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Related variety and regional growth in Hungary: towards a transition economy approach

Abstract

The aim of this paper is to adapt related variety calculations to the special case of Hungarian regional development in the late post-socialist transition period. First, we test regional employment growth in rising and declining regions separately, in order to distinguish those areas that could cope with economic transition and those that could not. We find that related variety speeded up growth in the dynamic regions but at the same time pushed lagging regions onto a downhill path; this may have been due to their inflexible industry structure. Following this, regional variety measures are decomposed into domestic and foreign subsets, and a new variable, ownership variety, is introduced. Findings suggest that regional employment growth is due to related variety in the domestic set in earlier phases, whereas the economy has evolved into a stage in which relatedness among foreign firms enhances regional employment growth significantly.

Keywords: related variety, regional employment growth, foreign-owned firms, post-socialist transition

Introduction

Co-location of companies is a central concept in the literature on regional economic growth. However, a fundamental debate has undermined the common understanding of regional employment growth in a region until recently: does regional specialization or diversity favour growth? Nevertheless, co-located companies from similar industries in industrial districts (Marshall 1890) or regional clusters (Porter 2003) are claimed to increase their productivity because they may obtain very special and detailed knowledge from each other. On the other hand, it is easier for companies co-located in economically diversified city-regions to share and combine knowledge across industries. As a result, they are more likely to create variety and incremental innovation (Jacobs 1969; Glaeser *et al.* 1992). Thus, regional specialization and diversity might drive regional economic dynamics simultaneously, but on a different basis.

A recent stream of literature claims that neither regional specialization nor regional diversity can provide efficient conditions for regional growth. Learning among very similar firms in a specialized region might not lead to growth because the probability of obtaining

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new knowledge is low; on the contrary, firms have to share some knowledge in order to understand each other. Thus, a golden mean of technological proximity between co-located firms is needed in order that inter-firm learning provides grounds for regional growth (Boschma 2005). This phenomenon was first captured quantitatively by Frenken et al. (2007) by the formulation of related variety in a region, which builds on the concept of technological proximity, and demonstrates that regional employment growth does not depend on diversity per se, but the extent to which industries are related to each other, which is crucial.

The contribution of the paper is twofold. First, we address the role of related variety in regional employment decline and growth in a post-socialist economy. Related variety might capture hidden characteristics of regional dynamics over economic transition because previously prosperous industrial areas faced economic downturn, and technological relatedness might have a distinctive role in this. Secondly, we argue that additional proximity dimensions have to be involved in related variety calculations in order to understand regional economic growth in these areas. This latter step is important as lagging firms maybe isolated from the dynamic ones in terms of institutional or social conditions; thus, it is not technological division, but the lack of institutional or social proximity that hinders inter-firm learning and regional growth.

The demonstration of this is based on two distinctions. Initially, the role of related variety in rising and declining regions is separately analysed; then variety measures are decomposed into domestic and foreign subsets. This latter step, namely the introduction of ownership categories into regional related variety calculations, requires an additional level of entropy decomposition and a new variable: ownership variety.

The findings suggest that related variety had a dual role in Hungarian regional development over the 1998-2005 period. It speeded up employment growth in those regions that could face the challenges of transformation. However, related variety had a negative effect on employment growth in declining regions, which suggests that technological relatedness pushed regions with an uncompetitive industrial structure onto a downhill path. We also find that regional employment growth is positively affected by related variety among the domestic set of firms initially, but relatedness in the foreign subset starts to contribute significantly to growth at a later stage.

The remainder of this paper is as follows. A brief overview of Hungarian regional development in the post-socialist period is given; this is followed by the introduction of the data. The adaptation of related variety calculation to the specific case is described in the fourth section. The fifth section gives an overview of the results and discusses the findings, with future research in the sixth section.

Hungarian regional development

The determining role of FDI, the remaining presence of some state-controlled services and stagnating domestic companies have been the main features of transition economies in their current development model (Szanyi 2003). In the first half of the transition period, from 1990 to 1995, a massive economic downturn occurred in Hungary. Large state-owned companies either went bankrupt or were privatized; the latter was followed by basic restructuring. Consequently, the unemployment rate, and especially long-term

unemployment, increased dramatically. MNEs started to carry out large investment projects in the tradable and service sectors (e.g. automotive and ICT), and in the untraded sectors with secure local markets (e.g. energy and communication) in Hungary. Simple, cheap unskilled labour-based activities were developed by additional investments (Iwasaki 2007).

Economic catching up started from 1995, and the employment rate again approached the level of 1992 at the end of the period of investigation. New, higher value-added activities were launched, which utilized local skilled labour and engineering talent; some of the foreign companies started to locate their R&D functions to their Hungarian sites (Lengyel–Cadil 2009).

The transition left a major footprint on regional development. Previously specialized industrial regions quickly fell back as they lost their markets and were unable to meet the challenges of global competition (Lux 2009). Both regional specialization and spatial concentration of industries were proved to have a negative effect on regional employment growth (Lengyel–Szakálné 2013) – regional development is thought to be investment-driven, in which foreign direct investments have a central role.

Despite this, the role of foreign-owned firms in regional dynamics is still unclear. On one hand, foreign-owned firms imported new knowledge to the economy, which many argue created positive spillover effects (Halpern–Muraközy 2007, Szanyi et al. 2011). On the other hand, domestic suppliers only had marginal roles in supplier networks of MNEs because their local decisions were usually determined by the parent company headquarters abroad (Grosz 2006). In many cases, suppliers and competitors of these MNEs were mainly de-novo foreign firms that had followed their main partners into Hungary (Békés 2005). Thus, a dual economic structure has evolved in Hungary that is characterised by a sharp foreign-domestic gap (Farkas 2000).

The dual economic structure and the gap between foreign-owned and domestic firms also affected regional development. Those regions, in which foreign-owned companies invested, became relatively more competitive, (Lengyel 2003). However, foreign-owned firms have only had positive effects in the relatively developed regions, and some argue that they have even destructed lagging regions (Lengyel–Leydesdorff 2011, 2013).

One might conclude that regional decline and catching up, the transition period itself, and the gap between foreign-owned and domestic companies created a unique field for testing the role of related variety in regional employment growth over the post-socialist era. The current paper addresses two central questions:

1. What is the role of related variety in regional employment decline and growth?
2. How did domestic and foreign related variety affect regional employment growth?

Data

The information used for the empirical analysis in this paper was collected from the annual census-type data of Hungarian firms, which were compiled from financial statements associated with tax reporting submitted to the National Tax Authority in Hungary by legal entities using double-entry bookkeeping. The observation period covers 1998 and 2005 on a yearly basis. The data includes all industries and contains basic information for each sample firm, including the company headquarters of the LAU1 region, NACE 4-digit

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industrial classification codes, the annual average number of employees, the amount of equity capital held by the type of owner, and major financial indices at the end of the term.

Foreign ownership is attributed to a firm when 10% or more shares of the stock of a firm are in foreign hands (HSCO 2007). This standard definition of the Hungarian Statistical Office considers a significant foreign interest in all of these firms even if domestic ownership is higher than foreign ownership in the firm.

All industries are present in the data, although for practical reasons we have excluded agriculture from the analysis and focus only on manufacturing and service sectors. The distribution of firms based on industry classifications, according to 2-digit NACE categories, can be found in Appendix 1.

A major limitation of the data is that due to a change in company codes in 2002, firms cannot be traced over the whole period. There is even a huge shift in terms of firm numbers across the two periods (Table 1). Although the data represents the total economically active population in a rather similar way (42% in 1998 and 48% in 2002), the regional, sectoral, ownership distribution of firms might be very different across the two datasets. Therefore, we analysed regional employment growth in two distinct periods: 1998-2001 and 2002-2005.

Table 1

Employment and number of firms in the data

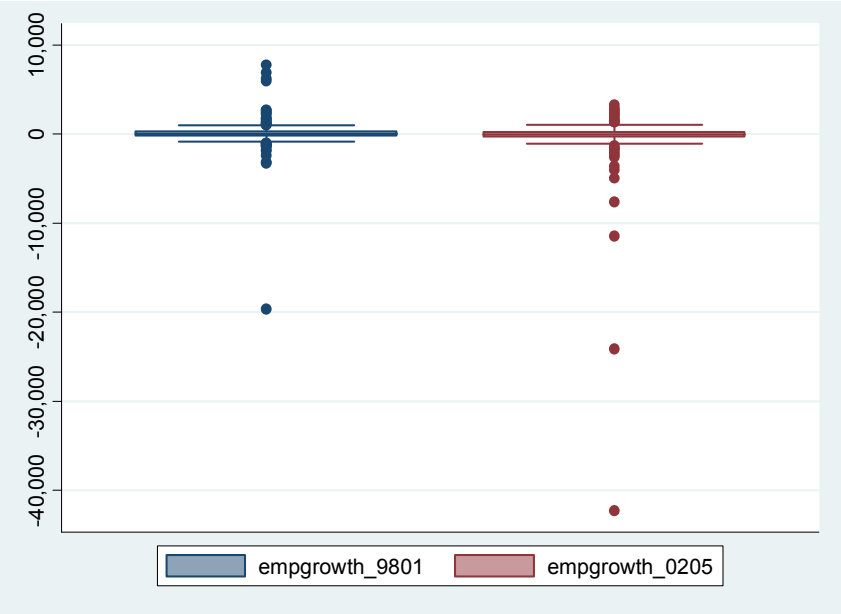
	1998	2002
Employment in the data	1,781,466	2,092,942
Share in economically active population, %	42	48
Domestic employment	1,196,222	1,563,175
Foreign employment	585,244	529,767
Number of firms	112,075	298,031
Number of domestic firms	93,736	272,111
Number of foreign firms	18,339	25,920

Note: Economically active population was 4.263 million employees in 1998 and 4.298 million employees in 2002 http://www.ksh.hu/docs/eng/xstadat/xstadat_long/h_qli001.html

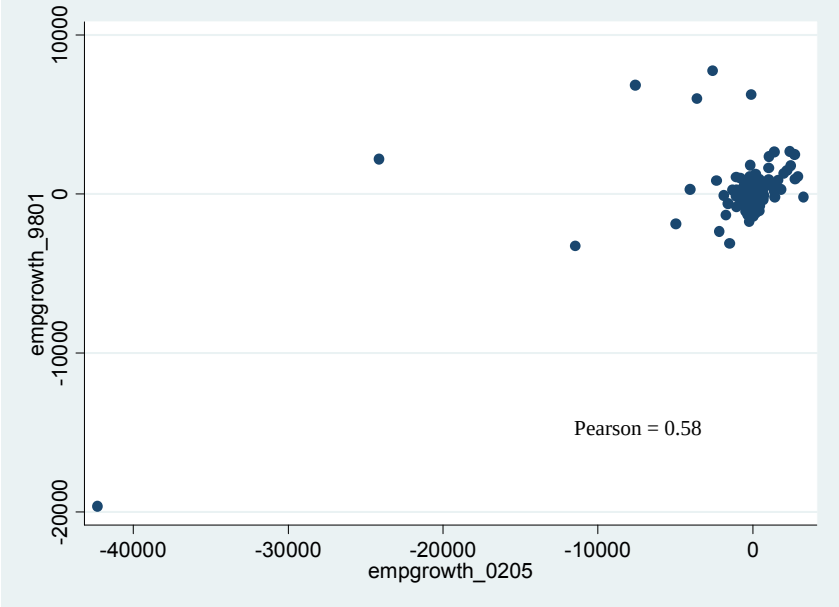
Despite company-level differences in the data, regional employment growth seems to be comparable across the two time periods under investigation. The average employment growth across regions are around zero in both time sets; however, distributions differ. While the distribution of EMPGRO_9801 is close to symmetric, Budapest (–19,418) is the only outlier, the EMPGRO_0205 distribution is more skewed towards negative values (Figure 1a). The two-way association between the two variables depicts a medium strong correlation; employment growth in most of the regions deviate around zero (Figure 1b).

Figure 1a, b

Employment growth in regions, 1998–2001 and 2002–2005



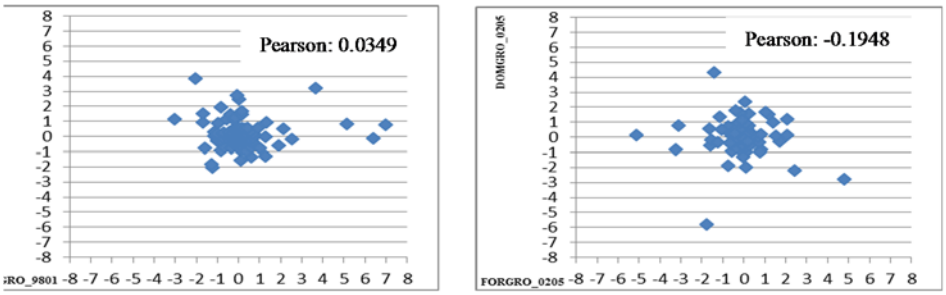
Regional employment growth across periods of investigation



Domestic and foreign employment growth scatter around zero in most of the regions and both time sets. However, foreign growth varies on a somewhat larger scale than domestic growth: some regions stand out or lag behind more drastically in terms of foreign growth than in domestic growth (Figure 2). Maps in Appendix 2 suggest that regional employment growth stood out in the agglomeration of Budapest in both periods (except the city itself). Foreign companies contributed to growth mainly in those regions that are proximate to Budapest or lie between the capital and the Austrian border. The level of employment has decreased in the peripheral regions of the country.

Figure 2

Foreign versus domestic employment growth in subregions, 1998–2001 and 2002–2005



Note: Budapest is left out for reasons of visualization.

Methods

We follow the seminal work of Frenken et al. (2007) in variable creation. Their argument claims that two co-located firms are technologically unrelated when they do not share two-digit level NACE codes, and might not be able to learn from each other. Two co-located firms are technologically related when they share the same two-digit level NACE codes but do not share the four-digit level NACE code. Related firms might share enough knowledge but are not too proximate; therefore, they do not only understand but might also learn new things from each other.

Related variety calculation is as follows. Let pi be the four-digit NACE share of employment and *Pg* the two-digit level NACE shares of employment that is derived by summing the four-digit shares. Then the variety of economic activity (V) in a region can be phrased as the sum of probabilistic entropy of four-digit level NACE shares (1). This variety can be decomposed to unrelated variety and related variety (2). Unrelated variety (UV) is given as the sum of probabilistic entropy of two-digit level NACE shares (3). Related variety (RV) is the sum of probabilistic entropy of four-digit level NACE shares within each two-digit level NACE shares (5) aggregated at the regional level (4).

$$V = \sum_{g=1}^{G} \sum_{i \in S_g} p_i \, log_2 \left(\frac{1}{p_i}\right) \quad (1)$$

$$V = UV + RV \quad (2)$$

$$UV = \sum_{g=1}^{G} P_g \, log_2 \left(\frac{1}{P_g}\right) \quad (3)$$

$$RV = \sum_{g=1}^{G} P_g H_g \quad (4)$$

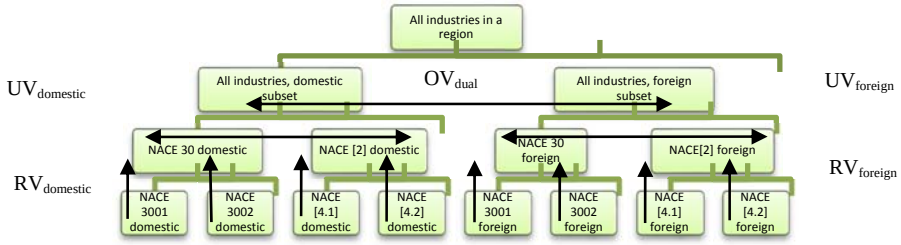
$$H_g = \sum_{i \in S_g} \frac{p_i}{P_g} log_2 \left(\frac{1}{p_i / P_g} \right) \quad (5)$$

It follows from these equations, that related variety measures the extent to which the technological knowledge base of firms are related in a region. Relatedness is formulated on the basis of technological proximity between firms. Other types of proximities included in the related variety calculation might be straightforward in less developed economies because the institutional gap between dynamic and lagging firms can set back inter-firm learning. The case of post-socialist transition is a good illustration: the majority of domestic firms had only limited abilities to learn from the local sites of multinational companies even if they were technologically close to each other (Békés 2005, Grosz 2006).

We address this issue by introducing ownership categories into regional related variety calculations. This needs another level of entropy aggregation, but enables us to decompose variety measures into domestic and foreign subsets. Unlike in previous papers, in which related variety was decomposed into subsets of manufacturing and service industries (Mameli et al. 2012) or high-tech manufacturing (Hartog et al. 2012), the introduction of ownership categories requires an additional level of entropy decomposition and a new variable: ownership variety.

Figure 3

Unrelated variety, related variety and firm ownership, a dual economy model



The formulation is visualized in Figure 3. Let poi be the share of employment in industries with four-digit NACE codes combined with ownership categories. Let poi sum up to Pog that is the share of employment in two-digit NACE codes combined with ownership categories. Also, let the sum of Pog be Po, the share of employment in all industries combined with ownership categories. Finally, let 'd' indicate domestic set of firms and 'f' indicate foreign set of firms.

Economic variety measured in the region will be equal to the entropy of the employment distribution of the finest bin structure that is the four-digit NACE code combined with ownership category (6). Then, variety in a region equals with the variety measured in the ownership distribution (OVdual), plus domestic and foreign unrelated varieties (UVD and UVF), plus domestic and foreign related varieties (RVD and RVF).

$$V = \sum_{o=f,d} \sum_{g=1}^{G} \sum_{i \in S_g} p_{oi} log_2 \left(\frac{1}{p_{oi}} \right) \quad (6)$$

$$V = OV_{dual} + UV_{dual} + RV_{dual} \quad (7)$$

$$OV_{dual} = \sum_{o=f,d} P_o log_2 \left(\frac{1}{P_o}\right) \quad (8)$$

$$UV_{F,D} = \sum_{o=f,d} P_o \sum_{g=1}^{G} \frac{P_{og}}{P_o} log_2 \left(\frac{1}{P_{og}/P_o}\right) \quad (9)$$

$$RV_{F,D} = \sum_{o=f,d} P_o \sum_{g=1}^{G} P_{og} \sum_{i \in S_g} \frac{p_{oi}}{P_{og}} log_2 \left(\frac{1}{p_{oi}/P_{og}}\right) \quad (10)$$

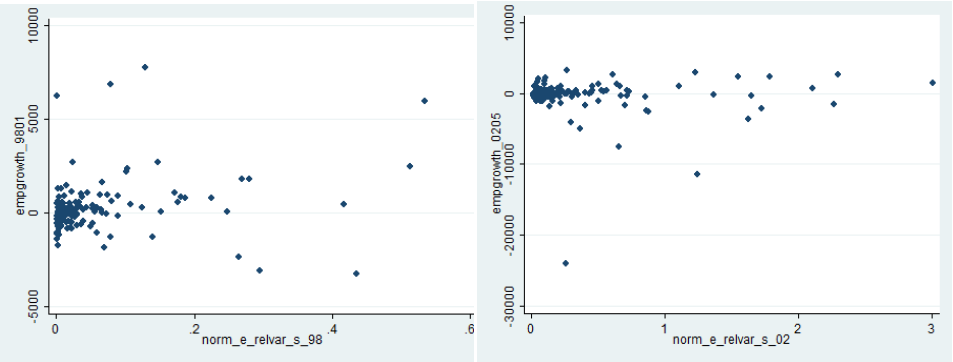
Because Hungarian subregions vary in terms of the size of their economy, we normalized variety measures by the number employed in the appropriate categories. Accordingly, unrelated variety, related variety, and ownership variety have been divided by the number employed in the region; domestic and foreign unrelated and related variety measures have been divided by the number employed in the respective subset in the region.

Results

According to a two-way scatter plot, Hungarian regional employment growth does not seem to be determined by related variety of economic activity in the region (Figure 4). However, one might observe a widening gap between growing and declining regions as related variety increases. Preliminary findings reflect on this issue, and directions for further work are set as follows.

Figure 4

Related variety and employment growth



The variables created with the methods above are tested in linear regression with heteroskedasticity-robust standard errors in which employment growth is the dependent variable. The distinct time periods are handled separately and we illustrate a reverse effect of explanatory variables in declining and growing regions. As a next step, we look at the effect of domestic and foreign related variety on employment growth. Finally, domestic and foreign employment growth will be analysed.

Pearson correlation values in Table 2 indicate a high level of association between several variables in both time sets. For example, EMPGRO_F_9801 and EMPGRO_D_0205 correlate to a very high degree with the respected EMPGRO variables.

Correlation values are also too high among few pairs of variety measures, namely UNRELVAR_98 and UV_D_98, just as between RELVAR_98, RV_D_98, and RV_F_98. Therefore, classic variety measures and variety measures decomposed to domestic and foreign subsets cannot be tested together, in order to avoid multicollinearity of explanatory variables.

A variety of control variables are introduced to the models (VIF values remains below 10 in all cases); for a description of control variables see Appendix 3. Budapest is left out when looking at separate sets of growing and declining regions because the capital is an extreme outlier in both of the time periods. County dummies are used in order to capture region-specific effects.

Table 2

Pearson correlation values, 1998 and 2002

1998		1	2	3	4	5	6	7	8	9
1	EMPGRO_98-01	1.0000								
2	EMPGRO_F_98-01	0.9335	1.0000							
3	EMPGRO_D_98-01	0.4045	0.0498	1.0000						
4	UNRELVAR_98	0.0444	–0.0115	0.1529	1.0000					
5	RELVAR_98	–0.7336	–0.8004	–0.0019	0.0582	1.0000				
6	OV_dual_98	0.0497	–0.0552	0.2792	0.4523	0.1212	1.0000			
7	UV_D_98	0.0315	–0.0061	0.1032	0.7755	0.0517	0.4290	1.0000		
8	RV_D_98	–0.7397	–0.8006	–0.0185	0.0784	0.9953	0.1165	0.1074	1.0000	
9	UV_F_98	0.0006	0.0040	–0.0085	0.2476	–0.0174	–0.2537	0.1914	–0.0099	1.0000
10	RV_F_98	–0.6565	–0.7093	–0.0196	0.0917	0.8766	0.0728	0.1827	0.8903	0.0101
2002		11	12	13	14	15	16	17	18	19
11	EMPGRO_02-05	1.0000								
12	EMPGRO_F_02-05	0.3253	1.0000							
13	EMPGRO_D_02-05	0.9585	0.0423	1.0000						
14	UNRELVAR_02	0.1184	0.0271	0.1169	1.0000					
15	RELVAR_02	–0.8011	–0.2226	–0.7793	0.0641	1.0000				
16	OV_dual_02	0.0007	–0.1894	0.0578	0.1695	0.1048	1.0000			
17	UV_D_02	0.0424	–0.0643	0.0642	0.7596	0.0794	0.4103	1.0000		
18	RV_D_02	–0.7974	–0.2585	–0.7646	0.0771	0.9920	0.1240	0.1185	1.0000	
19	UV_F_02	0.0264	0.0294	0.0190	0.1507	–0.0254	–0.3262	0.1134	–0.0247	1.0000
20	RV_F_02	0.0021	–0.0092	0.0050	0.3923	0.0655	0.1445	0.4931	0.0570	0.0798

Table 3

Regional employment growth, heteroskedasticity-robust linear regression

	1998–2001								2002–2005							
	All subregions				Growth>0		Growth<0		All subregions				Growth>0		Growth<0	
	Model 1		Model2		Model 3		Model 4		Model 5		Model6		Model 7		Model 8	
CONSTANT	–228,16		40,27		947,8		–663,24	***	–1663,94	**	–23140,5		598,04	***	1212,22	
	(–1,02)		(0,16)		(1,39)		(–4,26)		(–2,49)		(–0,81)		(3.91)		(1,2)	
UNRELVAR	22776,62	**	–10658,2		–25241,5		33793,42	***	45787,56	***	47670,13	**	–11014,1	**	–31352,9	
	(2,26)		(–0,68)		(–1,27)		(3,43)		–3,29		(2,3)		(–2,64)		(–1,05)	
RELVAR	–2091,69	***	3437,39		2023,41		–4846,82	***	–956,2	***	–473,22		729,05	**	4853,92	*
	(–23.19)		(1,18)		(0,96)		(–3,64)		(–106,4)		(–0,73)		(2,48)		(1,69)	
HHI_INI	–1578,54	**	–1825,25	**												
	(–2,3)		(–2,11)													
HHI_END	3329,75	**	3955,12	**			720,13	**	2286,35	*	2171,588	**	2207,52	***		
	(2.21)		(2,6)				(2,37)		(1,85)		–2,14		(2,75)			
EMPL_INI					0,083	***	–0,012	**							–0,251	**
					(2,85)		(–2,38)								(–2,54)	
COUNTY DUMMIES	NO		YES		YES		YES		NO		YES		YES		YES	
Adjusted R-square	0,56		0,68		0,65		0,82		0,67		0,69		0,57		0,63	
N	168		168		83		84		168		168		77		90	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Budapest was left out from Models 3,4,7,8..

Table 3 summarizes findings of the original related variety calculation (Frenken et al. 2007); unrelated variety is calculated by (3) and related variety is formulated by (4) and (5). Interestingly, both Model 1 and Model 5 attribute a significant positive effect to unrelated variety and a significant negative effect to related variety in influencing regional employment growth. These are controversial compared to what one expects because unrelated variety –being a measure of diversity– is thought to induce a portfolio effect. The higher the unrelated variety, the more the resistance against external shocks in the region; unrelated variety is expected to reduce the decline. On the other hand, related variety – being a measure of local learning capacities – is expected to enhance regional growth. Although the unexpected sign disappears when county dummies are introduced into the model in the 1998-2001 period (Model 2), unrelated variety still has a significant negative effect on growth in the 2002-2005 period (Model 6). In conclusion, we do not find a clear effect of related variety – that accords with previous findings in the literature – on regional growth in Hungary.

Our related idea, that merits and needs further efforts to prove it in forthcoming papers, is that growing and declining regions of transition economies might differ regarding the effect of related variety. In our case, inter-firm learning and technological relatedness is beneficial in those regions that could cope with post-socialist transformation. However, a large number of regions could not break away from the path they had been locked into previously and therefore, technological relatedness might be another burden for them. In other words, related variety might even enhance the lag of these latter regions that did not meet the challenges of transition because local learning occurs among uncompetitive industries that lock the region into a declining path. Preliminary results in Table 3 support the idea; however, further work is needed for a detailed demonstration.

Related variety enhances growth in rising regions over the 2002-2005 period and also eases the drop of employment in lagging ones (Model 7 and Model 8). However, related variety had a negative effect on growth in declining regions over 1998-2001, indicating that it speeded up decline in backsliding regions. In our understanding, these results imply that technological relatedness and local learning have a dual effect in Hungary. Furthermore, these effects might change over time; this will have to be investigated over a longer timescale.

One might also argue that unrelated variety performs a sort of portfolio effect as proposed by Frenken et al. (2007), because the higher the unrelated variety, the slower the employment drop in sinking regions. This suggests that regions with a relatively diversified economy suffer less from path-dependent recession than regions with a more specialized economy. Accordingly, unrelated variety eases employment loss in regions that drop behind over the 1998–2001 period (Model 4), but also hinders employment growth in prospering regions in 2002–2005 (Model 7).

Table 4

Regional employment growth, dual economy model, heteroskedasticity-robust linear regression

	1998–2001								2002–2005			
	All regions		Growth>0		Growth<0		All regions		Growth>0		Growth<0	
	Model 1		Model2		Model 3		Model 4		Model 5		Model6	
Constant	270,96		–73,03		499,44		1351,48		–57,59		–1326,73	
	(0,88)		(–0,3)		(0,79)		(1,18)		(–0,16)		(–1,49)	
OV_DUAL	12103,58		–12921,9		–1098,88		12823,44		13447,41	**	35190,59	
	(1,18)		(1,25)		(–0,15)		(1,35)		(2,26)		(1,38)	
UNRELVAR_D	93775,77	**	–293318,8	*	203956,7	*	64486,65		–214526,0	***	–422333	
	(2,05)		(–1,85)		(1,78)		(0,35)		(–3,07)		(–1,06)	
RELVAR_D	–215887	***	422332,5	**	–727769	***	–245876,7	***	92814,9		248635	
	(–18,06)		(2,43)		(3,37)		(–81,56)		(1,6)		(1,15)	
UNRELVAR_F	–49,36		533,57	*	41,43		20,77		193,38		320,7347	
	(–0,22)		(1,81)		(0,15)		(0,09)		(1,03)		(0,63)	
RELVAR_F	–85,29		–436,91		2823,14		24,7		150,27	**	3111,361	***
	(–0,11)		(–0,61)		(1,56)		(0,29)		(2,09)		(3,55)	
HHI_INI			4472,28	***								
			(2,82)									
HHI_END									2093,77	**		
									(2,56)			
DOMEMPL											–0,213	***
											(–3,25)	
FOREMPL			0,22	***	–0,126	***						
			(4,52)		(–3,8)							
AVRFIRMSIZE							–243,77	*				
							(–1,52)					
AVRDOMFIRMSIZE	–20,21	*			–22,54	**						
	(–1,89)				(–2,26)							
COUNTY DUMMIES	NO		YES		YES		NO		YES		YES	
Adjusted R-square	0,57		0,81		0,73		0,67		0,56		0,63	
N	168		83		84		168		77		89	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively. Budapest was left out from Models 3,4,7,8.

These first findings remain unchanged when unrelated and related varieties are decomposed into domestic and foreign subsets (Table 4). Note that the normalization process (described in Section 4) enables us to compare the effect of domestic and foreign populations even if foreign employment is minor compared to domestic employment in many subregions. Linear regressions with heteroskedasticity-robust standard errors in Table 4 suggest that regional employment growth is mainly affected by technological relatedness in the domestic subset of companies in the 1998–2001 period. Inter-firm learning opportunities among domestic companies might speed up regional growth (Model 2), but it has also widened the lag of declining regions (Model 3). Technological relatedness among foreign firms has a significant positive effect on growth over 2002–2005, whereas no such effect was found in the 1998–2001 period.

Regional economies might have evolved over the transition period in a complex way in terms of how domestic and foreign-owned firms have been involved in local learning. Technological relatedness among domestic companies could have widened the gap between dynamic and declining regions due to the lock-in phenomenon that we described earlier. The economy has probably developed to a stage, in which relatedness of co-located domestic companies have influenced regional employment growth in all regions regardless of their previous industry structure. However, we have not found a significant effect of domestic related variety in the 2002–2005 period. On the other hand, local learning among co-located foreign-owned companies may have become a crucial factor for regional employment growth. This issue merits a deeper analysis, in which the whole transition period should be investigated by further papers.

The last insight addresses the cross-effect of the related variety of the decomposed sets on domestic and foreign employment growth separately (Table 5). Interestingly, preliminary findings imply that relatedness among foreign firms remains unimportant for both domestic and foreign employment growth. On the other hand, relatedness among domestic companies favoured foreign employment growth in the 1998–2001 period while domestic unrelated variety hindered foreign growth significantly. One might argue that foreign growth in Hungary does not depend on local relatedness because foreign companies do not compete and co-operate on the local level as their strategies are developed in distant headquarters. However, foreign firms might also benefit from local inter-firm learning and new relatedness measures –that capture relatedness between foreign and domestic subsets– that might provide new insights to this issue.

Domestic employment growth is affected by domestic unrelated variety and domestic related variety in a similar manner as compared to the full set of firms. Unrelated variety hinders growth and related variety speeds up growth. Ownership variety also has a positive significant effect on regional employment growth in domestic firms. Since this latter variable is a simple probabilistic entropy measure of employment distribution in two categories, its positive impact on growth implies that the closer domestic employment is to foreign employment in absolute values, the higher the domestic growth. Thus, the results confirm previous findings that domestic employment growth is high in those regions where foreign employment is also relatively high.

Table 5

Domestic and foreign employment growth in the regions, OLS

	Domestic growth > 0								Foreign growth > 0							
	1998–2001				2002–2005				1998–2001				2002–2005			
	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8	
OV-dual	12307.77		7280.28		8189.539		9600.39		4688.786		5381.067		1211.4		8844.976	
	(1.98)	*	(1.14)		(2.26)	**	(2.16)	**	(0.33)		(0.37)		(0.21)		(1.61)	
UNRELVAR_D	–312181.5				–158275.4						–619449.1				–235567.5	
	(–3.85)	***			(–3.45)	***					(–3.29)	***			(–2.82)	***
RELVAR_D	305722.5				205093.3						756708.3				121910.9	
	(3.01)	***			(7.42)	***					(3.16)	***			(1.66)	
UNRELVAR_F			–186.53				–111.07		–838.5058				–2412.697			
			(–0.47)				(–0.25)		(–0.72)				(–1.05)			
RELVAR_F			–600.27				7.65		–809.9376				80.70932			
			(–0.55)				(0.09)		(–0.42)				(0.01)			
Constant	485.3697		381.43		168.6739		117.2		546.5496		759.548		482.689		482.3078	
	(3.11)	***	(2.19)	***	(1.08)		(0.58)		(1.76)	*	(2.66)	***	(1.94)		(2.41)	**
Adjusted R-square	0.15		0.01		0.39		0.02		0.01		0.1		0.02	*	0.08	
N	83		83		97		97		81		81		64		61	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Discussion

In this paper, the role of unrelated variety and related variety in Hungary, over the 1998–2005 period, have been analysed. The first special focus was a distinction between regional decline and regional growth. Then we decomposed the classic variety measures into subsets of domestic and foreign firms.

The initial findings suggest that related variety in a region has a dual effect in regional development over post-socialist transition. Technological relatedness increases employment growth in those regions that could cope with the new challenges of market economy because it creates learning opportunities among co-located firms that might lead to innovative outputs. However, related variety also speeds up employment decline in those regions that could not compete on the global economy. These regions might be locked into downhill paths, in which technological relatedness among uncompetitive industries is another obstacle. Future research on longer timescale data will pay extra attention to this phenomenon, and upcoming papers will focus on how the effect of related variety changes over time in a transition economy.

The second finding concerns technological relatedness in the domestic and foreign-owned subsets. While domestic related variety have predominantly influenced regional growth in the first half of the investigated period, technological relatedness among co-located foreign firms became important in the second half. A possible reason for this pattern is that the dual economic structure –which we usually talk about regarding Hungarian regional development– changes over time, and foreign firms might become more integrated into the local texture of the economy in the later stages of the transition than initially. Foreign employment growth was positively affected by domestic related variety, which is a sign of cross-effects. Therefore, future papers will explore foreign-domestic relations in more detail. For example, it is possible to re-organize the dual economy model of related variety calculations and introduce ownership categories on a lower level of aggregation (e.g. at two-digit or four-digit NACE code levels). These new models of decomposition might explain domestic-foreign relatedness better than the dual economy model presented in this paper. In addition, other types of data (e.g. international trade at company level) might capture foreign-domestic proximities better than employment distribution.

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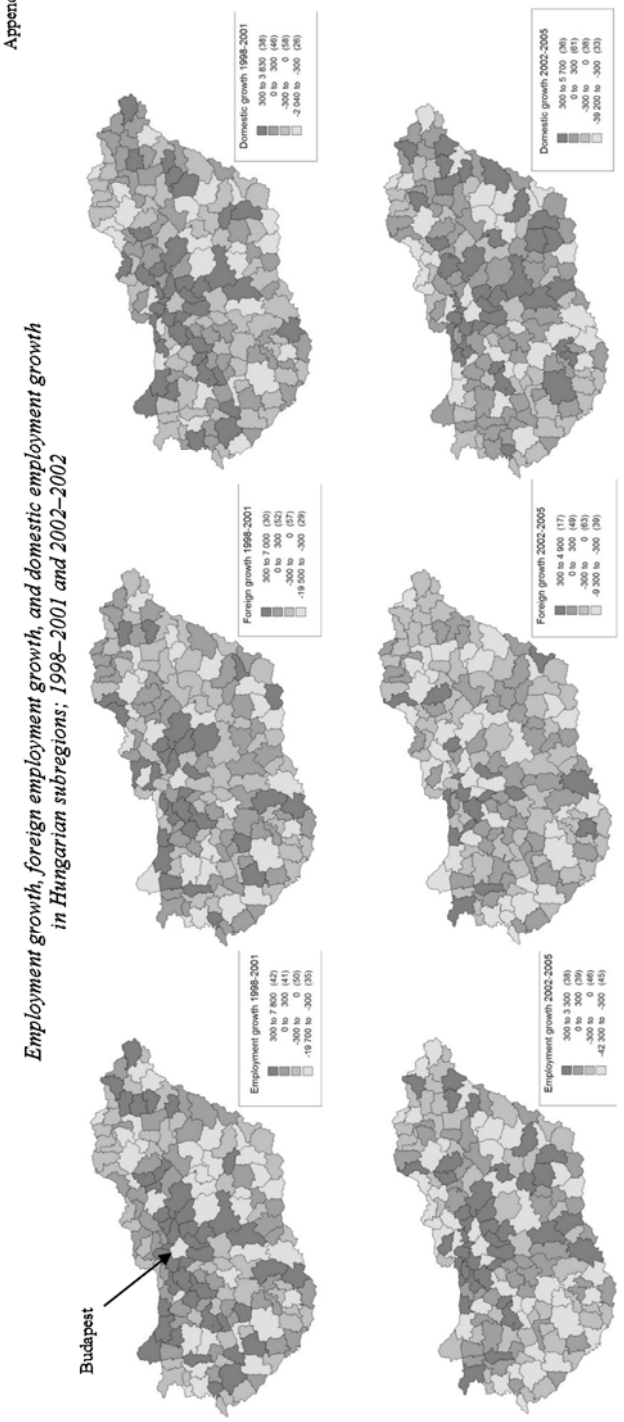
Appendix 1

Number of firms in industries, NACE 2 level

NACE2	1998	2002
15	2,557	4,226
16	7	6
17	727	1,394
18	1,071	2,463
19	348	554
20	1,129	2,631
21	229	495
22	2,363	6,14
23	7	13
24	501	711
25	960	1,754
26	676	1,48
27	227	333
28	2,478	5,532
29	1,95	3,454
30	131	307
31	669	1,192
32	486	936
33	753	1,648
34	221	294
35	123	263
36	965	2,776
37	83	211
40	201	287
41	214	307
45	10,025	27,805
50	4,801	11,767
51	20,118	32,088
52	12,988	40,815
55	4,05	13,708
60	2,58	7,057
61	47	104
62	46	76
63	1,754	3,634
64	315	953
65	575	797
66	24	94
67	532	2,801
70	6,334	16,879
71	765	1,622
72	3,143	11,118
73	627	1,687
74	17,213	50,024
80	833	5,203
85	1,523	12,03
90	471	790
91	439	2,519
92	3,051	12,012
93	745	3,052

Appendix 2

Employment growth, foreign employment growth, and domestic employment growth in Hungarian subregions; 1998–2001 and 2002–2002



Appendix 3

Description and statistics of control variables

Abbreviation	Description		Mean	St. Dev.	Min	Max
HHI_INI	Hirschman-Herfindhal index at the starting point of our period, calculated from company-level market shares.	‘98	.1409016	.1509218	.0063626	.8974066
		‘02	.1044115	.1210299	.0061086	.7810547
HHI_END	Hirschman-Herfindhal index at the ending point of our period, calculated from company-level market shares.	‘98	.1298001	.1388309	.0093472	.9825625
		‘02	.0941696	.1188845	.0070743	.767398
EMPL_INI	Absolute value of initial employment level in the region.	‘98	10603.96	55852.08	172	720730
		‘02	12457.99	61352.4	520	789646
DOMEMPL	Absolute value of initial domestic employment level in the region.	‘98	7120.369	35993	157	463912
		‘02	9304.613	44666.19	380	574023
FOREMPL	Absolute value of initial foreign employment level in the region.	‘98	3483.595	19934.86	0	256818
		‘02	3153.375	16834.9	0	215623
AVRFIRMSIZE	Average number of employees in firms in the region.	‘98	511.6148	4502.682	4.598214	41518
		‘02	7.423348	2.526928	2.915344	14.52036
AVRDOMFIRMSIZE	Average number of employees in domestic firms in the region.	‘98	15.00056	6.982313	4.90625	57.17213
		‘02	252.6752	3196.234	2.603261	41434