Regional Dynamics over Economic Transition: Related Variety and Foreign Ownership in Hungarian Regions, 1998 – 2005

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Abstract

Related variety of a region is frequently used to demonstrate that regional economic growth is positively affected by technological proximity between co-located firms (Frenken et al. 2007, Hartog et al. 2012). In a similar stream of the literature, revealed relatedness is used to measure the effect of technological proximity on firm entry to and exit from the region (Neffke et al. 2011). However, the role of technological proximity in regional dynamics over crisis times is not yet understood. We argue in this paper that technological proximity does not necessarily favour regional dynamics at all stages of regional evolution, it might even harm regions when the economy faces major economic transition.

The demonstration is based on balance-sheet data of the complete set of Hungarian firms over the 1998-2005 period. Hungary entered its' post-socialist era and opened up for foreign investments in the early '90ies and transition had a footprint on regional economies as well. Those regions grew dynamically into which foreign firms invested. However, domestic companies might have difficulties in learning from co-located foreign firms, as it was pointed out repeatedly (Békés et al, 2007) and might gain from the presence of them only in relatively developed regions (Lengyel and Leydesdorff, 2011).

The related variety indicator is first decomposed into foreign and domestic subsets. Preliminary results suggest that the role of technological proximity in regional dynamics evolves over time. Related variety among foreign firms favours firms entry over the full period, while relatedness among domestic firms had negative effect on firm entry and positive effect on firm exit in early times of the transition but this effect became positive at a later stage of the economic development.

Key words: related variety, firm entry and exit, foreign-owned firms, panel regression, post-socialist transition.

JEL Classification: F43, F23, L16

1 Introduction

Co-location of companies is central concept in the literature on regional economic growth. However, a fundamental debate has undermined the common understanding of regional dynamics in a region until recently: does regional specialization or diversity favours 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 migth obtain very special and detailed knowledge from each other. On the other hand, companies co-located in economically diversified city-regions share and combine knowledge across industries more easily and therefore are more likely to create new variety and incremental innovation (Jacobs, 1969; Glaeser et al., 1992). Thus, regional specialization and diversity might drive regional economic dynamics simultaneously, but on 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 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 are needed in order that inter-firm learning provide ground for regional growth (Boschma, 2005). This phenomena 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 depent on diversity per se but the extent, to which industries are related to each other, is crucial.

The contribution of our paper is twofolds. 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 special role in that. Second, 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, because lagging firms may be isolated from the dynamic ones in terms of institutional or social conditions; thus not technological division but the lack of institutional or social proximity is what hinders inter-firm learning.

Our demonstration is based on a distinction. We decompose variety measures 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.

2 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. Big state-owned companies either

went bankrupt or got privatized; the latter was followed by basic restructuring. Consequently, unemployment rate, and especially long-term unemployment increased dramatically. MNEs started to carry out large investment projects in the tradable and services sectors (eg. automotive and ICT) and untraded sectors with secure local markets (eg. energy and communication) of Hungary. Simple, cheap unskilled labour-based activities were developed by additional investments (Iwasaki, 2007).

Economic catching up started from year 1995, and employment rate approached again the level of year 1992 at the end of the period of our 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 and Cadil, 2009).

The transition had a major footprint on regional development. Previously specialized industrial regions fell back quickly because they lost their market and became 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 and Szakálné, 2013a). Regional development is thought to be investment-driven, in which foreign direct investments have central role.

However, the role of foreign-owned firms in regional dynamics is still unclear. On the one hand, foreign-owned firms imported new knowledge to the economy, and many argue that this created positive spillover effects (Halpern and Muraközy, 2007, Szanyi et al., 2011). On the other hand, domestic suppliers had only 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 structure of economy has evolved in Hungary, which can be characterised by a sharp foreign-domestic gap (Farkas, 2000). The dual economic structure and the gap between foreign-owned and domestic firms have had effected regional development as well. Those regions became relatively more competitive, in which foreign-owned companies invested (Lengyel I. 2003). However, foreign-owned firms have had positive effects in the relatively developed regions only and some argue that they have even destructed lagging regions (Lengyel and 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 firm dynamics over post-socialist era. The current paper addresses two central questions:

1. What was the role of related and unrelated variety in firm dynamics in different transition time periods in Hungary?
2. How did domestic and foreign related and unrelated variety affect entry, exit and membership of domestic and foreign firms?

3 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 LAU1 region of company seats, NACE 4-digit industrial classification codes, the annual average number of employees, the amount of equity capital held by type of owners, and major financial indices at the end of the term.

Foreign ownership is attributed to a firm when 10% or more shares of the stocks 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.

Tab. 1 Employment and number of firms in our 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

Source: http://www.ksh.hu/docs/eng/xstadat/xstadat_long/h_qli001.html

4 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 don't 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 don't share the four-digit level NACE code. Related firms might share enough knowledge but are not too proximate, therefore they can not only understand but might also learn new things from each other.
After that we applied panel logit approach to describe relations between related, unrelated, ownership variety in the region and firms entry, exit and membership.

1 Related variety and the ownership extension

Related variety calculation is as follows. Let p_i be the four-digit NACE share of employment and P_g 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).

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

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

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

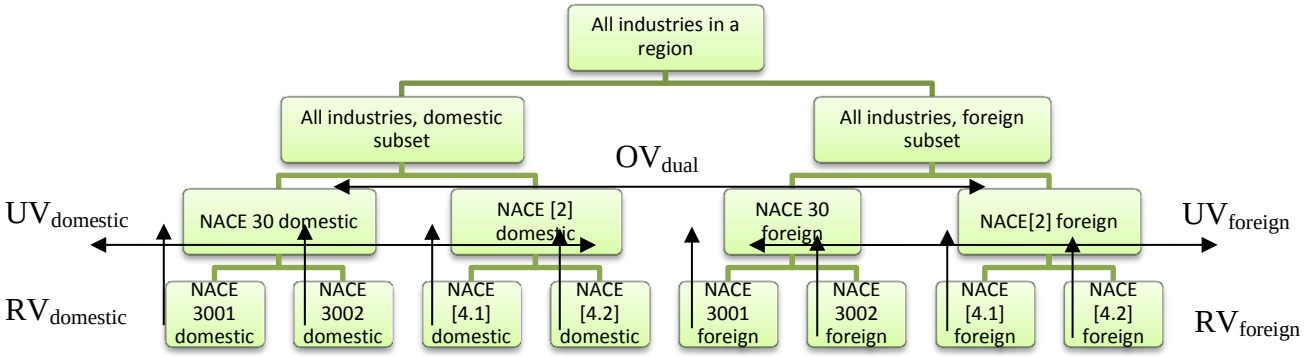
$$RV = \sum_{g=1}^{G} P_g H_g \quad (4)$$

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

As it follows from the above equations, related variety measures the extent to which the technological knowledge base of firms are related in a region. Relatedness is formulated on the base of technological proximity between firms. Other type of proximities into related variety calculation might be straightforward in less developed economies, because institutional gap between dynamic and lagging firms can set back inter-firm learning. The case of post-socialist transition is a good illustration: 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 with 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.

Fig. 1 Unrelated variety, related variety and firm ownership, a dual economy model



The formulation is visualized in Figure 1. Let p_{oi} be the share of employment in industries with four-digit NACE codes combined with ownership categories. Let p_{oi} sum up to P_{og} that is the share of employment in two-digit NACE codes combined with ownership categories. Also, let

the sum of P_{og} be P_o, 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 (UV_d and UV_f), plus domestic and foreign related varieties (RV_d and RV_f).

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

$$V = OV_{dual} + UV_{dual} + RV_{dual}$$

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

$$UV_{dual} = \sum_{o=f,d} P_o \sum_{g=1}^{G} \frac{P_{og}}{P_o} log_2 \left(\frac{1}{P_{og}/P_o} \right) = P_d UV_d + P_f UV_f$$

$$UV_d = \sum_{g=1}^{G} \frac{P_{dg}}{P_d} log_2 \left(\frac{1}{P_{dg}/P_d} \right)$$

$$UV_F = \sum_{g=1}^{G} \frac{P_{fg}}{P_f} log_2 \left(\frac{1}{P_{fg}/P_f} \right)$$

$$RV_{dual} = \sum_{o=f,d} P_o \sum_{g=1}^{G} P_{og} \sum_{i \in S_g} \frac{p_{oi}}{P_{og}} log_2 \left(\frac{1}{p_{oi}/P_{og}} \right) = P_d RV_d + P_f RV_f$$

$$RV_d = \sum_{g=1}^{G} \frac{P_{dg}}{P_d} \sum_{i \in S_g} \frac{p_{di}}{P_{dg}} log_2 \left(\frac{1}{p_{di}/P_{dg}} \right)$$

$$RV_f = \sum_{g=1}^{G} \frac{P_{fg}}{P_f} \sum_{i \in S_g} \frac{p_{fi}}{P_{fg}} log_2 \left(\frac{1}{p_{fi}/P_{fg}} \right)$$

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

2 Panel logit approach

We have the firm level database for two time periods 1998-2001 and 2002-2005. The first has been taken because it was the middle transition period while the second the late transition period. We have

- three binary dependent variables:
  - Entry (0-already there; 1-entrance in that year);
  - Exit (0-next year also there; 1-next year not there);
  - Member (1-both entry and exit = zero; 0-entry or exit happened).
- 3 sets of firms:
  - all, domestic and foreign;
- Explanatory variables, 2 approaches:
  - Related variety and unrelated variety (2 variables);
  - Ownership variety, related and unrelated varieties of the two subsets (5 variables);
- Control variable:
  - LQ – local specialization (NACE 4 level)

This means, that we tested altogether 36 different models.
Using a fixed effect model, firms with 000 or 111 are excluded from the investigation:

- In case of entry models this is not a problem (000 are already members they have no choice of entry) so we applied fixed effect model
- In case of exit and member models: it is a problem we used random effect model.

5 Results

Tab. 2 Firm entry, exit, and membership models in the late transition period

ENTRY MODELS												
	1998-2001						2002-2005					
	All		Domestic		Foreign		All		Domestic		Foreign	
LQ	-0.018	**	-0.049	***	-0.0008		-0.008	***	-0.006		-0.048	
	(-2.53)		(-4.12)		(-0.19)		(-1.64)		(-1.35)		(-1.48)	
UV	2.398		-10.22		106.89	*	-190.27	***	-247.42	***	-35.89	***
	(0.13)		(-0.52)		(1.73)		(-47.95)		(-54.23)		(-5.61)	
RV	-20.62	***	-19.07		-33.872	***	1.148	***	1.14	***	1.365	***
	(-14.48)		(-12.88)		(-5.51)		(53.13)		(48.49)		(14.75)	
N	22322		18466		2952		52938		47884		3552	
Chi2	6860.94		5165.68		1321.12		14438.17		13290.36		1511.35	
Ll-hood	-4305.74	***	-3816.98	***	-362.52	***	-11127	***	-9950.14	***	-475.35	***

Note:

Tab. 3 Firm entry, exit, and membership in dual economy models

ENTRY DUAL ECONOMY MODELS												
	1998-2001						2002-2005					
	All		Domestic		Foreign		All		Domestic		Foreign	
LQ	-0.027	***	-0.063	***	-0.0008		-0.014	**	-0.011	**	-0.08	**
	(-3.41)		(-4.81)		(-0.18)		(-2.37)		(-1.98)		(-2.00)	
OV	156.34	***	153.64	***	186.72	***	-60.89	***	-58.12	***	-112.58	***
	(17.30)		(15.88)		(6.07)		(-27.90)		(-26.09)		(-8.39)	
UV_D	-730.98	***	-848.26	***	-1161.92	***	-1114.92	***	-1137.46	***	-625.56	***
	(-5.66)		(-5.85)		(-3.23)		(-23.39)		(-22.99)		(-3.30)	
RV_D	-258.67	***	-3.958		-340.37	***	313.76	***	299.29	***	443.58	***
	(-3.95)		(-0.05)		(-4.26)		(67.26)		(61.80)		(19.89)	
UV_F	0.378		0.375		6.161		-9.282	***	-8.909	***	-28.64	***
	(1.26)		(1.32)		(1.19)		(-13.81)		(-13.28)		(-2.92)	
RV_F	36.12	***	31.37	***	38.79	***	1.523	***	1.464	***	2.421	***
	(11.56)		(7.45)		(5.36)		(19.04)		(17.61)		(5.93)	
N	22322		18466		2952		52938		47884		3552	
LR Chi2	6881.51		5205.67		1321.28		9509.06		1665.11		1437.37	
Ll-hood	-4295.46		-3796.99	***	-362.44	***	-13592.38	***	-12762.77	***	-512.34	***

We find that related variety hinders firm entry to the region in the earlier period (1998-2001), and favors firm entry at a later stage (2002-2005).
The hindering effect between 1998-2001 is due to relatedness among domestic firms;
Relatedness among foreign firms favors entry in every model.

We find, that the small effect of related variety on exit and membership separates sharply when it has been decomposed to foreign and domestic related varieties.
Towards a transition economy approach in relatedness research.

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