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Regional Growth Dynamics in Central and Eastern Europe

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Abstract

This paper examines the regional growth process of the countries of Central and Eastern Europe since the start of their transition to market economies. It relates this to three distinctive explanations of regional growth and examines empirically their relevance in explaining the patterns of disparity and polarisation that have emerged in these countries over the last two decades. The collapse of communism and the early transition shock that followed created in many respects an experiment-like situation with a set of 'initial conditions' conducive for analysing patterns of convergence and divergence in the processes of national economic development and cross-national catch-up growth. The path to EU accession intensified the speed of these processes at the national level thus making the corresponding regional evolutions more marked. Our empirical analysis unveils a complex pattern of non-linear regional growth dynamics with convergence tendencies largely swaddled by processes of cumulative causation. Despite the process of national catch-up growth, regional evolutions are on the whole divergent, with a pattern of convergence at the middle- and lower-ends of the distribution and a slower tendency for club formation at the higher end, and thus overall an increasing trend of polarisation.

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Note

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Regional Growth Dynamics in Central and Eastern Europe

1. Introduction

Regional evolutions in the countries of Central and Eastern Europe (CEE) have followed interesting patterns of convergence, divergence and polarisation over the last two decades. Such patterns are deeply linked to the process of post-communist transition and EU accession, the two dominant political and socio-economic processes that characterised the region since the collapse of communism. As central planning collapsed, a long process of deindustrialisation and economic restructuring started, which among its other effects, changed radically the spatial organisation of economic activity in these countries. Old spatial organisations and divisions, organised along the so-called 'enterprise space' (Pickles and Smith, 1998), were soon – and very radically – transformed into new formations along new (and uneven) geographical lines, that resembled more traditional schemes of core-periphery. Transition was soon followed by increasing economic openness, with substantial shifts in trade partners and specialisations and significant inflows of foreign investments, both of which contributed further to altering the economic geography of the countries concerned. Although institutions and local environments have played an important role to this process, the disappearance of the formerly dominant enterprise space has created a "t=0" set of initial conditions that lend themselves to the study of processes of equilibration and cumulative causation. The accession of these countries to the European Union in 2004/07 intensified the processes of economic integration, restructuring and national development, thus shrinking the evolutionary time during which the aforementioned processes were to take place.[1]

[1] For example, countries like Hungary and the Czech Republic transformed their economies in a matter of just over ten years, jumping from a level of development around 20% of the EU15

Under the influence of these processes, the last twenty years have seen a sharp increase in regional disparities in CEE. Moreover, strong patterns of polarisation emerged, as the process of national convergence, stimulated by increasing openness and economic and political integration, has not been accompanied by a similar trend for cross-regional equilibration. Besides their policy relevance, these developments are particularly important for academic inquiry, as they challenge simple concepts of convergence and instantaneous equilibration, 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 production technology (diminishing returns to individual factors of production)? 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 is the process of convergence and divergence conditioned on the level of national development?

In recent decades, the study of these questions has been dominated by the so-called 'convergence hypothesis' literature. Based on the Solow one-sector growth model under the assumptions of a common technology, diminishing returns and no systematic external shocks (Baumol, 1986; Barro and Sala-i-Martin, 1991), the convergence hypothesis asserts that economies that start from a higher level of development experience lower rates of equilibrium growth. As a consequence, less developed economies eventually (although, in the theoretical form of the model, asymptotically) catch-up, leading to a long-run stable equilibrium (steady-state) of convergence. Although more recent contributions have sought to move beyond the simplicity of the convergence hypothesis, either methodologically, by examining distributional dynamics (Magrini, 1999; Rey and Janikas, 2005), or substantively, looking in particular at the role of knowledge and institutions, including aspects of society and governance (see, inter alia, Storper, 1997; Martin and Sunley, 1998; Asheim and Gertler, 2005; Audretsch and Keilbach, 2005), the macroeconomic analysis of regional growth is still driven by the simplistic notion of convergence.

average in 1995 to around 40% in 2007 and shifting their export specialisations so that by 2005 over 80% of their trade with the EU15 was of intra-industry character.

Two broad intellectual traditions in the analysis of regional economic performance have suffered as a result. On the one hand are approaches based on the theory of cumulative causation (Myrdal, 1957; Kaldor, 1970).[2] On the other hand are approaches that derive from the development economics tradition and emphasise the interwoven relationship between the processes of regional growth and national development (Williamson, 1965).

Against this background, much of the empirical analysis of regional disparities in CEE since the collapse of communism has been largely within the convergence hypothesis framework – adopting it either methodologically (i.e., examining evidence of beta-convergence) or conceptually (i.e., not challenging the notions of equilibration and convergence). In a way, this represents a missed opportunity, as the collapse of central planning in these countries created an almost natural-experiment-like situation that was particularly suitable for the study of the applicability and relevance of competing theories of regional growth (Monastiriotis and Petrakos, 2010). This paper utilises this unique experience to examine the patterns of regional growth in CEE and the particular forms of disparity that developed over the last two decades. It looks at the evolution of regional disparities within the CEECs and examines the patterns of polarisation and clustering that emerged. Starting from this, it then seeks to relate the observed growth patterns and trends to specific processes deriving from the theoretical literature and in particular from three competing views on the evolution of regional disparities: the neoclassical convergence hypothesis (NC), the cumulative causation theory (CC) and the evolutionary approach of the regional Kuznets curve (KC).[3] The focus here is not with the causal explanation of these patterns, in the sense of seeking to identify the specific variables that account for them, but rather with unveiling the underlying growth process that best describes these patterns. The next section offers a literature-

[2] Although the development of the endogenous growth literature has allowed cumulative causation considerations to enter the convergence debate, in this literature such considerations are often reduced to a simple mechanism driven by the uneven availability of resources across space (mainly human capital and/or innovation) and the deterministic character that divergence takes in the original theory (through a self-perpetuating relation between agglomeration and demand) is largely overlooked.

[3] We discuss these approaches in detail in section 3.

based review on the evolution of regional disparities in CEE. Section 3 considers the three theoretical approaches and discusses how these can be instrumentalised in a nested model of regional growth. Section 4 presents the empirical investigation, while the last section concludes with some implications for theory and policy.

2. Transition, accession and regional growth in the CEECs

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; Brzeski and Colombatto, 1999; Römisch, 2003), but it continued throughout the period and in some cases intensified (Petrakos et al, 2000 and 2005a; Bradley et al, 2005; 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. One the one hand, there is a notable shift of industrial activity towards metropolitan regions and regions bordering the EU (Petrakos, 2000; Petrakos and Economou, 2002; Iara and Traistaru, 2003), stimulated partly by the self-selective inflow of foreign investments in these areas (Lorentzen, 1999; Nemes-Nagy, 2000; 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 (Raagmaa, 1996; Downes 1996; Petrakos, 2001; Traistaru et al, 2003; Hildebrandt and Worz, 2004; Resmini, 2007; Heidenreich and Wudner, 2008). 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) (Traistaru and Pauna, 2002; Resmini, 2003; Resmini and Traistaru, 2003; Longhi et al, 2004; Petrakos et al, 2005b; Petrakos and Kallioras, 2007; Krieger-Boden et al, 2008; 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 benefitted 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 EU New Member States, Niebuhr and Schlitte (2009; at the NUTS2 level for the period 1995-2000) and Paas et al (2007; at the NUTS3 level for the period 1995-2002), find evidence of fast cross-national convergence across countries and regional divergence or regional stability within countries – with an overall slow convergence of regional incomes across the CEE and EU countries. Using the same database in a simple NC framework, Petrakos et al (2005a and 2005b) 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 NC approach by incorporating a CC element and examining jointly short- and long-run dynamics in regional growth, Petrakos et al (2005c) find simultaneous evidence of short-run divergence and long-run convergence, with the level of disparities following a pro-cyclical path and a long-run convergent trend. Kallioras (2010) shows that NC results are conditioned on the size of the regional economies, with evidence of divergence when population size is taken into account and evidence of convergence otherwise.[4] Given that population is typically higher in more advanced and more dynamic regions, these findings can

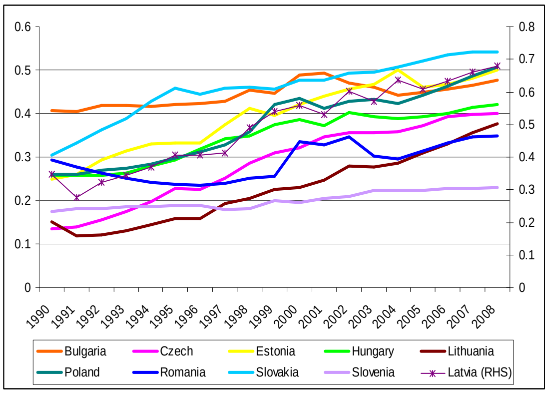
[4] See also Petrakos and Artelaris (2009) for similar evidence for the pre-2000 EU member states.

be interpreted as evidence signalling intra-country polarisation and, possibly, club convergence: smaller (and poorer) regions tend to converge to their own steady-state, but larger regions tend to follow different, more dynamic, paths. Direct evidence for this, in the form of club convergence, 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).

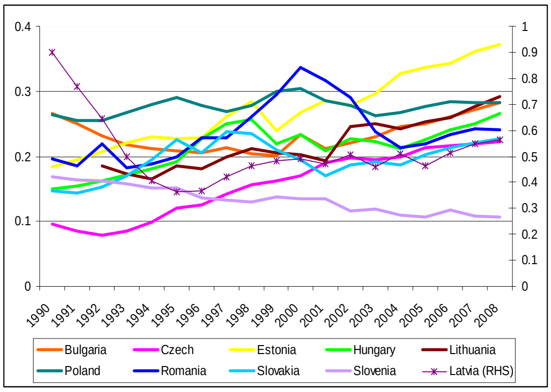
These patterns of polarisation and divergence are also confirmed by our exploratory analysis, using NUTS3-level data for the period 1990-2008 (Figure 1).[5] As can be seen, regional disparities have widened notably in all CEECs since the collapse of communism. On average, regional income disparities rose between 1990 (1995) and 2007 by 80% (50%). The increase in disparities in productivity was smaller (around 30% for 1990-2007), but still many times higher than that observed for the EU15 (13% for the same period). In terms of GDP per capita the increase was highest in the Czech Republic (196%) and lowest in Bulgaria (15%), while in terms of productivity some countries also experienced an absolute decline in regional disparities (Slovenia and for specific sub-periods Slovakia and Poland). The Czech Republic was again the leader, with an increase in disparity of over 100%, closely followed by the Baltic countries. Overall, disparities in the CEECs are over 50% higher than in the EU15.

[5] The four panels show the evolution of the within-country regional disparities (coefficient of variation) and polarisation (max-to-median ratio) for regional incomes (GDP per capita) and labour productivity (GVA per worker). All data are from the Cambridge Econometrics European Regional Database (http://www.camecon.org).

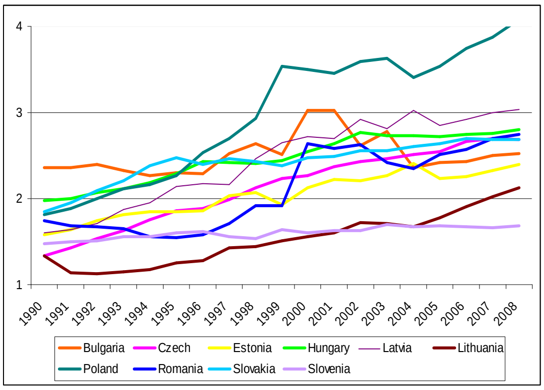
Figure 1: Income and productivity disparities and polarisation in CEE



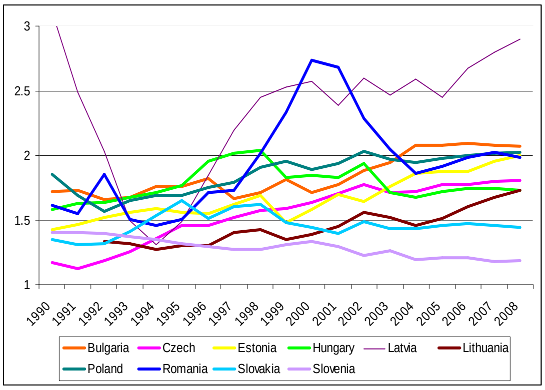
(a) Coef. of variation, GDP pc



(b) Coef. of variation, GVA pw



(c) Max-to-median, GDP pc



(d) Max-to-median, GVA pw

Source: Cambridge Econometrics; author's calculations.

Importantly, the rise in inequality, especially in terms of incomes, has not been uniform across space as polarisation appears to have increased much faster than overall regional disparities. On average, GDP pc in the best-performing region in each CEEC is over 2.5 times higher than in the corresponding median region, with polarisation having increased by over 70% during the period. Polarisation in labour productivity is somewhat lower and has been rising at a notably slower pace, while for some countries (Slovenia and, more recently, Slovakia and Hungary) it has actually been declining. Even in cases of declining polarisation, however, differences in the relative position of regions appear particularly persistent. Across the full CEE sample, a rank correlation analysis for 1990-2007 returns a persistence coefficient of 87% for GDP pc and 71% for productivity (the corresponding values for the 1995-2007 period are 92% and 84%). Within countries, persistence coefficients for the same period range from 48% in Hungary to 100% in Latvia, with most countries scoring between 70-90%. These patterns indicate clearly that regional convergence, of the neoclassical type, has certainly not taken place. In the next section we discuss some alternative theoretical processes that may be more suitable in accounting for the regional growth patterns observed in our data.

3. Conceptualising relative regional growth

There is a wide array of theoretical traditions and empirical approaches examining the regional growth process. These include open and closed economy models, endogenous and exogenous growth models, equilibrium and disequilibrium approaches, and approaches seeing regional growth as independent (region-specific) or relational. In this paper we focus on three competing theoretical approaches that, among other epistemological differences, differ in the way they conceptualise the growth process: as a mirror-image of the national (neoclassical convergence approach), as a non-linear function of the national (the regional Kuznets Curve hypothesis), or as an own function of the regional (the cumulative causation approach).

3.1. Neoclassical convergence

As is well known, the empirical formulation of the neoclassical convergence hypothesis makes regional growth a function of the initial income level of each region, as follows:

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

where y is the log of output, l is the log of employment, i and t index regions and time, respectively, and $b_1<0$, reflecting catch-up convergence. Two extensions of this model are possible. First, adding other controls, to capture region-specific structural characteristics (such as technology, preferences, propensities to save, etc.), takes us to the notion of "conditional convergence", where regions converge towards a region-specific steady-state. Second, by splitting the regions across a relevant dimension (e.g., large-small, metropolitan-peripheral, rich-poor, etc.), one can examine the so-called "club convergence" hypothesis, where regions converge towards two (or more) club-specific steady states (with club membership defined on the basis of similarity in initial conditions or time-persistent characteristics), resulting in polarisation in the distribution of regional incomes.[6] Thus, the general formulation of the NC story can be written as

$$\Delta(y-l)_{i,t} = (b_0 + b_0^C) + b_1(y-l)_{i,t-k} + b_2 C_i (y-l)_{i,t-k} + b_3 I_{i,t-k}(y-l)_{i,t-k} \qquad (2)$$

where $k \in$ {1, T}, C is a binary variable indicating membership into a club and I is a variable summarising region-specific characteristics.[7] By setting b_3=0 we move from conditional to unconditional convergence and by setting b_0^C, $b_2 \neq 0$ we move from universal to club convergence.

As is well discussed in the literature, the NC model assumes a monotonic (although asymptotic) process towards equilibration, largely driven by the law of diminishing returns and the assumption about constant returns to scale. Relaxing either of these assumptions (monotonicity and constant returns) takes us to two distinctively different theoretical traditions and thus two substantively different formulations of the regional growth process, as discussed in the remainder of this section.

[6] See the *Controversy* section at the July 1996 issue of the Economic Journal (No437) for an interesting discussion of the different notions of convergence. See also the excellent survey by Islam (2003).

[7] In panel-data formulations, the initial levels are typically replaced by a reasonably spaced time-lag (usually, simply t-1), which however captures then only short-run dynamics (mean-reversal – see Islam, 2003; Arbia and Piras, 2005) and the initial conditions are subsumed in the regional fixed effects that are included in the model.

3.2. Cumulative causation and increasing returns

Allowing for increasing returns to scale (IRS), as in the endogenous growth theory and models deriving from New Economic Geography, opens the possibility of equilibrium divergence, even within the NC framework (with $b_1 \geq 0$ in the formulation of eq.2). Indeed, estimates of divergence in this context are often interpreted as reflecting cumulative causation mechanisms (see Petrakos et al, 2005c, and Cibulskiene and Butkus, 2007 for relevant discussions), whereby richer regions grow permanently faster than less developed ones. Inversely, evidence of beta-convergence is often taken as a refutation of the CC story. This is however inaccurate. At least in Myrdal's (1957) original formulation, the CC process is not about a positive relationship between growth and initial incomes (beta-divergence), but rather a circular process of self-perpetuating growth, underlined by institutional and cultural as well as economic factors. By implication, the claim in Myrdal's CC approach is about a positive relationship between past and current rates of growth, irrespective, in a way, of initial incomes. This is because initial incomes capture only partly the initial advantages in regional conditions and characteristics; and because the latter both generate and maintain a region's growth advantage.[8]

A somewhat different formulation of this relationship is offered in Kaldor's (1970) CC model, which emphasises more explicitly[9] the role of increasing returns (following Verdoorn's Law). Verdoorn's Law places emphasis on the demand-side for generating increasing returns, as the rate of expansion of the regional economy is assumed to impact positively on labour efficiency and thus regional growth (in labour productivity) becomes a function of the rate at which the size of the economy (not in per capita terms) grows.[10] In contrast, in the urban and spatial economics

[8] For Myrdal the circular process is due to the so-called backwash effect, whereby more dynamic regions constantly drain resources from less developed ones. The process, however, does not necessarily continue in perpetuity, as spread effects may start dominating with economic development and policy intervention while external shocks (e.g., trade integration) and congestion diseconomies may at some point shift the balance between advantages and disadvantages in different regions.

[9] Indeed, Myrdal seemed to disagree with Kaldor's interpretation of his CC theory as something reducible to an IRS argument – see Berger (2008).

[10] Given concerns about the endogeneity of output growth in the Verdoorn equation (Rowthorn, 1975), a dynamic specification including past values of the growth rate may appear more

tradition (see Combes et al, 2008), IRS derive from the supply-side and from the knowledge- or technology-enhancing role of agglomeration, making productivity growth a function, not of the growth in the volume of output, but of output density (see Ciccone and Hall, 1996). Putting together this, admittedly very diverse, family of IRS approaches, leads to the following generic relationship:

$$\Delta(y-l)_{i,t} = c_0 + c_{11} y_{i,t-k} + c_{12} y_{i,t-k-1} + c_2 \Delta(l)_{i,t-k} + c_3 s_i \qquad (3)$$

where the *t-k* notation has been maintained to allow for dynamic links at longer time-horizons and *s* represents the physical size (e.g., square hectares) of the regional economy. Setting $c_{11}=-c_{12}$ and $c_2=c_3=0$ reproduces the Kaldorian formulation. Setting $c_{11}=-c_{12}=-c_2$ and $c_3=0$ brings us instead to the Myrdalian formulation. Finally, setting $c_{12}=c_2=0$ and $c_{11}=-c_3$ reproduces the agglomeration economies approach of Ciccone and Hall (1996). It should be emphasised that, in this formulation, divergence is not understood as a process whereby richer regions grow faster (as was the case with $b_1>0$ in eq.2) but as a *circular* process of self-perpetuating growth.

3.3. Non-monotonic convergence and the regional Kuznets curve

A third family of approaches sees regional growth as a function of the level of national development. Although relatively recent developments in urban and spatial economics (see Henderson et al, 2001; Duranton and Puga, 2004) offer insights and micro-foundations consistent with this view, this is essentially a tradition deriving from development economics, following the seminal contribution of Kuznets (1955) and its regional adaptation by Williamson (1965).[11] In this tradition regional growth

appropriate. Note also that local output growth can be replaced by output growth across a spatial field, thus linking the non-spatial formulation of Vernoorn's Law to the New Economic Geography's emphasis on market potential (see Angeriz et al, 2008). A fundamental difference exists, however, in the conceptualisation of IRS between Kaldor and NEG. For the former, these are mainly concentrated in manufacturing activity, whereas for the latter they relate to advanced service-sector activities.

[11] More recently, a weaker version of the KC hypothesis has been proposed (Higgins and Williamson, 2002; Francois and Rojas-Romagosa, 2008), which acknowledges that exogenous factors, such as openness to trade or technological progress, may be conditioning the relationship between national development and regional disparities, making the KC divergence-convergence path less deterministic.

depends not only on each region's relative position within the national space, but also on the level of development of the national economy. In underdeveloped economies regional disparities are low, but they rise sharply as the process of national development kicks-off and economic activity concentrates in a few only areas to take advantage of scale and agglomeration economies, including the concentration of human capital and managerial skills. In later phases, as connectivity across space improves (e.g., through infrastructure investment or, in its new economic geography formulation, declining transportation costs) and congestion diseconomies start biting, new growth opportunities emerge in more peripheral regions and disparities start subsiding.[12]

Traditionally, the KC approach has been examined empirically by testing the relationship between national incomes and measures of regional disparity (typically the Gini coefficient or the Atkinson index) across international datasets (Barrios and Strobl, 2006; Ezcurra and Rapun, 2006; Francois and Rojas-Romagosa, 2008; Persyn and Algoed, 2009). It is possible, however, by tracing the implications of the KC hypothesis, to derive a relationship between national and regional incomes in a growth formulation. This exploits the interaction between the two arguments that condition growth in the KC story, i.e., the fact that whether the level of national development produces faster or slower growth in any given region is conditioned on that region's level of development (relative to the national). Inversely, that whether regions of a certain level of development grow faster than average is conditioned on the level of national development.

Since the KC relationship is hypothesised to be bell-shaped, we can depict it in a simple regional growth formulation as follows:

$$\Delta(y-l)_{i,t} = d_0 + d_1[(y-l)_{i,t-k}(y^N - n^N)_t] + d_2[(y-l)_{i,t-k}(y^N - n^N)_t^2] \qquad (4)$$

[12] Although the KC hypothesis describes, in the initial phases of development, a process of divergence which is cumulative, and thus consistent with the CC approach, the former assumes a strict deterministic path towards convergence which is missing in the latter. For CC, 'return to convergence' is neither deterministic nor inevitable –and it is not directly linked to the level of national development.

where $y^N – n^N$ is the log of national income (GDP per capita[13]) and $d_1>0$, $d_2<0$ to account for the fact that at low (high) levels of national development regional disparities rise (fall), i.e., that growth is first faster and then slower for the more developed regions.

Despite the similarity of the theoretical processes described by the KC and CC approaches (see footnote 11), it is in fact the NC model that relates more directly to this KC formulation. Starting from the simple NC model and assuming that the speed of convergence is a (quadratic) function of the national income[14], such that

$$b_{1t} = e_0 + e_1(y^N - n^N)_t + e_2(y^N - n^N)_t^2 \quad (5)$$

we obtain

$$\Delta(y-l)_{i,t} = b_0 + e_0(y-l)_{i,t-k} + e_1[(y-l)_{i,t-k}(y^N - n^N)_t] + e_2[(y-l)_{i,t-k}(y^N - n^N)_t^2] \quad (6)$$

which is equivalent to equation (4) for $d_1=e_1$, $d_2=e_2$ and $e_0=0$. There is one major difference, however, between these two models. In the KC version (eq.4), the regional variable of interest is relative, measured as the region's distance from the national level of labour productivity. In the NC-derived formulation (eq.6) this variable is instead specified in absolute terms, as the assumption is that the national level of development affects the speed of convergence and thus the elasticity of regional growth to (absolute) past levels of productivity.

---

[13] As national GDP experiences year-to-year fluctuations that are not reflective of (changes in) the level of national development, an alternative formulation of eq.4 could replace $y^N – n^N$ with a time-trend, *T*.

[14] This is motivated as follows. At early stages of national development new technologies are introduced unevenly in space and thus disparities rise; but as the national economy matures and new technologies diffuse across space, neoclassical convergence kicks-in. Thus, countries that are in more advanced (or in very early) stages of development should exhibit faster rates of regional convergence.

4. Empirical results

Informed by the models derived in the previous section, our empirical investigation seeks to unveil the extent to which different theoretical hypotheses and formulations are validated by the CEE experience of regional growth over the last two decades. For our analysis we use NUTS-3 level data on regional output (gross value added) and productivity growth derived from the Cambridge Econometrics database. We start by testing the NC model. As shown in Table 1, the convergence hypothesis is broadly validated by the data. Even without taking into account national differences in growth rates (first row), evidence of neoclassical convergence across the 190 CEE regions of our sample is obtained. In fact, country differences in growth rates, although significant (see the rise in explanatory power between the models in rows 1 and 2), affect only marginally the obtained speed of convergence (the coefficient drops from 9.2% to 9.0%). In contrast, the speed of convergence changes significantly (increasing by 2.5 times) when we account for temporal variations in growth rates, i.e., for the position of the CEE business cycle (third row). Additionally, when we condition regional growth rates on fixed regional characteristics (captured here by a set of regional fixed effects), the estimated speed of convergence increases further, especially when temporal controls are also included (rows 5 and 6, respectively). Thus, the evidence is consistent with both convergence processes: the CEE regions converge fast towards their own steady-states (conditional convergence), which are also convergent across space (unconditional convergence).

Table 1: Regional growth in CEE and neoclassical convergence

Model	Constant		Lagged productivity		R^2
	All regions	Top 25%	All regions	Top 25%	
Unconditional convergence					
Cross-country NC (OLS)	0.219*** (0.012)		-0.092*** (0.006)		0.062
Within-country NC (Country FEs)	0.379*** (0.018)		-0.090*** (0.006)		0.127
NC with common business cycle (Year FEs)	0.356*** (0.016)		-0.224*** (0.009)		0.161
Country-and-time independent (Country & Year FEs)	0.503*** (0.020)		-0.259*** (0.010)		0.237
Conditional convergence					
Conditional: on regional characteristics (Within FE)	0.645*** (0.021)		-0.313*** (0.011)		0.209
... add time dummies	0.960*** (0.031)		-0.413*** (0.012)		0.317
... and replace with 5-year lag	0.104*** (0.008)		-0.048*** (0.005)		0.096
Club convergence					
Club convergence: speed (includes C&Y FEs)	0.530*** (0.020)	-0.0004 (0.035)	-0.290*** (0.011)	0.040*** (0.015)	0.253
Club convergence: steady-state (includes C&Y FEs)	0.517*** (0.020)	0.0853*** (0.010)	-0.283*** (0.010)		0.251

Notes: Standard errors in parentheses. *, ** and *** show significance at the 10%, 5% and 1% levels, respectively.

This interpretation is challenged, however, when we replace lagged productivity with its 5-year lag (third row from bottom), to account for the fact that in data with year-to-year variation evidence of convergence (in the long-run) may be convoluted with evidence of mean reversal (in the short-run). This time the convergence coefficient is over eight times smaller than previously, suggesting that over longer time-horizons convergence is much slower and that much of the evidence on convergence is driven by short-run dynamics.[15] This is a first indication that the NC hypothesis may not be telling the full story about the CEE regional growth process of the last two decades. A first step to exploring this further is by examining evidence of club convergence. In the bottom panel of Table 1 we have interacted lagged productivity and the intercept with a dummy indicating membership into a group of

[15] We have also tested the convergence hypothesis using other time-lags, ranging between 2 and 10 years. For lags of 3 years or more the results are consistent with the pattern depicted by the 5-year lag.

high-productivity regions.[16] As can be seen, the interaction terms are statistically significant, thus suggesting some form of club convergence. When interacting club membership with lagged productivity (penultimate row of Table 1), our results suggest that high-productivity regions convergence more slowly to the steady-state (which, in this model appears to be common, as the club dummy is not significant statistically). When we allow for differences in steady-state growth but not in speeds of convergence (last row), the results provide strong evidence of differentiation, with steady-state productivity growth being over 15% higher for high-productivity regions compared with the rest.

Although this evidence in itself is not sufficient to allow for a conclusive interpretation, it appears that processes of divergence, polarisation and cumulative causation may well be in place. To explore this, we turn next to examining more formally the case of cumulative causation. Table 2 presents a selection of indicative results. We start with a very simple specification, which follows the Myrdalian argument of circular (self-reinforcing) growth, as discussed in the previous section. When productivity growth is regressed on its one-year lag without temporal or spatial controls, the lagged term is highly insignificant and the model has no explanatory power (R^2=0.0002; not shown). Controlling for temporal fixed-effects produces a circular causation effect which is highly significant statistically (at 1% – see column 1). Nevertheless, the fit of the regression remains disappointingly low and the estimated persistence coefficient is in economic terms trivial (3.8%). The results become significantly stronger, however, when we include temporal lags of a longer horizon (columns 2-5). The fit of the model increases and all lagged terms are significant irrespective of estimation method (OLS, DVLS, Within, or Arellano-Bond) and whether or not we include country and temporal dummies (columns 2 and 3), region-specific fixed effects (col.4) or controls for the possible autocorrelation between the fixed effects and the lagged regressors (col.5). Although the evidence is undoubtedly less than overwhelming, some support for the circular causation mechanism is nevertheless obtained.

[16] Results presented here concern a club defined as those regions whose productivity belonged to the top-25% of their national distribution of regional productivities in each and every of the 19 years of our sample. The results are very similar when we use alternative definitions: (a) as above, but using the median or the mean as the membership threshold; (b) as in (a) but with the condition applying to the majority of years (or alternatively to at least one year) rather than to all years; (c) as in (b) but with the reference value being the national productivity level of each particular year, rather than a point in the distribution of regional productivities across all years.

Table 2: Regional growth in CEE and processes of cumulative causation

Model	OLS	OLS	DVLS	Within	xtabond	OLS	DVLS	DVLS	DVLS	DVLS	OLS	DVLS	Within	DVLS	DVLS
Productivity growth t-1	0.0377	0.1490	0.1242	0.1041	0.0864									0.0472	0.0689
	(0.014)	(0.010)	(0.011)	(0.011)	(0.012)									(0.010)	(0.009)
Productivity growth t-2		0.0822	0.0590	0.0489	0.0409									0.0070#	
		(0.007)	(0.007)	(0.008)	(0.008)									(0.009)	
Productivity growth t-3		0.0255	0.0230	0.0143^	0.0092									-0.0448	
		(0.006)	(0.006)	(0.006)	(0.006)									(0.006)	
Output growth						0.8691	1.114		0.7058					0.7680	1.103
						(0.027)	(0.026)		(0.017)					(0.018)	(0.018)
Output growth t-1								0.0591	0.2341	0.1223				0.1398	
								(0.020)	(0.011)	(0.014)				(0.015)	
Output growth t-2									0.0786	0.0652				0.0049#	
									(0.006)	(0.008)				(0.012)	
Output growth t-3									0.0740	0.0660				0.1081	
									(0.006)	(0.008)				(0.011)	
Output density											0.0035#	0.0107	0.3382	-0.0044	-0.004^
											(0.003)	(0.003)	(0.021)	(0.001)	(0.002)
Fixed effects	Year	--	Year & Country	Year & Region	Year & Region	--	Year & Country	Year & Country	Year & Country	Year & Country	--	Year & Country	Year & Region	Year & Country	Year & Country
Constant	0.121	0.023	-0.002#	0.025	0.021	0.024	0.348	-0.170	-0.003#	0.006#	0.047	0.265	0.334	-0.031	0.221
	(0.013)	(0.001)	(0.006)	(0.005)	(0.005)	(0.003)	(0.015)	(0.015)	(0.005)	(0.006)	(0.005)	(0.020)	(0.031)	(0.005)	(0.011)
R-squared	0.051	0.100	0.175	0.091	.	0.236	0.406	0.105	0.490	0.193	0.000	0.091	0.142	0.515	0.594

Notes: Standard errors in parentheses. All coefficients are significant at the 1% level, unless otherwise stated. ^ shows significance at 5%; # shows lack of statistical significance (p-value>0.10). xtabond is the Arellano-Bond estimator for dynamic panel data.

Departing from what is essentially a simple test of persistence, in columns 6-10 of Table 2 we examine the Kaldorian specification. The obtained Verdoorn coefficient in col.6 is particularly high.[17] When we introduce controls for temporal and cross-country differences in growth rates the obtained estimate becomes even larger and the relationship becomes stronger, indicating clearly the presence of a cumulative causation mechanism relating to increasing returns. The self-reinforcing (cumulative) nature of this mechanism is confirmed in the regressions of columns 8-10, where it is shown that the relationship persists over time, with productivity growth being positively related to past output growth of at least up to three years ago, irrespective of when we control or not for the contemporaneous relation between the two aggregates.[18]

Evidence of cumulative growth due to increasing returns could of course be reflective of either a demand- or a supply-driven process, as discussed earlier. The Kaldorian formulation has been linked to demand-side processes, whereby market expansion drives technological adaptation and production efficiency (and thus growth – see Thirlwall, 1980; Angeriz et al, 2008). Evidence of increasing returns, however, could be consistent also with a supply-side story, where productivity growth is driven by agglomeration, and thus knowledge and technology diffusion, rather than by demand-induced scale effects. The regressions in columns 11-13 in Table 2 try to test for this, by making productivity growth a function of the density of output, following Ciccone and Hall (1996) and Angeriz et al (2008). As can be seen, output density, while not statistically significant in a simple OLS formulation, appears to be a significant contributor to productivity growth in better specified models. This holds especially true for deviations in the volume of output from its regional and year-specific average (col.13), with a 1% deviation resulting in a 0.34% rise in productivity growth.

[17] Previous estimates are in the area of 0.5, but are invariably derived from models where the dependent variable measures productivity growth in manufacturing. Our dependent variable here measures gross value added in all sectors. Further, in the absence of data on capital, it measures labour productivity growth than total factor productivity growth.

[18] Although not in a formal way, this also addresses the question of the direction of causality between output growth and productivity growth (see Dixon and Thirlwall, 1975; Angeriz et al, 2008), at least in its Granger-causality sense.

Overall, our exploration of the cumulative growth hypothesis has provided evidence in support of all alternative views on the process. In the last two columns of Table 2 we attempt to examine the relative validity of each of these, by estimating a model that nests all three interpretations. Despite concerns about definitional correlation among the regressors[19] the performance of the models is very good and the R^2 increases significantly, suggesting that each of the three nested models adds a distinctive piece of information into the analysis. The variables corresponding to the two traditional CC interpretations are both highly significant and have the correct signs. Of the two, the Kaldorian interpretation appears to produce stronger and more robust results, as the circular mechanism relating to the Myrdalian interpretation seems to die out quickly and even to reverse at t-3. In contrast, the agglomeration-economies interpretation returns a counter-intuitive result, with output density being negatively related to productivity growth. It thus appears that demand-driven cumulative growth, and to a lesser extent persistence, reflect more strongly the process of regional growth in our CEE sample. Controlling for such drivers, as well as for country and temporal fixed effects, wipes out completely any positive influence that agglomeration, and thus supply-side processes, may be exerting on productivity growth.

On balance, then, we see that both processes of convergence and of cumulative causation may be in operation. Although not directly deriving from these, the regional Kuznets Curve hypothesis may thus be particularly relevant in unveiling the conditions under which each of these processes dominates. In Table 3 we explore this, through a set of regressions that examine various specifications of eq.4 and its augmented version as given in eq.6. Starting from a simple OLS model (first column), it appears that the KC hypothesis is not validated by the data. The obtained

[19] On the right-hand-side we have GDP growth, GDP per hectare, and lags of the growth of GVA per worker. However, this does not seem to be a problem in the estimation. When we run the reduced form of the nested model (as depicted in eq.3) the area variable (corresponding to the density argument) was highly insignificant and statistically very different from the estimate obtained for the regional GDP variable (in the notation of eq.3, $c_{11}\neq-c_3$ and $c_3=0$); the coefficients for output and lagged output where not statistically different in absolute terms (so that $c_{11}=-c_{12}$, consistent with the Kaldorian formulation); while the coefficient for employment growth was statistically different from the elasticities found for output (i.e., $c_{12}\neq c_2$ – for the Myrdalian formulation equality should hold). Thus, the process described by the Kaldorian interpretation appeared to carry more weight, similar to our findings in Table 2.

coefficients have the correct signs but they are not statistically significant. Moreover, they remain not significantly different from zero when we add controls for temporal and country-specific fixed effects (results not shown). Nevertheless, the relationship becomes highly significant when we test a version of the conditional KC hypothesis (col.2), by adding region-specific fixed effects, thus controlling for time-invariant region-specific characteristics (such as location and, to a lesser extent, informal institutions, industrial structures, etc.). The validity of this effect, however, and its relevance to the KC hypothesis is weakened by the fact that when we replace the national level of development with a time-trend (col.3 – see also footnote 10), the derived pattern is reversed and the obtained estimates suggest a cumulative (exponential) process of divergence over time.[20]

Table 3: Regional growth in CEE: Kuznets curve and non-linear processes

Model	(1)	(2)	(3)	(4)	(5)	(6)
Past productivity (x) national income	0.050	0.114**	-0.027***	0.963***	-1.237***	0.222***
	(0.044)	(0.058)	(0.0085)	(0.293)	(0.093)	(0.045)
Past productivity (x) nat'l income squared	-0.016	-0.040***	0.001***	-0.173***	0.208***	-0.060***
	(0.012)	(0.015)	(0.0005)	(0.047)	(0.013)	(0.012)
Past productivity				-1.328***	1.212***	-0.220***
				(0.439)	(0.169)	(0.015)
Output growth						0.830***
						(0.033)
Fixed effects	--	Region	Year & Region	Year & Region	Year & Region	Year & Region
Nat'l development measured by	GDPpc	GDPpc	Time-trend	GDPpc	GDPpc	GDPpc
Past reg'l prod/vity measured in	Relative terms	Relative terms	Relative terms	Relative terms	Absolute terms	Relative if interacted
Constant	0.039***	0.029***	0.026	-0.106***	0.903***	0.482***
	(0.004)	(0.005)	(0.017)	(0.017)	(0.022)	(0.037)
R-squared	0.002	0.006	0.077	0.085	0.470	0.445

Notes: Standard errors in parentheses. *, ** and *** show significance at the 10%, 5% and 1% levels, respectively. Models including fixed effects have been estimated by the Within FE estimator.

In col.4 we revert to the country-specific measure of national development (GDPpc) and amend the model of col.2 to include the past level of relative productivity as an additional regressor. This tends to stabilise the results and maintain the bell-shaped

[20] The use of the time-trend as a measure of development imposes the assumption of a common development path across all CEECs. Clearly, our results suggest that relative regional growth and convergence/divergence dynamics have not been influenced by common developments in the CEE region but rather by country- and region-specific factors and characteristics.

relationship (which is now consistent across econometric specifications and for both definitions of development – GDPpc and time-trend). Nevertheless, despite the fact that the direct effect of past productivity (in relative-to-national terms) turns out to be inversely related to current growth, for within-sample values the KC process is not convergent: even for the highest national GDPpc value in our sample, poorer regions continue to grow at a slower pace (implying that national levels of development in CEE have not reached the threshold required for dispersion forces to become dominant). To examine whether this result captures simply a non-linearity in the NC process, rather than a genuine KC dynamic, in col.5 we test specifically the former, as specified in eq.6 (using past productivity measured in absolute terms). The results are radically different: for extremely (out-of-sample) low values of national development the model predicts divergence; while the speed of convergence first increases with the process of national development and then starts to decelerate, leading to a return to divergence for very high values of national development (but within the range of our sample values). Thus, based on the in-sample performance of the two models, it seems that the non-linear NC process provides a more accurate description of the data.

The last model of Table 3 (col.6), nests within it the simplest forms of all three competing interpretations of the regional growth process examined in this paper (KC: col.2 of Table 3; CC: col.7 of Table 2; and NC: row 6 of Table 1). As can be seen, in this model all three approaches are validated: evidence of a regional Kuznets Curve is clearly present (first two rows), as is evidence of neoclassical convergence (conditional on the other processes as well as on regional and temporal fixed effects) and of cumulative causation[21] (third and fourth rows, respectively). Still, despite being an amalgamation of the three approaches (and despite the obtained results being fully robust to the inclusion or exclusion of subsets of right-hand-side variables), this model does not produce a better fit than the augmented NC model of col.5. Importantly, this model outperforms all KC models presented in Table 3 (the

[21] Results reported correspond to the Kaldorian interpretation of cumulative causation. The results are qualitatively identical, however, when we replace the growth of output with a distributed lag structure of the dependent variable, to approximate the Myrdalian interpretation of circular causation.

latter explain persistently less than 10% of the regional and temporal variation of growth rates in our sample) as well as the original NC models presented in Table 1 (the obtained R^2 for the augmented NC model is 1.5 times higher than that of the conditional NC model in the sixth row of Table 1) and it is equally strong as the best-performing CC models of Table 2. We discuss the implications of these findings in the concluding section.

5. Conclusions

There are two key points of departure for the analysis in this paper. On the one hand, that owing to the 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 tools used for the analysis of these developments, as elsewhere in the literature, have been rather limiting, owing to the dominance, as a key analytical tool, of the NC hypothesis, which pays only rudimentary attention to processes of cumulative causation and national-regional interactions. To overcome this, in this paper we looked at three distinctive analytical traditions and tried to synthesise them in a model of regional growth that allows not only for convergence-divergence but also for cumulative and non-linear growth paths. We then engaged in an extensive econometric examination of the regional growth patterns in CEE seeking to unveil the relevance and applicability of the competing explanations in our data.

Our results provide evidence in support of all three processes (convergence, cumulative growth and a regional Kuznets curve), but on balance they seem to favour a hybrid explanation, which sees regional growth as a non-linear process which is dependent on the level of national development and produces aggregate divergence and polarisation at later stages of development despite instances and tendencies for convergence. This hybrid model is as suitable for describing the regional growth paths observed in CEE as are the processes of NC, CC and KC, combined. There is a very important implication stemming from this observation.

Despite prima facie evidence to the contrary (row 1 in Table 1), the regional growth process in CEE is not obeying the rule of convergence, either monotonically (neoclassical) or through a bell-curve (regional Kuznets curve). Rather, convergence dynamics, although present, are significantly swaddled by processes of cumulative causation (Table 2), especially in early and, later-on, in more advanced stages of national development (Table 3), where the importance of agglomeration and, importantly, demand-side market-size effects is increasingly heightened. As a result, through the process of national catch-up growth, and despite the tendency for mean-reversal, regional evolutions continue to be on the whole divergent, with a pattern of convergence at the middle- and lower-ends of the distribution and a slower tendency for club formation at the higher end, and thus overall an increasing trend of polarisation.

Interestingly, in a preliminary extension of the analysis presented here, we find that this process (as captured by the model of col.5 in Table 3) is not applicable with the same force and in the same manner to the case of the older member states of the EU. There, evidence of divergence is much weaker; and although the speed of convergence tends to decline with the level of national development, the relationship between past productivity and future growth remains strictly monotonic.[22] This raises the question as to whether the growth process of the CEE regions is qualitatively different to that of the regional economies of older, more advanced and more mature, capitalist economies. On the basis of the evidence reviewed in this paper, it seems justifiable to argue that this is the case.

Despite their spectacular growth in the pre-crisis period, the CEE economies are still in a phase of development and restructuring. Industrial and urban agglomerations are not fully developed while the main drivers of growth, until recently, have been of the kind that conceptually favours concentration and divergence: large volumes of locationally-selective foreign investments; fast credit expansion and consumption-driven growth, both of which tend to be higher in the large urban centres; and export-led specialisations in relatively few products and sectors, which typically rely

[22] Preliminary results can be made available upon request.

on fixed locational characteristics, including urbanisation and localisation economies. It appears that in this phase of development –and perhaps under the pressures for accelerated cross-national convergence emanating from the process of economic and political integration– regional evolutions in these countries became more disparate and cross-regional inequalities became more acute and more persistent. As our exploratory econometric investigation showed, these developments are driven by a mixture of convergence tendencies within specific clubs and a cumulative causation process more applicable to the more developed regions. Until now, the growth of their respective national economies has in fact intensified this cumulative force and the polarisation that it produces.

One question remains unanswered by our choice not to engage in a formal explanatory analysis in this work: namely, will further national development condense and reverse this process of polarisation and divergence; or is this process rather embedded in the institutions, economic-industrial structures and wider developmental models that these countries developed in the process of transition and EU accession, and thus less likely to change as the region converges to the income and development levels of the older EU member states? Further research is needed to address this question. But while the specific variables and factors that determine the absolute and relative growth performance of the regional economies of the CEE is indeed a matter for further research, it is hoped that the present analysis offers valuable insights into the structural dynamics that drive the sub-national growth process in the region.

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