							0.014*	0.032*
status							(0.001)	(0.005)
Constant	0.326*	0.182*	-0.012*	-0.069*	0.203*	0.216*	0.238*	0.321*
	(0.012)	(0.017)	(0.002)	(0.016)	(0.009)	(0.016)	(0.010)	(0.019)
Year FE	39.17*	36.81*	60.96*	36.24*	53.74*	42.13*	55.03*	44.00*

[2] The regressions in columns 1 and 2 control for country and time fixed effects. The result, however, is universally consistent across alternative specifications (regional FEs, random effects, etc).

Country FE	153.76*	53.86*	32.89*	31.50*	134.21*	66.69*	152.68*	72.20*
Obs	20,402	3,176	20,400	3,176	20,400	3,176	20,400	3,176
Regions	1,086	190	1,086	190	1,086	190	1,086	190
R^2	0.173	0.239	0.407	0.366	0.461	0.420	0.468	0.428

Notes: Heteroskedasticity-corrected standard errors in parentheses (using the Davidson and MacKinnon, 1993 correction). Asterisks (*) denote significance at the 1% level.

Despite this – admittedly, basic – confirmation of the 'convergence hypothesis', however, when testing the Kaldorian specification (cols.3-4) we obtain a positive and statistically significant effect for regional output growth. This is puzzling, as it clearly suggests a process of cumulative divergence in contrast to the inference drawn from cols.1-2.[3] Adding to this is the fact that, as with the convergence coefficient, the so-called Verdoorn coefficient is also larger (and statistically more significant) in the EU15 than in the CEE sample – by some 30%. These results remain robust when we nest the two specifications (cols.5-6): in both groups of countries we obtain simultaneous evidence of neoclassical convergence and cumulative causation. In the EU15 the convergence and Verdoorn coefficients decline (by 30% and 8% respectively) and in the CEE they rise (by 11% and 3%, respectively), but in all cases they maintain their high statistical significance.

In cols.7-8 we examine whether the simultaneous evidence of convergence and cumulative causation may be driven by different growth trajectories among different sub-groups of regions. Specifically, it is possible that a group of regions – presumably the most advanced ones – benefit more strongly by increasing returns (thus producing a positive Verdoorn coefficient in the pooled sample), while convergence takes place among the regions exhibiting low-to-medium levels of productivity. The results only partly support this hypothesis. The coefficient on the dummy for high-productivity regions[4] is positive and statistically significant in both samples, suggesting that regional growth is ceteris paribus higher in more advanced regions (by 1.4 percentage points in the EU15 and notably more, by

[3] The specification of eq.2 has received a number of criticisms in the literature (Mamgain, 1999; Angeriz et al, 2008), concerning its culpability to spurious correlation (due to simultaneity) and its implicit assumption of a constant capital/labour ratio (Harris and Liu, 1999; Castiglione, 2011). Nevertheless, the evidence of a positive Verdoorn coefficient is obtained consistently across many alternative specifications (results available upon request) and thus seems very robust. Evidence of cumulative divergence has also been obtained for the CEE regions from a specification drawing on the Myrdalian notion of circular causation (Monastiriotis, 2013).

[4] We have classified these as those regions that have belonged to the top-25% of their national distribution of regional productivities for each and every year in our sample. The results are very similar under alternative definitions, including (a) replacing the 75th percentile with the median, the mean or the national value; and (b) varying the eligibility from 'all years' to 'majority of years' or 'a subset of years'.

3.2pp, in the CEE). Further, the convergence coefficients increase in both samples (both by around 17%), suggesting that convergence is indeed speedier "at the bottom". However, in both EU15 and CEE, the Verdoorn coefficients remain practically unchanged, implying that this effect is not driven by the process of divergence (and club-formation) "at the top".

4. The regional Kuznets curve and the process of transition

4.1. Theoretical considerations

Analytically, both theoretical streams examined so far see the process of regional growth as conditioned on the regional development context – negatively for neoclassical convergence and positively for the cumulative causation approach. The puzzle of the obtained evidence pointing simultaneously to both convergence (Table 1) and divergence/polarisation (Table 1 and Figures 1 and 2), and the fact that the former appears stronger in the EU15 sample, where levels of development are significantly higher, while the latter is stronger in the less developed CEE region, invites us to consider the possibility that the process of *convergence itself* may also be conditional – this time on the context of national development, possibly along a non-linear path, whereby inequalities first rise, as economies start to grow out from initially low levels of development, and then subside, as national economies advance.

This is essentially the process described by Williamson's (1965) 'regional Kuznets curve' (henceforth, RKC). According to this, regional disparities, originally low for low levels of development, rise sharply as the process of national development accelerates and economic activity concentrates to take advantage of scale and agglomeration economies. In later phases, as connectivity across space improves (e.g., through infrastructure investment or declining transportation costs) and congestion diseconomies start biting, new growth opportunities emerge in more peripheral regions and disparities start subsiding.[5] Formally, the RKC hypothesis makes regional disparities a non-linear function of national development:

[5] Similar arguments have been developed more recently also in the urban economics literature (Henderson et al, 2001; Duranton and Puga, 2004). Further, as we saw earlier, this process of intensifying regional convergence at more advanced stages of national development is also supported empirically in the scant literature on the topic (Ezcurra and Pascual, 2007; Gennaioli et al, 2013).

$$Var(y_i - l_i)_t = d_0 + d_1(y_N - l_N)_t + d_2(y_N - l_N)_t^2 \quad (3)$$

where the subscript *N* indexes the national level and $d_1>0$, $d_2<0$. Studies drawing on this formulation have provided evidence in favour of the RKC (Barrios and Strobl, 2006; Ezcurra and Rapun, 2006; Francois and Rojas-Romagosa, 2008) without examining specifically the *growth* process at the regional level. It is however possible to express this relationship in terms of regional growth in a way more consistent with the neoclassical convergence model.

Imagine an initial stage of very low development nationally, where the whole economy is employed in the production of a set of goods (say, agriculture) under constant returns to scale and thus all regions have similar levels of productivity. In this economy, all regions grow at a very similar pace, at or around the national growth rate, and small idiosyncratic deviations from the national level of productivity are 'corrected' instantaneously resulting in very high observed speeds of convergence. In algebraic form,

$$\Delta(y-l)_{i,t} = z_0 + z_1\Delta(y-l)_{N,t} + z_2(y-l)_{i,t-1} \quad (4)$$

with $z_0\approx0$, $z_1\approx1$ and $z_2<0$. As the national economy grows and labour productivity increases, conditions emerge for the adoption of new technologies and/or the introduction of new products[6], some of which will be characterised by increasing returns to scale. Idiosyncratic deviations at the regional level will ensure that not all regions reach this stage simultaneously. Those that do so first, will obtain an advantage which, due to the nature of the new technology (increasing returns), will be cumulative. Higher profitability and productivity gains in these regions and perhaps also stronger consumption externalities (agglomeration effects) will shift investment towards them, instigating a process of regional divergence, while at the same time pushing upwards the average (national) level of development. In this instance national growth will be a less accurate descriptor of regional growth (so that z_1 becomes statistically less significant[7]) and neoclassical convergence will be reversed (so that $z_2\geq0$, or at least $z_2^B>z_2^A$, if the lagging regions continue to converge – where A and B index stages of development).

Provided that the less well-off regions are not permanently prevented from the adoption of the new technology, and in the absence of any systematic shocks favouring the more

[6] For example, technology products whose production is characterised by high fixed costs and thus requires a certain level of productivity so as for production to be profitable.

[7] Essentially, whether z_1 becomes greater or smaller than 1 will depend on the shape of the distribution of regional growth rates and the relative size of the leading regions. In this case, z_0 will also now be different, as we depict later in eq.4'.

advanced regions, with the passage of time the lagging regions will also move to the new production regime (that is, as long as they continue to grow while in stage B). This will instigate a return to the process of convergence, so that $z_2^C<0$ (where C stands for the new stage of national development).[8] Naturally, the picture will be different if in the course of stage B some forces emerge to perpetuate the agglomeration advantage of the leading regions. In line with endogenous growth theory, such forces may well be endogenous – for example, due to the embeddedness of human capital into physical labour or due to a positive correlation between levels of productivity and the incidence of positive technology shocks. However, such forces may also be exogenous – if for example a national shock favours systematically high-productivity regions. As we discussed in the first part of this paper, the post-communist transition experienced by the CEE countries may well represent such a national shock that may have favoured the more advanced regions, selectively directing there new technologies embodied in foreign investments and reinforcing their agglomeration advantages. In contrast, in more advanced economies with more developed credit markets, lower political uncertainties and overall risks and better institutional and physical infrastructure to facilitate mobility, the conditions for the emergence of centrifugal forces, and thus of regional convergence, will be stronger.[9]

We can thus identify two alternative paths within stage C. In path C1, agglomeration forces are persistent and possibly reinforced, resulting in continuous divergence ($z_2^{C1}\geq 0$, so that the convergence path is monotonic but not necessarily concave); while in path C2 agglomeration forces die out and convergence re-emerges ($z_2^{C2}<0$, so that the convergence path is concave but non-monotonic (hump-shaped)) – until perhaps a new technological shock starts the convergence-divergence cycle again. We can represent these trajectories in algebraic form by extending eq.4 as follows:

$$\Delta(y-l)_{i,t} = D^S z_0 + \sum_S D^S z_1 \Delta(y-l)_{N,t} + \sum_S D^S z_2 (y-l)_{i,t-1} \qquad (4')$$

where D^S is a set of binary dummies indexing stages of national development (S={A, B, C1, C2}). Drawing on our discussion, we expect z_2 to follow a non-linear (initially, hump-shaped) path along stages of development and the *statistical significance* of z_1 *to decline over time*, at least initially. We moreover expect that for higher levels of development (stage C), the

[8] This requires that, despite the increasing returns technology, the returns to any individual factor of production remain diminishing (otherwise the first-mover advantage becomes permanent).

[9] Similar developments are described in some models within the NEG tradition (see Krugman, 1991 and, in particular, Ottaviano and Puga, 1998, and Puga, 1999).

coefficient z_2 to be more negative in the EU15 sample and (more) positive in the CEE sample. We examine the validity of these predictions next.

4.2. Empirical results

To perform our analysis we need to identify different stages, or thresholds, of development across which the direction and intensity of convergence may differ. This is not a straightforward task, especially as it is not practically possible to derive a universal definition of 'stages of development' across our two samples.[10] Opting thus for the use of group-specific definitions of 'stages', we were confronted with a number of options, ranging from adopting an exogenous classification, either ad hoc or by drawing on existing international classifications, to deriving our groups endogenously, e.g., through cluster analysis. For our analysis we favoured a simpler classification method, largely due to its simplicity, splitting each of the two samples (EU15 and CEE) on the basis of the treciles (33rd and 66th percentiles) of the group-specific distributions of national incomes (GDP per capita).[11] This is convenient, as it splits each sample independently into three group-specific 'stages of development', in line with our theoretical stages A, B and C, and avoids the practical problems of a universal definition of stages of development.

Nevertheless, we also developed an alternative classification, driven there by our early findings and the experimentation with other classification schemes. This was as follows. First, we applied a linear scale transformation (distance from minimum divided by range) to standardise the distribution of GDP per capita within each group. We then derived trecile thresholds from these standardised distributions and merged them, producing five distinctive categories ('stages': from the lowest trecile of the CEE distribution to the top trecile of the EU15 distribution), and applied subsequently these thresholds to the two standardised distributions separately. As these thresholds did not overlap (i.e., the 33rd percentile of the EU15 distribution was above the 66th percentile of the CEE distribution), in effect this classification is identical to the simple treciles classification above, with the only

[10] National incomes differ substantially across the EU15 and CEE countries and thus the income distributions of the two country groups hardly overlap. Besides this, given the specificity of the CEE transition context, it is in some respects questionable whether east-west differences in GDP per capita actually reflect differences in *levels* of development.

[11] We have replicated the analysis for other thresholds (quartiles and quintiles – results available upon request) but the patterns were broadly consistent with those derived from the treciles and overall less informative than the alternative method described next in the text.

difference that, additionally, 'stage C' (the upper trecile) of the CEE distribution and 'stage A' (lower trecile) of the EU15 distribution are split each into three sub-stages. This provides us with a more detailed picture for the 'early' stages of development in the EU15 and for the 'late' stages of development in the CEE which, as we will see, helps unveil some very interesting patterns.

It should be noted that the analytical approach and modelling strategy followed here (e.g., modelling regional growth as a function of national growth; creating a discontinuous space by splitting into 'stages') do not allow us to incorporate in our analysis an examination of processes of spatial dependence (lag, error, or both) – although relevant tools have recently been developed also for the case of panel data (Baltagi and Li, 2006; Kapoor et al, 2007; Anselin et al, 2008; Elhorst, 2009).[12] Spatial association processes are of course undoubtedly important in the process of regional growth, both analytically and empirically (Fingleton and López-Bazo, 2006; Arbia, 2006; Dall'erba et al, 2008; Rey and Le Gallo, 2009). Given, however, the primary focus of our analysis on the role played by the *national* growth/development context, the examination of these is rather beyond the scope of this paper – but it is very much something to consider for future research.

We start our analysis by estimating the model specified in eq.4' using the simple three-stage classification (Table 2). As can be seen in columns 1-2, the national growth variable is highly significant and – consistent with the predictions made earlier – at 'early' stages of development it is much closer to 1, especially in CEE, and notably more significant statistically than in later stages. The stage-specific fixed-effects are also very significant, especially in the EU15 sample, in line with our assumption that z_0 will be different across stages of national development. In contrast, the results concerning the intensity of convergence confirm only partially our earlier predictions. In stage 1, both samples produce negative and statistically significant convergence coefficients. In the CEE, the coefficient declines substantially in stage 2, becoming statistically not different from zero, and turns positive at stage 3, showing slow but statistically significant divergence. If we are to interpret our empirical stages as accurate reflections of the theoretical stages discussed earlier, then

[12] Omitting a significant spatial lag can produce bias in the parameter estimates; while not taking account of a significant spatial error process may lead to biased standard errors. Often, however, these biases concern the imputed speed of convergence and not the direction or overall significance of the convergence coefficient, thus not altering significantly the substantive interpretation of the process under study. For example, Arbia et al (2008), using data for a selection of EU regions, compare the performance of different estimation methods on the standard neoclassical convergence model and find that "the beta parameter is always negative [and significant] and has a quite small range regardless of the specification chosen" (p.220).

we should conclude that the convergence-divergence path followed in the CEE corresponds to the trajectory described by C1 in our earlier discussion (persistent divergence). However, as the convergence coefficient in stage 2 is clearly non-positive, it is also possible that the estimate of stage 3 simply captures our theoretical stage B (i.e., that stages 1 and 2 are both 'early' stages of development), making it uncertain as to whether the CEE regions are following a divergent or a hump-shaped path.

Table 2. Regional growth and stages of economic development

	Eq.4'		z_1=0		1994-2006		Within countries		Five stages	
	CEE	EU15	CEE	EU15	CEE	EU15	CEE	EU15	CEE	EU15
Nat'l growth										
Stage 1	0.995***	1.174***			0.997***	1.520***	0.990***	1.168***	0.994***	1.098***
	(34.13)	(33.54)			(25.03)	(16.45)	(31.30)	(29.74)	(33.64)	(11.31)
Stage 2	0.959***	0.139***			0.905***	1.048***	0.955***	0.144***	0.957***	1.788***
	(25.15)	(5.092)			(18.96)	(22.20)	(24.10)	(5.31)	(25.00)	(13.04)
Stage 3	1.026***	0.922***			1.054***	0.997***	1.114***	1.032***	1.002***	1.011***
	(19.41)	(15.62)			(13.01)	(14.55)	(18.34)	(15.81)	(13.72)	(51.89)
Stage 4									1.009***	0.134***
									(14.70)	(4.927)
Stage 5									1.559***	0.887***
									(3.514)	(15.28)
Reg'l p/ty (t-1)										
Stage 1	-0.0255***	-0.0185***	-0.0416***	-0.0222***	-0.0391***	-0.0123***	-0.0297***	-0.0569***	-0.0254***	-0.0723***
	(-3.624)	(-6.408)	(-4.243)	(-7.163)	(-3.872)	(-3.671)	(-3.388)	(-8.951)	(-3.576)	(-9.762)
Stage 2	-0.00685	-0.117***	-0.0241***	-0.114***	-0.01000	-0.0535***	-0.0143**	-0.1205***	-0.0072	0.0058
	(-1.221)	(-25.75)	(-3.602)	(-25.59)	(-1.610)	(-16.44)	(-2.438)	(-26.237)	(-1.271)	(1.068)
Stage 3	0.00944***	-0.00238	0.00209	-0.00322	0.00852**	-0.0153***	0.00045	-0.0072**	0.0102*	-0.0207***
	(3.208)	(-0.872)	(0.528)	(-1.144)	(2.138)	(-3.952)	(0.089)	(-2.522)	(1.887)	(-5.539)
Stage 4									0.0171***	-0.1174***
									(2.728)	(-25.86)
Stage 5									-0.0236	-0.0022
									(-1.641)	(-0.818)
Year FE	1.90*	22.94***	18.99***	35.67***	1.55*	5.24***	2.06***	24.01***	1.96**	22.85***
Stages FE	11.80***	254.54***	12.24***	223.72***	10.50***	53.12***	6.10***	241.38***	6.24**	141.56***
Country FE							1.96**	24.90***		
Constant	0.0344***	0.0587***	0.0935***	0.0833***	0.0481***	0.0364***	0.0550***	0.2175***	0.0346***	0.219***
	(3.092)	(5.993)	(6.180)	(7.975)	(3.235)	(3.121)	(2.932)	(9.080)	(3.075)	(9.738)
Observations	3,173	20,402	3,176	20,402	2,466	14,114	3,137	20,402	3,173	20,402
R-squared	0.550	0.254	0.160	0.172	0.458	0.170	0.554	0.275	0.551	0.272

Notes: Heteroskedasticity-corrected t-statistics in parentheses (using the Davidson and MacKinnon, 1993 correction). The FE rows report F-statistics for the joint significance of the corresponding fixed-effects. *, ** and *** show significance at the 10%, 5% and 1% levels, respectively.

In contrast, the results for the EU15 sample produce a U-shaped trajectory of convergence with a very large and statistically very strong convergence coefficient in stage 2 and an insignificant but still negative coefficient in stage 3. Quite clearly, the results do not support the RKC hypothesis or any of the processes sketched out in our discussion of section 4.1. Rather, they seem to be more consistent, broadly speaking, with the non-linear convergence/polarisation paths found (but under different specifications and measures of inequality) in the studies of Ezcurra and Pascual (2007) and Petrakos et al (2011).

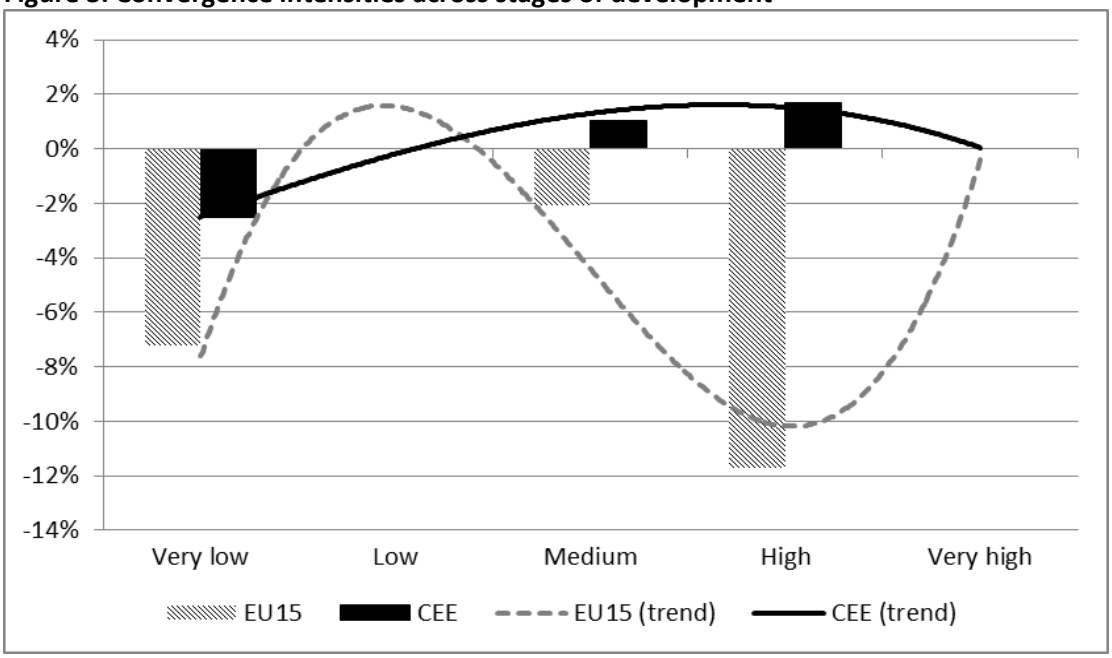
The overall thrust of these trajectories is repeated consistently across alternative specifications.[13] When we exclude the national growth variable (setting z_1^S=0) the path towards divergence in the CEE appears slower but is certainly in the same direction, while the EU15 results do not change. When we restrict our estimating samples to a shorter time-span, to exclude the turbulent years at the beginning and the end of the period, the CEE result is exactly as in the original model, while in the EU15 the convergence coefficient in stage 3 becomes significant. Similarly minor are the differences when we introduce country-specific fixed effects (cols.5-6).

In the last part of Table 2 we report the results from our more refined (but asymmetric) 5-stage classification. As can be seen, some of the earlier results concerning especially the CEE sample apply in the same way in this specification. As before, the significance of the national growth variable drops continuously as we move to higher stages of development.[14] Similarly, convergence is strongest in stage 1 and it gradually loses significance, turning to statistically significant divergence by stage 4 (in line with, but more emphatically than, what was found in col.1), while the estimate for stage 5 suggests a return towards convergence, although this is not statistically significant. In contrast, in the EU15 sample the 5-stage classification produces a convergence trajectory that is qualitatively very different than before. Between stages 1 and 4, the convergence coefficient follows a very clear hump-shaped path, becoming very strongly negative in stage 4 (which corresponds to stage 2 in col.1). In stage 5, however, the direction of the path reverses and the convergence coefficient becomes insignificant. This result, which is directly comparable to the one obtained in col.1 under stage 3, explains our earlier inference concerning a U-shaped convergence trajectory in the EU15. We depict visually these convergence-divergence trajectories in Figure 4.

[13] The results are also consistent across alternative estimation methods, including the GLS random effects and PCSE estimators.

[14] In the EU15 sample this applied less strongly in the three-stage classification and does not seem to apply at all here.

Figure 3. Convergence intensities across stages of development



Notes: Convergence coefficients (setting equal to zero if not statistically significant) obtained from Table 2, cols.9-10. Fitted lines are based on a third-order polynomial.

5. Discussion

There are two key points of departure for the analysis in this paper. On the one hand, that owing to processes of transition and integration, regional disparities in the CEECs increased substantially over the last two decades and regional productivities and incomes became significantly polarised. On the other, that the traditional approach to the analysis of these developments is rather limiting, as it pays little attention to the national-development context – while the two main theories typically tested on the data seem to provide contradictory results. Reflecting especially on this second point, this paper attempted to provide a link, both theoretically and empirically, between national development and the process of regional growth and convergence. Our results provide clear evidence in support of the assertion that the convergence process – and regional growth more generally – is significantly different across different levels/stages of development. The evidence obtained, across the two samples, is at least partly consistent with our adapted RKC story.

In the CEE, regional growth seems to follow a process broadly in line with our theoretical predictions: starting from convergence, divergence gradually emerges as we move to higher levels of development. The absence of a (statistically significant) 'return to convergence' at

the highest stage is consistent with our assertion that transition may be favouring centripetal forces against the tendency for speedier convergence at higher levels of development. Although of course we cannot exclude the possibility that this result may simply reflect that the CEECs have not yet reached the levels of national development needed to (re-)mobilise regional convergence[15], it should be noted that at comparable levels of development (stage 1 for the EU15 sample) the EU15 regions were converging fast – admittedly within a very different political-economic context – and thus the level of development per se does not appear in itself as a sufficient explanation for the absence of a return to convergence. If we were to speculate on the factors that may explain this variation, quite naturally our attention would fall on the processes of post-communist transition and market integration/liberalisation that followed – in line with discussions elsewhere in the literature as reviewed briefly in the early parts of section 2.

For the EU15, the evidence concerning the RKC hypothesis is more mixed. On the one hand, at very low to medium levels of national development (stages 1-4) we do observe a path that is similar to the one described by the RKC (Fig.4). However, in no stage of development do we get convincing (statistically significant) evidence of divergence – which would be more in line with the RKC hypothesis. Moreover, we find that even at higher levels of development the convergence coefficient is not stable but rather tends to reverse. While this, too, is not part of the original RKC hypothesis, the overall convergence path depicted in Fig.4 is in fact broadly consistent with our theoretical discussion of section 4.1. Using this discussion to interpret the evolution of the convergence coefficient in the EU15, we could hypothesise that in this group technological (or other) shocks pushing towards divergence have a higher frequency but lower intensity. Thus, episodes of slower and faster convergence alternate, with more advanced regions occasionally increasing their distance from the less well-off regions, but without reversing the overall pattern of convergence (presumably, amongst the latter group of regions).

Moving beyond these interpretations, we wish to conclude by relating the main message emanating from our analysis, namely the existence of a strong link between national economic context and the process of regional convergence, to related arguments in the literature. As discussed earlier, a presumed link between national development and aspects of regional disparity has been suggested not only by Williamson's (1965) regional Kuznets

[15] This could be in line with Gennaioli et al (2013) who claim that convergence occurs faster in more developed countries with better infrastructure and greater factor mobility. Note, however, that this prediction does not get support in the EU15 sample which represents higher levels of development.

curve but also in more recent contributions (Ezcurra and Pascual, 2007). However, no study has examined thus far, in a systematic way, the differentiation and *non-linearity* of the speed of convergence across different stages of economic development. A small number of empirical studies have showed that convergence speeds differ at different stages in the process of economic integration and over different national growth regimes (e.g., Tondl, 1997; Geppert and Stephan, 2008). The model recently developed by Gennaioli et al (2013), and the empirical evidence presented there, added a different perspective, suggesting that the speed of convergence increases linearly with economic development. The evidence presented in this paper is in the same spirit as these observations. Like others, we find that the speed of convergence is not constant over time. But we also offer unique evidence showing that its evolution follows a rather deterministic path and is non-linear. We defer to future research the pursuit of a more detailed analysis of the factors explaining this.

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APPENDIX

Table A.1. Regional disparities within and across the European countries

Country	*Disparity (CoV)*		*Polarisation*		*Persistence*
Period	Early transition	Post accession	Early transition	Post accession	Early - Post
BG	0.22	0.26	1.73	2.08	0.38
CZ	0.09	0.21	1.26	1.78	0.30
EE	0.21	0.35	1.51	1.91	1.00
HU	0.17	0.24	1.67	1.72	0.22
LT	0.18	0.26	1.31	1.59	0.83
LV	0.38	0.52	1.55	2.68	0.49
PL	0.27	0.28	1.69	1.99	0.89
RO	0.19	0.23	1.34	1.95	0.59
SI	0.16	0.11	1.37	1.19	0.90
SK	0.17	0.21	1.43	1.45	0.33
CEE	0.44	0.55	2.82	2.82	0.63
AT	0.16	0.15	1.31	1.30	0.85
BE	0.13	0.13	1.34	1.40	0.86
DE	0.23	0.16	2.07	2.37	0.66
DK	0.10	0.08	1.20	1.15	0.61
ES	0.14	0.08	1.27	1.22	0.65
FI	0.09	0.14	1.23	1.42	0.90
FR	0.14	0.16	1.68	2.17	0.82
GR	0.54	0.30	3.45	1.96	0.05
IE	0.15	0.23	1.31	1.46	0.81
IT	0.12	0.12	1.21	1.31	0.79
MT	0.16	0.07	1.11	1.05	1.00
NL	0.15	0.17	1.61	1.56	0.76
PT	0.26	0.30	1.67	2.00	0.96
SE	0.06	0.09	1.14	1.30	0.31
UK	0.13	0.17	1.46	1.65	0.46
EU15	0.25	0.23	2.18	2.40	0.64

Notes: Early transition covers the period 1990-1995; post-accession is for 2004-2008. Comparative data are presented for the same periods for the EU15.