Papers in Evolutionary Economic Geography

13.12

Related Variety and Regional Economic Growth in a Cross-Section of European Urban Regions

Frank van Oort, Stefan de Geus, Teodora Dogaru

Utrecht University
Urban & Regional research centre Utrecht

Related Variety and Regional Economic Growth in a Cross-Section of European Urban Regions

Frank van Oort, Stefan de Geus & Teodora Dogaru

Abstract

This paper introduces indicators of regional related variety and unrelated variety to conceptually overcome the current impasse in the specialisation-diversity debate in agglomeration economics. Although various country-level studies have been published on this conceptualisation in recent years, a pan-European test has until now been missing from the literature. A pan-European test is more interesting than country-level tests, as newly defined cohesion policies, smart-specialisation policies, place-based development strategies and competitiveness policies may be especially served by related and unrelated variety conceptualisations. We test empirically for the significance of variables based on these concepts, using a cross-sectional dataset for 205 European regions during the period 2000-2010. The results confirming our hypotheses are that related variety is significantly related to employment growth and that specialisation is significantly related to productivity growth. We do not find robust relationships that are hypothesised between unrelated variety and unemployment growth. Our analyses show that evolutionary economic geography and institutional and policy-based regional development may be integrated fruitfully at the European level.

1. Introduction

This paper focuses on agglomeration circumstances influencing economic growth across European urban regions. Empirical studies on agglomeration economies are characterised by a high diversity of approaches. Rosenthal and Strange (2004) present a brief review of papers focusing on urbanisation economies as advantages of cities applying to every firm or consumer. Noteworthy is that most early (pre-1990s) works on agglomeration simply used cities' population as a measure of agglomeration. These studies assume that the population elasticity of productivity is constant. Rosenthal and Strange (2004) conclude that this

literature has found relatively consistent evidence: doubling the population of a city increases productivity by 3-8%. Since the findings of Glaeser et al. (1992), it has become more commonplace to analyse growth variables using employment in cities, suggesting a relationship between agglomeration and economic growth and thereby introducing the possibility that increasing returns in an urban context operate in a dynamic, rather than static, context. Sector-specific localisation economies, stemming from input-output relations and firms' transport cost savings, human capital externalities and knowledge spill-overs, are generally offset against the general urbanisation economies defined earlier using conventional measurements. A large body of literature builds on this new conceptualisation of agglomeration economies, as reflected in three recent overviews and meta-studies. These studies show that the relation between agglomeration and growth is ambiguous and indecisive with regard to whether specialisation or diversity is facilitated by (sheer) urbanisation as context. The first goal of this paper is to take a step towards the concept of renewal as a possible way out of this currently seemingly locked-in debate and to introduce related and unrelated variety as concepts in the empirical modelling of growth across European regions. These concepts have until now been tested only at the country level in Europe[1], and no pan-European test has been provided due to data limitations. This paper provides a first pan-European test of these concepts.

The second goal of the paper is to contribute to the recent policy discussion on place-based or place-neutral development strategies in the European Union. This debate is highlighted in the context of a series of recent major policy reports: the place-neutral policies in the 2009 World Bank report (World Bank 2009) and the European place-based development strategies in the studies of Barca (2009) and Barca et al. (2012). As highlighted by Van Oort & Bosma (2013) and Barca et al (2012), place-neutral strategies rely on the agglomerative forces of the largest cities and metropolitan regions to attract talent and growth potential. Place-based development strategists claim that the polycentric nature of a set of smaller and medium-sized cities in Europe (often also called 'second-tier' cities), each with its own peculiar characteristics and specialisation in the activities to which it is best suited, creates fruitful urban variety, which optimises economic development. This perspective implies that medium-sized city-regions have not declined in importance relative to larger urban ones, a proposition that has indeed been indicated in monitoring publications by the OECD (2009, 2011, 2012).

[1] See also Frenken et al (2007) for The Netherlands, Bishop et al (2010) for a study in Great Britain, Boschma and Iammarino (2009) and Quatraro (2010) for studies in Italy and Boschma et al (2011) for Spain.

Until now, however, there has been little empirical support for explanations based on the concepts of related and unrelated variety and sectoral specialisation.

For our empirical testing, we use a fairly standardised setup entailing the cross-sectional modelling of agglomeration externalities and economic growth (employment growth and productivity growth between 2000 and 2010) that distinguishes among various drivers of localised growth processes. In line with Dogaru et al (2011), we show that this type of modelling is informative for competitive and cohesive growth policies in the European Union, especially those with a focus on the role of (polycentric) medium-sized urban regions.

This paper is structured as follows. Section 2 introduces the current locked-in debate on specialisation versus diversity dominance in agglomeration economics. This section shows that the dominance of neither concept can be established and that conceptual renewal is needed to move past this controversy. Section 3 introduces related and unrelated variety as such a conceptual renewal to act in empirical modelling instead of generalised indicators for urbanisation economies that have usually been applied in modelling. This section ends with three hypotheses concerning the effects of related variety, unrelated variety and sectoral specialisation on regional economic development. A fourth hypothesis is formulated based on the polycentric nature of (smaller and medium-sized) European regions in relation to economic development. Section 4 introduces the data and variables used in our regional cross-sectional growth models. Section 5 presents our modelling outcomes for regional employment growth, productivity growth and unemployment growth for the period 2000-2010. Section 6 concludes and directly addresses the four hypotheses and the issues of polycentricism and place-based development strategies.

2. Agglomeration economies between specialisation and diversity

Agglomeration economies in relation to urban and regional growth are receiving attention in an ever-burgeoning literature on its causes, magnitude and (policy) consequences. This rise of agglomeration economies in economic and geographical studies has met much criticism (McCann and Van Oort 2009). Some observers have argued that the modern treatment of agglomeration economies and regional growth in fact represents a rediscovery by economists of well-rehearsed concepts and ideas with a long pedigree in economic geography. Several criticisms of the monopolistic modelling logic underpinning New Economic Geography have come from economic geography schools of thought and from both orthodox and heterodox

schools of economics. Conversely, advocates of relatively new economic approaches, such as institutional economics and evolutionary economic geography, argue that their analyses do provide insights into spatial economic phenomena that were previously unattainable under existing analytical frameworks and toolkits.

A prime example of potential gains of different theories and conceptual frameworks is the specialisation-diversity debate in the urban economics and economic geography literatures. Should regions and cities specialise in certain products or technologies to locally gain from economies of scale (in so-called clusters), shared labour markets and input-output relations, or should regions diversify over various products and industries and hence have both growth opportunities from inter-industry spill-overs as well as portfolio advantages that hedge a regional economy in times of economic turmoil? This question has captured the attention of many researchers over the last two decades (Beaudry and Schiffauerova 2009), following papers by Gleaser et al. (1992) and Henderson et al. (1995) that, respectively, advocate sectoral diversity and specialisation as the main economic-geographic circumstance propagating growth. The dichotomy specialisation-diversity has ever since been treated as a rather strict division – many studies try to find the definitive answer to the question "Who is right: Marshall or Jacobs?". Although practically every study conducted in the framework tries to conclude that either specialisation or diversity is a driver of growth and innovation, the studies by Van Oort (2004), Paci and Usai (1999), Neffke et al. (2011) Shefer and Frenkel (1998), Duranton and Puga (2000) and O'Hualloachain and Lee (2011) prove that this is in fact not an "either-or" question, finding that both specialisation and diversity matter for regional economic performance – on different geographical levels, for different time periods, over the industry life-cycle and in different institutional settings.

That the specialisation-diversity issue is not an "either-or" question has now been concluded by two meta-studies and an extensive overview of all published empirical analyses on this matter (De Groot et al. 2009, Melo et al. 2009, Beaudry and Schiffauerova 2009). From these three overviews, it becomes clear that the specialisation-diversity debate appears to become an unproductive line of argument in addressing the nature, magnitude and determinants of agglomeration externalities. The answer to the "either-or" diversity-specialisation question is at best inconclusive, with outcomes being dependent on measurement in many respects (e.g., scale, composition, context, period, type of performance indicators). Aside from these methodological issues, the many tests provided do not actually measure knowledge transfer or knowledge spill-overs (Van Oort & Lambooy 2013) – one of the main mechanisms supposed

to drive agglomeration economies. Finally, theoretically the debate focuses on the old theory of agglomeration as introduced by Marshall (1890) and does not use insights from newly developed theoretical models and conceptualisations in evolutionary and institutional geographical approaches.

3. Conceptual renewal and hypotheses: related and unrelated variety, specialisation and place-based development

The divergence observed in the literature concerning diversification and specialisation, in addition to the observed differences in measurements of classifications and methodological issues, is most likely related to the weak conceptualisation and limited theoretical underpinning of the concepts. New theoretical developments in institutional and evolutionary economic geography have recently emerged, offering heterodox economic explanations for the regional economic development and the role of relatedness and diversification (Boschma and Martin 2010). For economic geographers, as well as institutional and evolutionary economists working in this tradition, cultural and cognitive proximity are deemed to be equally as important as geographical proximity in the transmission of ideas and knowledge (Boschma 2005). Boschma and Lambooy (1999) further argue that the generation of local externalities are also crucially linked to the importance of variety and selection in terms of the 'fitness' of a local milieu. The now-burgeoning tradition in evolutionary economic geography has prompted the question of whether concepts of diversification and specialisation may fully capture the complex role of variety within the capitalist economy. This development has led to a recent revival of interest in the role of specific forms of variety, specifically related and unrelated variety (Frenken et al. 2007). Jacobs (1969) initiated the idea that the variety of a region's industry or technological base may affect economic growth. Frenken et al. (2007) state that variety and diversification consist of related and unrelated variety, arguing that not simply the presence of different technological or industrial sectors will trigger positive results but that sectors require complementarities that exist in terms of shared competences. This need induces a distinction in related and unrelated variety because knowledge spill-overs will not transfer to all different industries evenly, due to the varying cognitive distances between each pair of industries. It is argued that industries are more highly related when they are closer to each other within the SIC classification system. Frenken et al. (2007) find that for Dutch urban regions, the positive results of knowledge spill-overs are higher in regions with related variety, whereas regions characterised by unrelated variety are better hedged for economic

shocks (portfolio effect). The authors also find marked differences between employment growth and productivity growth. An interesting theoretical contribution to the specialisation-variety debate that focuses on these explained variables has been provided by lifecycle theory, which holds that industry evolution is characterised by product innovation (and more employment growth) in a first stage and process innovation (and more productivity growth) in a second stage. This distinction does not imply that product innovation occurs exclusively at the time of birth of a new industry, with process innovation only occurring thereafter. Rather, product lifecycle theory assumes that product innovation peaks before process innovation peaks. In accordance with the economics of agglomeration, evolutionary economists also stress the important role of variety in creating new varieties. In other words, Jacobs' externalities are assumed to play an important role in urban areas in creating new varieties, new sectors and employment growth. When firms survive and become mature, they tend to standardise production and become more capital-intensive and productive.

This background leads to three hypotheses on the relation between specialisation, variety and economic development in regions:

Hypothesis 1: Urban regions with a sector structure of *related variety* experience an increased rate of product innovation, co-evolving with higher *employment* in the short run and with both higher employment and higher productivity in the long run. We summarise this hypothesis as follows to create a testable version for this paper: *In the short run, employment growth is positively related to related variety and negatively related to specialisation.*

Hypothesis 2: Regions with a sector structure of *unrelated variety* experience fewer job losses from asymmetric shocks, which leads to *lower unemployment.* This phenomenon is more pronounced in the long run than in the short run. We summarise this hypothesis as follows to create a testable version for this paper: *In the short run, labour productivity growth is positively related to specialisation.*

Hypothesis 3: Regions with a sector structure of *specialisation* experience an increased rate of process innovation and reduced production costs, which leads to higher *productivity*. This phenomenon is more pronounced in the short run than in the long run. To the extent that process innovation is labour saving, it will lead to lower employment in both the short and long runs. We summarise this hypothesis as follows to create a testable version for this paper: *In the short run, unemployment growth is negatively related to unrelated variety.*

A fourth hypothesis relates the agglomeration concepts to urban size and structure. In Europe, the character of urban regions is fundamentally different from that of urban regions in other parts of the world (such as the US and Asia). It is exactly this urban structure that has fuelled the recent place-based versus place-neutral development debate. Barca et al. (2012) and Van Oort & Bosma (2013) summarise the place- and people-based policy debate in the European context in detail. Based on current economic geographical theories of innovation and the density of skills and human capital in cities, globalisation, and endogenous growth through urban learning opportunities, spatially blind approaches argue that intervention, regardless of context, is the best way to resolve the old dilemma of whether development should be about "places" or "people" (Barca et al. 2012, p. 140). It is argued that agglomeration in combination with encouraging people's mobility not only allows individuals to live where they expect to be better off but also increases individual incomes, productivity, knowledge, and aggregate growth (World Bank 2009). Consequently, development intervention should be space-neutral, and factors should be encouraged to move to where they are most productive. In reality, this phenomenon occurs primarily in large cities. In contrast, the place-based approach assumes that the interactions between institutions and geography are critical for development, and many of the clues for development policy lie in these interactions. Investigating the interactions between institutions and geography to understand the likely impacts of a policy requires the explicit consideration of the specifics of the local and regional contexts (Barca et al. 2012, p.140). The various forms that proximity may take in networks (e.g., physical, social, technological and institutional) are important in this respect.

According to place-based development strategists, economic growth is not uniquely related to mega-city regions (Barca et al. 2012). Instead, growth may be distributed across various urban systems in different ways in different countries (OECD 2009, 2011). The place-based approach's emphasis on interactions between institutions and economic geography has allowed for the examination of urban development in European cities of *all* sizes. Because the roles of very large and small communities have been addressed extensively in the literature, Barca et al (2012) emphasise the simultaneous role of medium-sized ('second tier') cities and argue that these are over-represented in Europe. Many highly productive cities in the EU are indeed small- to medium-sized cities whose dominant competitive advantage is that they exhibit high degrees of connectivity compared to urban or home market scales. This phenomenon leads to the formulation of our fourth hypothesis:

Hypothesis 4: *Agglomeration externalities are related to economic performance in all urban sizes of regions in Europe, where medium-sized regions exhibit growth opportunities because of their polycentric character.*

4 Data and variables used in empirical analysis

Our empirical analysis will test the relationship between productivity growth and employment growth in distinctive large, capital regions in Europe on the one hand and more polycentric medium-sized and small urban regions on the other, controlling for other important factors, and will make conclusions on the place-based policy implications suggested in the recent policy discourse. To test our hypotheses, we conduct an empirical analysis on growth differentials over 205 European NUTS2 regions in 15 EU countries[2] between 2000 and 2010, focusing on different urban sizes.

Measuring diversification over sectors in regional economies is sensitive to the indicator applied. In our empirical analysis, we apply an entropy measure (see Frenken et al 2007 for a detailed discussion). Because it is decomposable, this measure provides a straightforward indicator of variety. In the context of measuring regional variety to analyse the effects on growth, decomposition is informative, as one expects entropy/variety at a high level of sector aggregation to have a portfolio effect on the regional economy, protecting it from unemployment, whereas one expects entropy/variety at a low level of sector aggregation to generate knowledge spill-overs and employment growth. Put differently, entropy at a high level of sector aggregation measures unrelated variety, whereas entropy at a low level of sector aggregation measures related variety. We use geo-coded AMADEUS micro data (provided by Bureau van Dijk) on European firms aggregated into European NUTS2 regions as a source for the calculation of related and unrelated variety. Because small firms are underrepresented in this database, firm level data are weighted by turnover values. This approach allows us to best capture the large and sectorally heterogeneous regional economy. Marginal variety may be computed at all four-digit SIC levels in the dataset, indicating an increase in variety when moving from one digit level to the next. Because the marginal entropy levels at the three- and four-digit levels are correlated strongly, we chose to compute the marginal increase when moving from the one-digit level to the four-digit level. We label this variety indicator as *related variety*, as opposed to the two-digit level entropy, which we

[2] Belgium, Denmark, Finland, France, Ireland, Italy, Portugal, the Netherlands, Spain, Sweden, the United Kingdom, the Czech Republic, Hungary, Poland, and Slovakia.

associate with *unrelated variety*. We will include both types of variety to test whether related variety and unrelated variety have different effects.

The maps of related and unrelated variety in European regions are provided in figures 1 and 2, which present two different regional patterns for related variety (two-digit variety) and unrelated variety (marginal increase in entropy when moving from one- to four-digit differences). As the maps clearly show, variety at high levels of aggregation shows little resemblance with variety at low levels, which strongly suggests that the choice of sector aggregation is not trivial.

Figure 1: Related variety across European regions

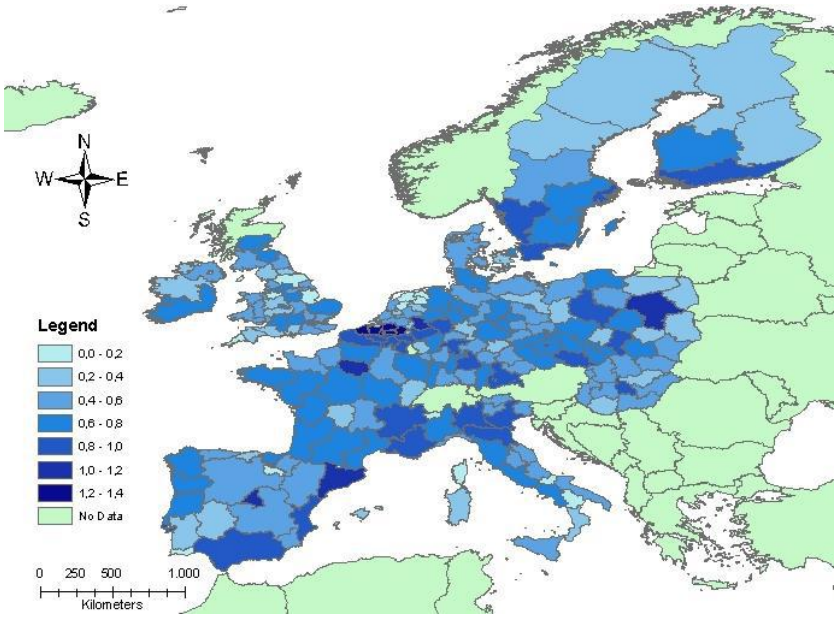
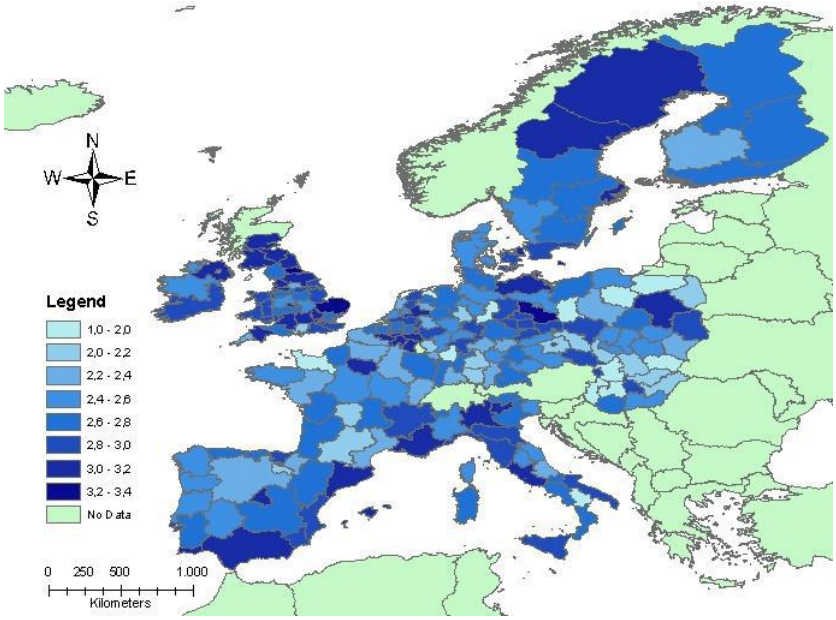


Figure 2: Unrelated variety across European regions



Employment and labour productivity (output per employee) data were obtained from the Cambridge Econometrics statistical database on European regions. We obtained data from this dataset for the years 2000 and 2010. Productivity growth and employment growth are defined as $\ln(emp_{2010}/emp_{2000})$ and $\ln(prod_{2010}/prod_{2000})$ to normalise their distributions.

Localisation economies, measured in 2000 for endogeneity reasons, are associated with the concentration of a particular sector in a region. This type of economy is often captured using specialisation indicators. The degree of regional specialisation in our models is measured using the Theil index over the location quotients of production in 59 products, including agriculture, manufacturing and services. This unique dataset has been collected by the Netherlands Environmental Assessment Agency (PBL) and is based on regionalised production and trade data for European nuts2 regions, 14 sectors, and 59 product categories (compare Combes & Overman 2004). Location quotients measure the relative specialisation of a region in a certain sector as the percentage of employment accounted for by a sector in a region relative to the percentage of employment accounted for by that sector in Europe as a whole. This quotient measures whether a sector is over- or underrepresented in a region compared with its average representation in a larger area and thus is to comprise localisation or specialisation economies of agglomeration. The Theil coefficient then measures deviations from the European average distribution of employment specialisations in all sectors. A high score represents a large degree of sectoral specialisation in a region, and a low score

represents sectoral diversity. In the largest national economies of Germany, France and the United Kingdom, regions have high levels of sectoral diversity (all regions contain most of the existing sectors, including services). Eastern European regions in Poland, Slovakia, the Czech Republic and Hungary are relatively specialised, as are Scandinavian and Irish regions. These regions lack concentrations of certain activities, e.g., specific types of services, manufacturing, distribution or agricultural activities. A group of medium-sized economies, such as the Netherlands, Belgium, Denmark, Italy, Portugal and Spain, show moderate levels of specialisation.

To test and control for either convergence or divergence, both productivity and employment growth in the period 2000-2010 are, respectively, related to the productivity and employment levels in 2000. These relations are hypothesised to be negative (convergence). All other explanatory variables in our models for employment and productivity growth are also measured for the year 2000 because of endogeneity reasons. The circumstances shown in 2000 may cause subsequent growth in the period 2000-2010, but those shown in 2010 cannot. *Investments in private and public research and development (R&D)* are calculated as percentages of GDP from Eurostat statistics. These investments in innovation are generally believed to be positively related to economic growth (Moreno et al 2006). Private R&D investments occur mainly in regions with larger multinational enterprises. Public R&D is more highly related to regions with technological universities and regions where universities and firms ally.

The *degree of economic openness* of European regions is calculated as the total value of imports and exports in a region divided by the region's GDP. This indicator for the volume of trade is based on a make-and-use table (IO-table) for 2000 at the nuts2 level concerning 14 sectors and 59 product categories, including services. This dataset is developed by the Netherlands Environmental Assessment Agency (PBL). The volume of trade increases with the size of the region at a declining rate and is strongly dependent on global economic development with competition in global markets, driving up productivity and attracting new investments and collaborations. High potential may also spill over to nearby regions or in the regional network of specialised and subcontracting industries and regions. *Density* (measured as population density) measures whether agglomeration (economic size) plays a role in economic growth. This dimension of agglomeration is related not to localisation economies (specialisation) and diversity economies but to pure urban size effects (Frenken et al. 2007).

In general, the literature suggests that higher density enables better interaction, enhancing growth (Puga 2002).

We measured the *average educational level* of regions by the percentage of the tertiary and higher educated population within the total population. The relationship of education with (employment and productivity) growth is thought to be positive, as more highly skilled people can be more productive, and agglomeration may attract more of these people. Remarkably low scores on this indicator are found in eastern European regions and Italian regions. The regional *wage level*, as an indicator of personal income, is hypothesised to be positively related to growth. The wage level variable is highly correlated with GDP per capita as an indicator. Higher wage levels and productivity levels are also highly correlated. In the productivity growth models, the wage level is thus excluded from the analysis (and the productivity level is included). *Market potential* is measured by a gravity equation on production in all regions, corrected for distances. Finally, a dummy variable is introduced into the models for large and capital regions opposed to medium-sized and smaller regions. The degree of urbanisation over the 205 regions is determined by the distribution of classes distinguished in OECD (2012, 2013) comprising large and capital regions (at least 3 million inhabitants), medium-sized regions (between 1.5 and 3 million inhabitants) and small regions (fewer than 1.5 million inhabitants). Although this distinction differs from the one originally presented for all cities in the world in OECD (2012, 2013), these cut-off points yield a distribution for the European regional classification adopted in this paper that is comparable to the OECD distribution on a global scale. In our analysis, large and capital regions are categorised within the large urban regime, and small- and medium-sized regions are categorised within the medium-sized urban regime.

To avoid multicollinearity in our models, we tested for high correlations among these explanatory variables, and we analysed variance inflation factors for each variable added to the models. None of the correlations is disturbingly high. As previous research has shown that spatial dependence between proximate regions in Europe is an important source for divergent growth opportunities in productivity and employment (Le Gallo et al 2011), we will control for this finding in our analyses by introducing ML estimation, which includes spatial lags, using inverse distance weighting matrices[3].

[3] Squared inverse distance weights are not better for capturing the spatial dependence in our models for productivity growth and employment growth.

5. Modelling outcomes

This section discusses modelling outcomes presented in Tables 1, 2 and 3 for employment growth, productivity growth and unemployment growth, respectively. The models are constructed in similar ways, starting with an OLS model, then moving to a ML spatial-lag model that corrects for spatial dependence (the spatial lag variable is denoted as w_growth in the Tables), and finally moving into a ML-spatial lag model that decomposes the observation into the following two regimes, which are estimated simultaneously and which we wish to use to test our hypotheses: the regime of large and capital regions and the regime of medium-sized and smaller regions. The model fit usually increases over these successive modelling steps, the significance of spatial regimes are indicated by the outcomes of a spatial Chow-Wald test, and variables that significantly differ from each other over regimes are presented in boxes in the tables. Due to space limitations, we focus on our four hypotheses in our discussion of the outcomes. Hypothesis 1 links related variety to employment growth positively and to specialisation negatively. Table 1 shows that that this hypothesis is confirmed in the OLS model (1) and the spatial lag models (2) and (3). The regime analysis in column (4) shows that this relationship particularly holds true for medium-sized and smaller regions and not for larger capital regions. Hypothesis 2 positively linked specialisation to productivity growth. Table 2 confirms this for all models and all regimes applied, indicating that this relation is very robust.

Table 1: modelling outcomes for employment growth 2000-2010

Explanatory Variables	(1) OLS Model		(2) Spatial Lag Model W_1		(3) Spatial Lag Model W_2		(4) Regimes' Urban Size: Small- & Medium-Sized		(4) Regimes' Urban Size: Large & Capital Regions	
(Constant)	0,3	*0,216*	0,303	*0,189*	0,312	*0,164*	0,706	*0,212*	-0,146	*0,536*
Employment 2000	-0,025	*0,013*	-0,028	*0,011*	-0,027	*0,01*	-0,038	*0,011*	0,03	*0,046*
Private R&D	-0,005	*0,006*	-0,003	*0,005*	0	*0,005*	0	*0,005*	-0,01	*0,025*
Public R&D	-0,006	*0,006*	-0,003	*0,005*	0	*0,005*	0,002	*0,005*	-0,017	*0,017*
Openness Economy	0,052	*0,017*	0,048	*0,015*	0,032	*0,013*	0,024	*0,014*	0,065	*0,063*
Market Potential	-0,092	*0,021*	-0,069	*0,018*	-0,047	*0,016*	-0,05	*0,017*	-0,043	*0,06*
Education	0,024	*0,015*	0,02	*0,013*	0,012	*0,011*	0,01	*0,011*	0,035	*0,07*
Population Density	0,005	*0,006*	0,005	*0,005*	0,005	*0,005*	0,008	*0,005*	-0,019	*0,021*
Wages	0,043	*0,011*	0,03	*0,01*	0,017	*0,009*	0,014	*0,009*	0,008	*0,033*
Related Variety	0,078	*0,04*	0,088	*0,035*	0,084	*0,03*	0,108	*0,033*	-0,069	*0,12*
Unrelated Variety	0,035	*0,015*	0,029	*0,013*	0,024	*0,011*	0,018	*0,011*	0,068	*0,084*
Specialisation	-0,368	*0,12*	-0,274	*0,105*	-0,194	*0,091*	-0,244	*0,096*	-0,217	*0,37*
W_Employment Growth			0,95	*0,035*	0,919	*0,041*		0,924	*0,039*	
Summary Statistics:										
N	205		205		205			205		
R^2	0,265		0,291		0,402			0,447		
Chow-Wald	-		-		-			18,6	*0,1*	
BP (heteroskedasticity)			42,002	*0*	45,915	*0*		3,565	*0,059*	
LR (spatial lag)			37,583	*0*	80,966	*0*		83,4	*0*	
LM (spatial error)			48,364	*0*	2,484	*0,115*		1,042	*0,307*	

Coefficients and t-values; darker red and green indicate higher significance.

Table 2: modelling outcomes for productivity growth 2000-2010

	(1) OLS Model		(2) Spatial Lag Model W_1		(3) Spatial Lag Model W_2		(4) Regimes' Urban Size: Small- & Medium-Sized		(4) Regimes' Urban Size: Large & Capital Regions	
(Constant)	0,463	*0,167*	0,048	*0,14*	-0,036	*0,121*	-0,23	*0,123*	-1,156	*0,392*
Productivity 2000	-0,223	*0,018*	-0,168	*0,015*	-0,092	*0,014*	-0,102	*0,013*	-0,153	*0,058*
Private R&D	0,024	*0,005*	0,017	*0,004*	0,007	*0,004*	0,01	*0,003*	-0,029	*0,025*
Public R&D	-0,006	*0,005*	-0,005	*0,004*	-0,001	*0,004*	-0,004	*0,003*	0,035	*0,012*
Openness Economy	-0,032	*0,016*	-0,025	*0,013*	-0,022	*0,011*	-0,041	*0,01*	0,035	*0,036*
Market Potential	0,079	*0,018*	0,075	*0,015*	0,055	*0,013*	0,048	*0,012*	0,12	*0,033*
Education	0,066	*0,012*	0,054	*0,01*	0,03	*0,009*	0,026	*0,008*	0,099	*0,05*
Population Density	-0,003	*0,005*	-0,004	*0,004*	-0,004	*0,004*	-0,002	*0,004*	-0,037	*0,013*
Wages	0,007	*0,014*	0,008	*0,012*	0,004	*0,01*	0,009	*0,009*	0,026	*0,049*
Related Variety	-0,028	*0,021*	-0,026	*0,018*	-0,018	*0,015*	-0,025	*0,014*	-0,095	*0,079*
Unrelated Variety	0,005	*0,013*	0,004	*0,011*	0	*0,009*	-0,01	*0,008*	0,094	*0,071*
Specialisation	0,56	*0,103*	0,414	*0,086*	0,268	*0,074*	0,188	*0,068*	0,965	*0,26*
W_Productivity Growth			0,96	*0,027*	0,899	*0,043*		0,89	*0,043*	
Summary Statistics:										
N	205		205		205			205		
R^2	0,759		0,781		0,837			0,887		
	-		-		-			85,8	*0*	
BP (heteroskedasticity)			55,01	*0*	78,453	*0*		0,033	*0,857*	
LR (spatial lag)			57,061	*0*	113,714	*0*		127,6	*0*	
LM (spatial error)			39,49	*0*	0,051	*0,821*		0,742	*0,389*	

Table 3: modelling outcomes for unemployment growth 2000-2010

	(1)		(2)		(3)		(3) Regimes' Urban Size			
	OLS Model		Spatial Lag Model W_1		Spatial Lag Model W_2		Small- & Medium-Sized		Large & Capital Regions	
Explanatory Variables										
(Constant)	1,289	*1,069*	1,536	*0,847*	1,393	*0,788*	2,517	*0,84*	-1,119	*2,12*
Unemployment 2000	-0,561	*0,034*	-0,453	*0,027*	-0,371	*0,03*	-0,385	*0,029*	-0,072	*0,103*
Private R&D	-0,105	*0,035*	-0,076	*0,028*	-0,053	*0,026*	-0,047	*0,025*	0,494	*0,138*
Public R&D	-0,032	*0,033*	0,008	*0,026*	0,008	*0,025*	0,031	*0,024*	-0,124	*0,09*
Openness Economy	0,5	*0,099*	0,517	*0,078*	0,428	*0,073*	0,413	*0,071*	1,039	*0,282*
Market Potential	-0,592	*0,114*	-0,43	*0,09*	-0,324	*0,086*	-0,367	*0,09*	-0,564	*0,257*
Education	-0,064	*0,081*	-0,129	*0,064*	-0,118	*0,06*	-0,164	*0,058*	-0,426	*0,346*
Population Density	0,083	*0,033*	0,042	*0,026*	0,034	*0,025*	0,012	*0,027*	0,259	*0,094*
Wages	0,225	*0,065*	0,124	*0,052*	0,078	*0,049*	0,027	*0,048*	0,447	*0,171*
Related Variety	0,138	*0,137*	0,206	*0,109*	0,191	*0,102*	0,229	*0,101*	-0,476	*0,48*
Unrelated Variety	0,134	*0,084*	0,051	*0,067*	-0,006	*0,063*	0,003	*0,059*	0,936	*0,44*
Specialisation	-4,238	*0,666*	-3,101	*0,528*	-2,305	*0,501*	-2,953	*0,502*	-3,224	*1,928*
W_Unemployment Growth			0,961	*0,027*	0,758	*0,058*	0,767	*0,056*		
Summary Statistics:										
N	205		205		205		205			
R^2	0,717		0,766		0,814		0,844			
Chow-Wald	-		-		-		40,6	*0*		
BP (heteroskedasticity)			24,087	*0,012*	23,267	*0,016*	0,016	*0,899*		
LR (spatial lag)			77,163	*0*	101,389	*0*	107,3	*0*		
LM (spatial error)			21,683	*0*	1,992	*0,158*	5,239	*0,022*		

Coefficients and t-values; darker red and green indicate higher significance.

The regime analysis shows that large urban and capital regions feature a stronger relationship between specialisation and productivity growth compared to medium-sized regions. The third hypothesis proposes that unemployment growth is negatively related to unrelated variety (portfolio argument). The findings presented in table 3 indicate that this hypothesis is rejected for all specifications. The reasons for this finding may be diverging national regulations and institutions in Europe, which cause national regimes to exist across the continent. This finding also indicates that for this variable, pan-European relations highly diverge from those found at individual country levels. Our fourth hypothesis, stating that regions of all sizes are involved in growth accounting, is confirmed. Employment growth is more naturally suited in medium-sized regions, whereas productivity growth is enabled by specialisation patterns in both large and medium-sized regions (with a higher coefficient being found in large urban regions).

6. Conclusions and discussion

This paper introduces indicators of regional related variety and unrelated variety to conceptually overcome the current impasse in the specialisation-diversity debate in

agglomeration economics. Although various country-level studies have been introduced on this conceptualisation in recent years, a pan-European test has until now been missing from the literature. A pan-European test is more interesting than country-level tests, as newly defined cohesion policies, smart-specialisation policies, place-based development strategies and policies aimed at fostering competitiveness may be served particularly well by related and unrelated variety conceptualisations.

We empirically investigated the contribution of agglomeration economies to economic growth in European regions while separating regions by size. A conceptual discussion on development burgeons between, on the one hand, spatially blind approaches that argue that intervention regardless of context ("people-based policy") is the best means of development and, on the other hand, place-based approaches that assume that interactions between institutions and geography are more critical for this purpose. This idea has recently been translated into a focus on either the largest urban concentrations ("people-based policies") or an urban network setting combining clusters of cities ("place-based policies"). Our framework combining productivity growth and employment growth shows that spatial regimes classified by the regional size of urban areas differ significantly in both sets of models, confirming their *joint* significance. In medium-sized urban regions private R&D and specialisation levels (inter alia) are especially important in relation to productivity growth, and sectoral specialisation (negatively), related variety and the openness of the economy (inter alia) are especially important in relation to employment growth. In large urban regions, population density (negative), educational level, public R&D and the degree of specialisation (inter alia) are relatively more important for productivity growth. The outcomes of these analyses suggest particular roles in development processes for medium-sized ('second-tier') urban regions *alongside* the largest urban regions. This marked regional heterogeneity indicates that micro-economic processes play out differently in different regions, thereby confirming that European place-based policy strategies may play an important role for regional development alongside place-neutral (people-based) policy strategies. However, this heterogeneity also suggests that, similar to European regional innovation patterns, which are differentiated among regions according to their regional context conditions (Camagni & Capello 2013), regional heterogeneity and inter-regional network positions support the careful consideration of how 'smart specialisation' is evaluated in Europe (Thissen et al 2013).

The hypothesised relationship between unemployment growth and unrelated variety is not confirmed in our first pan-European exercise. This finding suggests that national regulations

and institutions in Europe cause the pan-European model to deviate from national models. More research is needed on this issue. In addition, future work should pay more attention to causality (i.e., whether variety induces development or whether developing regions create more variety), panel estimation to ensure the robustness of the relations found, the testing of other types of spatial heterogeneity (e.g., cohesion regions versus core regions, or university regions versus non-university regions), and continuous space modelling of firm-level data to avoid spatial scale and selection processes. Recall that our analyses (also) do not address many of the critiques formulated in the meta-analyses on measurement and selection issues. This paper does show that conceptual renewal may represent a fruitful and exciting way to advance the debate on agglomeration and spatial heterogeneity in light of European reforms and policy formulations.

References:

Barca, F. (2009) *An agenda for a reformed cohesion policy: a place-based approach to meeting European Union challenges and expectations* Report for the European Commission, Brussels.

Barca, F., McCann, P. & Rodriguez-Pose, A. (2012) 'The case for regional development intervention: place-based versus place-neutral approaches'. *Journal of Regional Science* 52: 134-152.

Beaudry, C. & A. Schiffauerova (2009), 'Who's right, Marshall or Jacobs? The localization versus urbanization debate'. *Research Policy* 38: 318-337.

Bishop, P. & P. Gripaios (2010) 'Spatial externalities, relatedness and sector employment growth in Great Britain'. *Regional Studies* 44: 443-454.

Boschma, R.A. (2005), 'Proximity and innovation: a critical assessment'. *Regional Studies* 39: 61-74.

Boschma, R.A. & J.G. Lambooy (1999), 'Evolutionary economics and economic geography'. *Journal of Evolutionary Economics* 9: 411-429.

Boschma, R.A. & S. Iammarino (2009), 'Related variety, trade linkages, and regional growth in Italy'. *Economic Geography* 85: 289-311.

Boschma, R.A. & R. Martin (2010), *The handbook of evolutionary economic geography*. Cheltenham: Edward Elgar.

Boschma, R., A. Minondo & M. Navarro (2012), 'Related variety and economic growth in Spain'. *Papers in Regional Science* 91: 241-256.

Camagni, R. & R. Capello (2013), 'Regional innovation patterns and the EU regional policy reform: towards smart innovation policies'. *Growth and Change* 44: 355-389.

De Groot, H.F.L., J. Poot & M.J. Smit (2009), 'Agglomeration externalities, innovation and regional growth: theoretical reflections and meta-analysis'. In: R. Capello & P. Nijkamp (eds) *Handbook of Regional Growth and Development Theories*. Edward Elgar, Cheltenham: 256-281.

Dogaru, T., F.G. van Oort & M. Thissen (2011), 'Agglomeration economies in European regions: perspectives for objective-1 regions'. *Journal of Economic and Social Geography (TESG)* 102: 486-494.

Duranton, G. & D. Puga (2000), 'Diversity and specialisation in cities: why, where and when does it matter?'. *Urban Studies* 37: 533-55.

Frenken, K., F.G. van Oort & T. Verburg (2007), 'Related variety, unrelated variety and regional economic growth'. *Regional Studies* 41: 685-697.

Glaeser, E.L., H. Kallal, J. Scheinkman & A. Shleifer (1992), 'Growth in cities'. *Journal of Political Economy* 100: 1126-1152.
Henderson, V, A. Kuncoro & M. Turner (1995), 'industrial development in cities'. *Journal of Political Economy* 103: 1067-1085.
Jacobs, J. (1969), *The economy of cities*. New York: Random House.
Le Gallo, J. & Y. Kamarianakis (2011), 'The evolution of regional productivity disparities in the European Union from 1975 to 2002: a combination of shift-share and spatial econometrics'. *Regional Studies* 45: 123-139.
Marshall, A. (1890) *Principles of economics*. MacMillian, London.
McCann, P. & F.G. van Oort (2009), 'Theories of agglomeration and regional growth: a historical review'. In: R. Capello & P. Nijkamp (eds.), *Handbook of regional growth and development theories*. Cheltenham: Edward Elgar:19-32.
Melo, P.C., D.J. Graham & R.B. Noland (2008), 'A meta-analysis of estimates of agglomeration economies'. *Regional Science and Urban Economics* 39: 332-342.
Moreno, R., R. Paci & S. Usai (2005), 'Spatial spillovers and innovation activity in European regions'. *Environment & Planning A* 37: 1793-1812.
Neffke, F., M. Henning & R. Boschma (2011), 'How do regions diversify over time? Industry relatedness and the development of new growth paths in regions," *Economic Geography* 87: 237-265.
OECD (2009), *Regions matter: economic recovery, innovation and sustainable growth*. Paris: OECD.
OECD (2011) *Regional outlook. Building resilient regions for stronger economies* Paris: OECD.
OECD (2012), *Promoting growth in all regions*. Paris: OECD.
O'Huallachain, B. & D.S. Lee (2011), 'Technological specialization and variety in urban invention'. *Regional Studies* 45: 67-88.
Paci, R. & S. Usai (2000), 'Externalities, knowledge spillovers and the spatial distribution of innovation'. *Geojournal* 49: 381-390.
Puga, D. (2002) European regional policies in light of recent location theories, *Journal of Economic Geography* 2: 373-406
Quatraro, F. (2010), 'Knowledge coherence, variety and economic growth: manufacturing evidence from Italian regions'. *Research Policy* 39: 1289-1302.
Rosenthal, S.S. and Strange, W.C. (2004), 'Evidence on the nature and sources of agglomeration economies'. In: J.V. Henderson & J.F. Thisse (eds.), *Handbook of Regional and Urban Economics*. Amsterdam: Elsevier: 2119–2171.
Shefer, D. & A. Frenkel (1998), 'Local milieu and innovativeness: some empirical results'. *The Annals of Regional Science* 32: 185-200.
Thissen, M., F. van Oort, D. Diodato & A. Ruijs (2013), *Regional competitiveness and smart specialization in Europe. Place-based development in international economic networks*. Cheltenham: Edward Elgar.
Van Oort, F.G. (2004), *Urban growth and innovation. Localized externalities in the Netherlands*. Aldershot: Ashgate.
Van Oort, F.G. & N. Bosma (2013), 'Agglomeration economies, inventors and entrepreneurs as engines of European regional development'. *Annals of Regional Science* 51: 213-244.
Van Oort, F.G. & J.G. Lambooy (2013), 'Cities, knowledge and innovation'. In: M. Fischer & P. Nijkamp (eds.), *Handbook of Regional Science*. Berlin, Springer (forthcoming).
World Bank (2009), *World Development Report: Reshaping economic geography*. Washington, DC: World Bank.