Lengyel I. – Vas Zs. (eds) 2016: *Economics and Management of Global Value Chains*. University of Szeged, Doctoral School in Economics, Szeged, pp. 65–86.

4. Related trade linkages, foreign firms, and employment growth in less developed regions

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How does international trade of foreign-owned companies contribute to regional economic growth in less developed regions? Are there knowledge externalities at play between co-located trade activities of foreign and domestic firms? We address the above questions by analysing the impact of technological relatedness of regional import and export activities performed by foreign and domestic companies on regional employment growth in Hungary between 2000 and 2007. Results suggest that the related variety of export activities benefits regional employment growth in general, while the host economy benefits more from the technological relatedness of domestic firms' trade activities, rather than relatedness to or between foreign firms' activities. Employment of domestic firms benefits from the trade activity of co-located foreign firms only if it is in the same product class.

Keywords: related trade variety, trade similarity, foreign-owned and domestic firms, regional employment growth

1. Introduction

International trade has long been considered a decisive underlying mechanism in regional development because export is a major source of income for regions, which can be multiplied by internal input-output relations (North 1955), and also because the level of success in international trade is linked to the cumulative emergence of agglomeration economies in the region (Krugman 1991). The intensification of globalization gave rise to empirical explorations on this matter (for an overview see Brülhart 1998), and also brought the role of foreign-owned firms in regional development into the focus of interest (Beugelsdijk et al. 2010, Dicken 1994, Iammarino – McCann 2013, Young et al. 1994). This is because multinational firms are more active than other firms in the global division of labour (Greeneway – Keller 2007), because spillovers from foreign firms increase the productivity of domestic companies (Haskel et al. 2007), and also decrease the entry cost for other potential exporters (Aitken et al. 1997). However, the effect of foreign firms in less developed regions is far from being clear since local economies might differ in the ways in which they can exploit the presence of foreign firms through production links and spillovers (Görg – Greeneway 2003, Phelps 2008, Soci 2003).

The recently emerging literature of evolutionary economic geography stresses the role played by technological relatedness in local knowledge spillovers (Frenken et al. 2007),

because co-located firms might learn from each other if their technological profile is not too different, but cannot benefit from this if their knowledge bases are identical (Boschma 2005). Furthermore, the role of technological relatedness of export is decisive in the development of countries (Hidalgo et al. 2007). Based on these arguments Boschma and Iammarino (2009) established an empirical framework for analysing the role of related trade linkages in regional economic growth. They argue that technological relatedness between the import and export profiles of a region matters for growth, because import can be considered as knowledge inflow into the region. This external knowledge may create new growth potentials if it is related but is not identical to existing productive knowledge, captured by export portfolio, in the region. To put it differently; if one considers regions to be the unit of production and import to be the inputs and export to be the outputs, then those regions are expected to grow faster that combine related imports in producing the exports.

We wish to contribute to this discussion in two ways. First, we offer evidence on the effect of related variety in trade activities from a less developed economy, as empirical results so far predominantly focused on regions of more developed economies. Second, to our knowledge no previous work offered evidence on the relationship between regional growth and the technological relatedness of trade activities performed by foreign firms and the host economy. In order to do this, we rely on a panel dataset of Hungarian exporter firms containing balance sheet variables, firm location, and the value of export and import products by SITC product codes for the period between 2000 and 2007. We argue that the Hungarian case is suitable to discuss the above issue because the country has a small and open economy, which means that most of the inputs has to be imported, and also because the economy is dominated by a small set of foreign-owned firms.

In the remainder we aim to understand how knowledge externalities stemming from international trade activities lead to economic growth in regions. Thus, the following research questions will be addressed:

(1) How does the related variety of export activities affect regional employment growth?
(2) How does technological relatedness between imported and exported products influence regional employment growth?
(3) Does technological relatedness between the trade activities of foreign and domestic firms influence regional employment growth?

In the following section we describe the economic context of Hungarian import and export activities and the historically formed duality of foreign- and domestic-owned

companies. We formulate our hypotheses based on the relevant literature. Next we elaborate on our research design by describing the quatitative approach we relied on, and explaining our key variables. We report our key findings in the results section, and finish the paper by offering conclusions based on the results.

2. Context and hypotheses

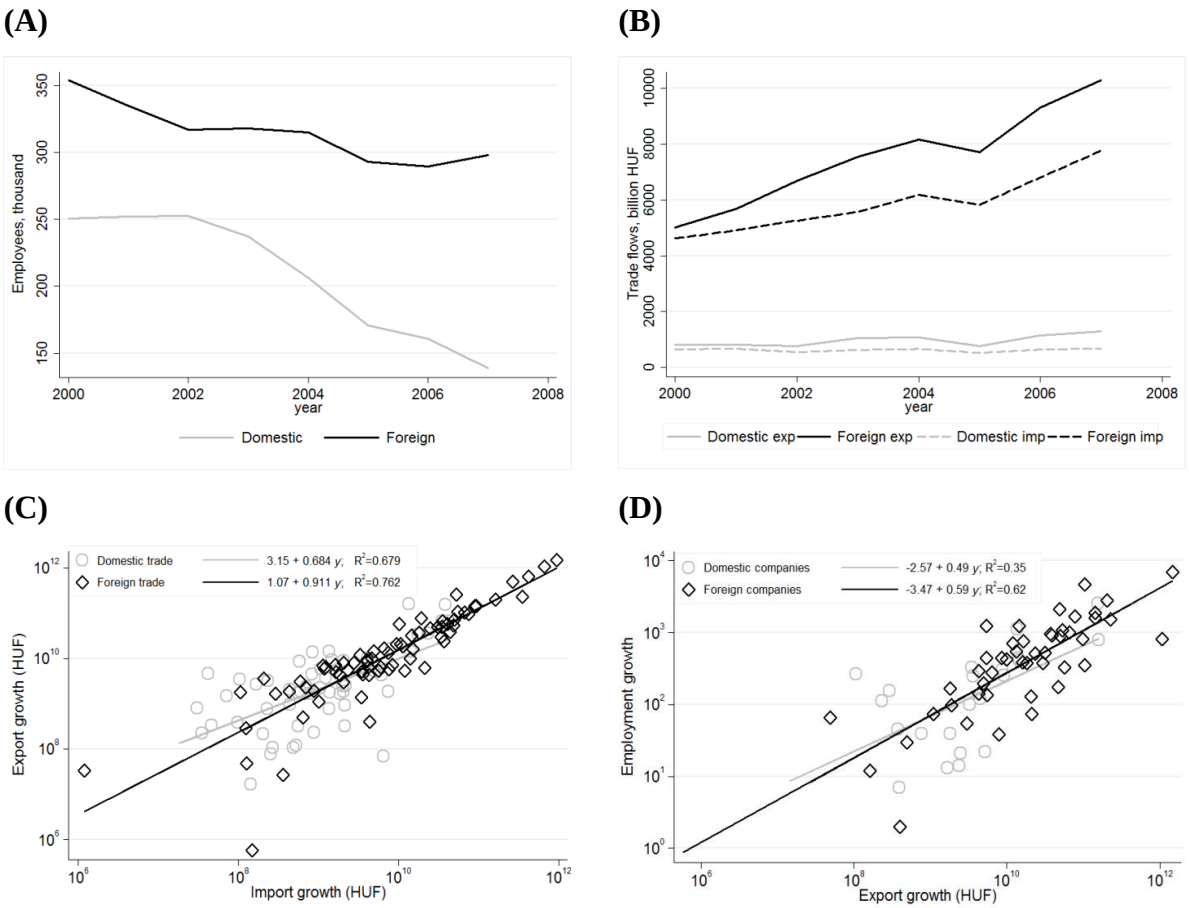
After the post-socialist transition, similarly to other countries in Central and Eastern Europe, regional economic development in Hungary was repeatedly found to be driven by investment decisions of multinational and foreign-owned companies (Lengyel – Leydesdorff 2011, 2015, Lengyel – Szakálné Kanó 2014, Radosevic 2002, Resmini 2007). Productivity spillovers have been found between foreign-owned firms and domestic companies, which decrease as geographical distance grows (Halpern – Muraközy 2007). However, the interactions between co-located foreign and domestic companies evolved slowly, and technological relatedness between them affected regional employment growth and entry-exit of domestic companies only in the 2000s (Lengyel – Szakálné Kanó 2013, Szakálné Kanó et al. 2016). These phenomena might be due to the fact that only those domestic companies could benefit from the presence of foreign-owned firms that were productive enough to absorb the positive externalities (Békés et al. 2009). Further evidence based on Hungarian data shows that foreign firms use imported inputs more effectively than domestic firms (Halpern et al. 2015), and that trading firms benefit more from agglomeration economies than non-trading firms (Békés – Harasztosi 2013).

The majority of foreign trade in Hungary can be attributed to foreign firms, especially in the case of the manufacturing industries, and they are also the drivers of export growth (Holland et al. 2000, Sass 2003). The period of our investigation is between 2000 and 2007, when the divide between foreign and domestic manufacturing export widened (Figure 1A).

The number of employees in foreign-owned manufacturing exporter firms was 350.000 in 2000, which fell to 300.000 by 2007. One can observe a much sharper decrease in the case of domestic firms: the number of employees fell from 250.000 to 150.000. However, the foreign-domestic gap is even more pronounced in terms of trade flow values; the volume of foreign export increases sharply over the period in question and exceeds import significantly, which is hardly the case for domestic companies (Figure 1B). One can also get the impression that foreign firms are more likely to combine imported inputs and re-export than domestic firms, because the growth of foreign export strongly correlates with growth in foreign import

while the correlation is weaker between domestic export and import growth (Figure 1C). Furthermore, foreign export increases foreign employment in the region more than domestic export increases domestic employment in the region (*Figure 1D*).

Figure 1 International trade and economic growth in a dual economy context, 2000–2007



Notes: (A) Total annual employment in manufacturing export (thousand employees) performed by foreign and domestic companies. (B) Total annual export and import in manufacturing (billion HUF) by foreign and domestic companies. (C) Correlation of import and export growth in foreign and domestic companies at the regional level. Grey hollow circles represent the aggregate of domestic companies and black hollow diamonds represent the aggregate of foreign companies in the region. Only growing regions are depicted. The solid lines represent a linear estimation. (D) Correlation of employment and export growth in foreign and domestic companies at the regional level. Grey hollow circles represent the aggregate of domestic companies and black hollow diamonds represent the aggregate of foreign companies in the region. Only growing regions are depicted. The solid lines represent a linear estimation.

Source: own construction

In order to answer our research questions within the previously outlined context, we first elaborate on the related variety literature recently developed in the field of evolutionary economic geography. Scholars have previously argued that firms of a region benefit from various positive externalities like localization economies (Marshall 1920), urbanization economies (McCann 2008), and Jacobs-externalities (Jacobs 1960). The relative importance of these externalities in regional growth is debated to this day (Beaudry – Schiffaeurova 2009, Glaeser et al. 1992, Henderson et al. 1995). In their influential paper Frenken et al. (2007) proposed that it is not specialization (spillovers within industries), nor the variety (spillovers between industries) of economic activities per se what matters for growth, but the extent of related variety in a region. Related variety in a region is composed of industries that are not too close in their knowledge base, so that they can learn from each other, but not too far either, so that they are able to understand each other (Boschma 2005). The variety of industries too dissimilar in their knowledge base is then considered unrelated variety. Following Frenken et al. (2007) related variety is expected to increase employment in the region due to knowledge spillovers across technologically related industries and thus the improved innovation potential. Empirical evidence so far fairly systematically shows that related variety is beneficial for regional employment growth in particular (Frenken et al. 2007, Boschma – Iammarino 2009, Boschma et al. 2012), and that these benefits are not equally available to all industries (Bishop – Gripaios 2010, Hartog et al. 2012, Mameli et al. 2012), and region sizes (Van Oort et al. 2013, Lengyel – Szakálné Kanó 2013) (see overview on the effect of related variety in Appendix 1).

The variety of export activities plays an important role in the explanation of growth based on spillovers. Saviotti and Frenken (2008) showed that long term economic growth of countries is stemming from the increase in variety (doing new things), not specialization (doing more of the same). Furthermore, Boschma and Iammarino (2009) and Boschma et al. (2012) showed a positive relationship between related variety of export products and the growth of employment in regions. Based on these findings we formulate our first hypothesis:

Hypothesis 1: Related variety of export activities has a positive effect on regional employment growth.

A further aspect to take into account in regional growth is the role of interregional trade flows, because new knowledge may reach regions from the outside as well and regional growth might depend on the re-combination of the external knowledge. Hidalgo et al. (2007)

argued that the economic development of countries is driven by their endowment of productive knowledge, which can be combined in meaningful ways into new products. This productive knowledge entails technological knowledge and production experience, industry-specific and general institutions, and scientific knowledge among others. They found that countries seldom "jump" from the production of less complex products (requiring less productive knowledge) to the most complex ones. On the regional scale, Boschma and Iammarino (2009) found that the variety of import was beneficial for growth when it was related to export activities, i.e. some elements of productive knowledge for a product were already present. Following this latter approach, we expect that relatedness between import and export industries is beneficial for growth, and state our second hypothesis:

Hypothesis 2: Related variety of export and import products has a positive effect on regional employment growth.

With this paper we would like to further improve our understanding on the local impact of foreign firms' trading activity on the domestic firms' trading activity using a related trade linkages approach. As discussed above, it is often proposed that foreign owned firms might generate knowledge spillovers to domestic companies in the form of increased human capital, management routines and new technologies. However, foreign-owned firms are usually less embedded in the local production networks than domestic firms, and in general domestic firms in Hungary are less innovative. Additionally the benefits of relatedness might be unequally available for domestic and foreign firms, as was the case with different industries, i.e. spillovers between trade activities might be structured along firm ownership. In-deed Szakálné Kanó et al. (2016) showed that the best fitting model for the Hungarian economy was the one assuming no relatedness between domestic and foreign firms, compared to the models assuming stronger proximity between ownership groups. In such a case we would expect that foreign and domestic firms interact predominantly through value-chain linkages rather than knowledge spillovers. This is also in line with the characteristics of Hungarian manufacturing export relying on low value-added assembling activities. For these reasons we state our last set of hypotheses concerning employment growth in the host economy:

Hypothesis 3a: Similarity of export by foreign and domestic firms has a positive effect on regional employment growth of domestic firms.

Hypothesis 3b: Similarity of import by foreign and export by domestic firms has a positive effect on domestic regional employment growth.

3. Research design

3.1. Data

Our empirical exercise relies on secondary data made available by the Hungarian Central Statistical Office. The dataset, collected by the Hungarian Customs Office, consists of the value of all international export and import flows in HUF by trading firm and by SITC product classes detailed at the 4-digit level. We restricted the data to the firms with double entry bookkeeping in order to match additional information including location of company seat (microregion level), the NACE class of the firms main activity (detailed at the 4-digit level), the number of employees and various balance sheet data (*e.g.* net revenue, total capital, foreign capital) from the balance sheet dataset collected by the Hungarian Tax Office. The dataset consists of data ranging from 2000 to 2007. We opted for microregions (LAU1) as the spatial unit of analysis. 175 microregions have been delineated in Hungary in accord with the EU spatial planning system, representing nodal regions.

The following efforts of data cleaning have been made before the regional variables were calculated. First, both SITC classifications changed in the time window at hand, therefore products had to be recoded from SITC rev. 4 to rev. 3 in 2006 and 2007. Second, international trade flow values were originally in current prices. Price indexes of SITC product classes, provided by the Hungarian Central Statistical Office, were used to deflate these values (2000=100%). We filled missing values of balance sheet data, if a firm was missing in the data for exactly one year (was present in the previous and the next year). For numeric values (*e.g.* number of employees, total equity capital) we filled these gaps with the average of last and next year values. For categorical values (e.g. region, NACE class), we used the value of the previous year.

In order to increase the reliability of the dataset we focused only on those firms that had at least 2 employees in every year between 2000 and 2007. Furthermore we solely focused on manufacturing firms (15-37 NACE rev 1.1 classes) for two reasons. First, we have access to company seat data that is more likely to represent the location of actual production activities in the case of manufacturing industries. Second, we are focusing on the import and export of products. For analytical purposes we consider a firm "foreign", if at least 10% the total equity capital of the firm is in foreign ownership. This limit is in accord with the OECD (2008) benchmark definition on foreign direct investment.

3.2. Estimation framework

Fixed-effect panel regression was chosen for estimation framework as this approach allows us to control for time-invariant unobserved effects such as institutions in different regions (Cameron – Trivendi 2009). Formally:

$$Y_{it} = \beta X_{it-1} + u_i + \varepsilon_{it} \quad (1)$$

where Y_{it} is the level of the dependent variable in region i at time t, X_{it-1} is the vector of the region-specific independent variables at time $t-1$, u_i is the fixed-effect and ε_{it} is the error term. As the Hungarian spatial structure is extremely skewed, *i.e.* Budapest, the capitol holds 20–25% of total employees in export and total export volume, we apply the natural logarithm of the dependent, as well as the independent variables. We use the one period lagged values of our independent variables, because we expect that changes in the variety of the regional product mix need some time to have an effect on regional employment and export volume.

Our dependent variable is regional employment (REGEMP) that measures the increase of productive capabilities, either as a result of establishing a new firm, or the growth of incumbent ones, aggregated at the regional level. In order to estimate the effect of variety on our dependent variable, we rely on the following regional controls. We attempt to control for the effect of intra-industry spillovers and localization economies with FHHI, the Herfindahl-Hirschman concentration index of export shares of different firms in the regional portfolio. Therefore a high FHHI value would suggest higher endowment in productive knowledge specific to only a few firms. Urbanization economies or urban size is controlled for by population density (POPDENS), as it is commonly used in economic geography. We also used total capital equity per employee (CAPPERLAB), regional productivity (export per employee) (REGPROD) and the volume of gross investments (INVEST) as regional control variables, since all three had acceptable (i.e. below 0.6) levels of correlation with the other variables (see Appendix 2 for detailed description of control variables).

3.3. Indicators of related variety of the regional export product mix

To assess the impact of (related) variety of the regional export product portfolio, we opted for the entropy-based approach of measuring variety, commonly used in evolutionary economic geography. The entropy-based approach measures the observable variety in a

probability distribution (Frenken 2007). Empirical applications most commonly rely on the classification of economic activities (e.g. NACE). Alternatively the classifications of products (e.g. PRODCOM, HS or SITC) can be used (e.g. Boschma – Iammarino 2009, Boschma et al. 2012). In this paper we make use of the SITC product classification. The entropy-measure takes its maximum value, when productive activities have an equal distribution over the classification (entropy of this system is maximal), and entropy takes its minimum value when activities are concentrated in one of the classes (entropy of this system is minimal). An attractive feature of the entropy-measure is its decomposability. The total entropy of a distribution with several subclasses equals the sum of the average within class entropy and the between class entropy (Frenken 2007).

First, we measure the overall diversity of productive activities with the VARIETY variable. It is the entropy of export product volumes at the 4-digit SITC level. Formally let $i = 1, \dots, N$ be a 4-digit export product in a region. Let p_i be the share of that export product i in the regional export. Then VARIETY can be calculated as:

$$VARIETY = \sum_{i=1}^{N} p_i \log_2 \left(\frac{1}{p_i}\right) \tag{2}$$

A region with diverse export portfolio has a high value of VARIETY as compared to a region with a specialized export portfolio. The positive effect of VARIETY on regional growth would suggest the prevalence of inter-industry knowledge spillovers.

However, as it is argued in the evolutionary economic geography literature, inter-industry spillovers can be expected when said industries are technologically related, *i.e.* not too different, yet not too similar in their productive knowledge. This is captured by the decomposition of the overall variety of the regional export portfolio into related variety and unrelated variety, as first proposed by Frenken et al. (2007). The related variety of regional export products is the weighted average entropy of export products within 2-digit product classes. Formally let $g = 1, \dots, G$ be a SITC 2-digit product class, and let S_g be any SITC 2-digit class. Related variety is calculated as:

$$RELVAR = \sum_{g=1}^{G} P_g H_g \tag{3}$$

where P_g is the aggregation of the 4-digit export shares:

$$P_g = \sum_{i \in S_g} p_i \tag{4}$$

The entropy within each 2-digit product class S_g is H_g:

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

In the decomposition of the overall entropy, unrelated variety captures the variety that can be observed between export products that are considered technologically unrelated, i.e. inter-industry knowledge spillovers are less likely to occur between them. We measure unrelated variety as the entropy of 2-digit export products in a region:

$$UNRELVAR = \sum_{g=1}^{G} P_g \log_2 \left(\frac{1}{P_g} \right) \tag{6}$$

3.4. Indicators of related variety of trade linkages

For assessing the impact that extra-regional trade linkages have on regional growth, we adopted the approach taken by Boschma and Iammarino (2009). We measured the overall variety of import products by the import entropy at the 4-digit level. Formally let $i = 1, \dots, N$ be a 4-digit import product in a region, and let p_i be the share of that 4-digit import product i in the regional import volume. Then the variable can be calculated as:

$$IMPVAR = \sum_{i=1}^{N} p_i \log_2 \left(\frac{1}{p_i} \right) \tag{7}$$

However, the overall import variety may not be the strongest indicator of potential access to extra-regional knowledge, as export industries might not be able to absorb that new knowledge. Therefore a related trade variety indicator of import and export industries was proposed by Boschma and Iammarino (2009). Here we slightly modified this measure to match the available SITC product data. The related trade variety measure determines for each

4-digit import product the import entropy within the same 2-digit class, excluding the 4-digit product in question. These cases are then weighted by the relative share of the same 4-digit product in the regional export. Finally the weighted entropy values are aggregated at the regional level. Formally let $i = 1, \dots, N$ be a 4-digit export activity in a region. Let $OE_4^M(i)$ be the import entropy within the 2-digit class that activity i belongs to, but excluding activity i. Finally let $X_4(i)$ be the relative size of activity i in the overall regional export portfolio:

$$RELTRADVAR = \sum_{i=1}^{N} OE_4^M(i) * X_4(i) \tag{8}$$

Following Boschma and Iammarino (2009) we check as well whether the import of products have any effect on regional growth, if the import activity is the same, as the export activity the region is already specialized in. The similarity of trade as an indicator is determined by the product of the absolute values of regional import and export volumes for each 4-digit product, aggregated at the regional level. Formally let $X_4(i)$ be the absolute trade value of export activity i in the regional export portfolio, and let $M_4(i)$ be the absolute trade value of import activity i in the regional import portfolio:

$$TRADESIM = \log \sum_{i=1}^{N} X_4(i) * M_4(i) \tag{9}$$

3.5. Indicators of related variety in and between ownership groups

In this paper we are particularly interested in whether the impact of related variety and related trade variety on regional growth is structured by ownership, i.e. whether the dual character of the less developed economy of Hungary makes this impact different according ownership group. We applied this structuring perspective on our dependent and independent variables as well. We calculated the values of the dependent variable of regional employment in export separately for the foreign and the domestic group of firms. In the case of the variety indices, we calculated the measures separately for ownership groups, and also between them. In the former case we calculated entropy measures from equation (2) to (6) separately for export activities of domestic and foreign firms, yielding us six measures of variety and relatedness. In the latter case we relied on a slightly modified version of equations (8) and (9)

in order to establish relatedness between the ownership groups. First we calculated the average level of relatedness of export between foreign and domestic firms ($RELFDIVAR$), as well as the complementary similarity indicator ($FDISIM$). Second, we applied the same approach in the case of international trade linkages in general leaving us with two structuring dimensions (direction of trade and ownership) and a total of eight relatedness or similarity measures (Table 1). For example $RELTRADVAR^{FD}$measures the related foreign import variety around domestic export products, aggregated at the regional level (see Appendix 2 for detailed description of all indicators).

Table 1 Indicators of relatedness structured by ownership and direction of trade flow

	Export not considered	**Export by domestic firms**	**Export by foreign firms**
Import not considered		$VARIETY^D$	$VARIETY^F$
		$RELVAR^D$	$RELVAR^F$
		$UNRELVAR^D$	$UNRELVAR^F$
		$RELFDIVAR$	
		$FDISIM$	
Import by domestic firms	$IMPVAR^D$	$RELTRADVAR^{DD}$	$RELTRADVAR^{DF}$
		$TRADESIM^{DD}$	$TRADESIM^{DF}$
Import by foreign firms	$IMPVAR^F$	$RELTRADVAR^{FD}$	$RELTRADVAR^{FF}$
		$TRADESIM^{FD}$	$TRADESIM^{FF}$

Notes: single character upper indexes signify variables calculated within the domestic ("D") or foreign ("F") subset of firms; double character upper indexes signify direction of foreign trade, and ownership groups involved: the first character represents import (by foreign or domestic firms), while the second character represents export (by foreign or domestic firms).
Source: own construction

4. Results

An overall picture of the impact of relatedness in trade activities is provided in Table 2. All models are statistically significant based on the F-statistic. Among our control variables, CAPPERLAB shows consistently negative and significant effect, meaning that higher total equity capital-employee ratio leads to decrease in overall regional employment. In the first three models INVEST shows a significant positive effect on growth, suggesting that investments are followed by an increase in the utilisation of labour as an input. We introduce VARIETY in Model 1 and decompose it into RELVAR and UNRELVAR in Model 2 in order to assess the impact of relatedness within export portfolio and within the productive

knowledge agglomerated in regions on regional employment in export. Model 2 suggests that even though variety in itself has a positive and significant effect on employment, this is only due to the positive effect of related variety of export activities; while unrelated variety has no significant effect. This result suggests that employment in export activities of the region increases if the general level of technological relatedness across export products is high in the region's portfolio. The finding is in accord with our expectation based on the evolutionary economic geography literature; related variety of export activities allows for novel recombination of productive knowledge, leading to new market niches and employment growth in the context of less developed Hungarian regions as well, thus Hypothesis 1 can be accepted.

Table 2 Related trade variety and export employment growth in Hungarian microregions between 2000 and 2007

	Model (1) $(REGEMP)$	**Model (2)** $(REGEMP)$	**Model (3)** $(REGEMP)$	**Model (4)** $(REGEMP)$
$\ln FHHI_{t-1}$	0.004	–0.021	–0.019	–0.045**
	(0.0551)	(0.0516)	(0.0506)	(0.0471)
$\ln POPDENS_{t-1}$	0.447	0.365	0.340	0.409
	(0.590)	(0.602)	(0.588)	(0.537)
$\ln REGPROD_{t-1}$	0.024	0.017	0.016	–0.072**
	(0.0398)	(0.0389)	(0.0362)	(0.0461)
$\ln CAPPERLAB_{t-1}$	–0.125***	–0.118***	–0.121***	–0.114***
	(0.0451)	(0.0430)	(0.0450)	(0.0382)
$\ln INVEST_{t-1}$	0.041**	0.046**	0.041*	0.028
	(0.00939)	(0.00941)	(0.00941)	(0.00859)
$\ln VARIETY_{t-1}$	0.083**			
	(0.249)			
$\ln RELVAR_{t-1}$		0.093***		
		(0.246)		
$\ln UNRELVAR_{t-1}$		–0.002		
		(0.241)		
$\ln IMPVAR_{t-1}$			0.076***	
			(0.250)	
$\ln RELTRADVAR_{t-1}$				0.051**
				(0.168)
$TRADESIM_{t-1}$				0.198***
				(0.0341)
N	1052	1052	1051	1049
R–squared	0.082	0.104	0.093	0.142
Adj. *R*–squared	0.077	0.098	0.088	0.136
F	5.29	5.80	5.31	7.85
Sig.	0.0001***	0.0000***	0.0000***	0.0000***

Notes: standardized beta coefficients; standard errors in parentheses; * p<0.1,** p<0.05,*** p<0.01
Source: own construction

In Model 3 and 4 in Table 2 we look at the relation between the region's import and export portfolios and find significant effect of relatedness in trade flows on employment growth. First, Model 3 suggests that the variety of import flows in itself has a positive effect on employment; the more diverse imported products are combined into exported products in the region the higher growth of employment. The variety of export products might indicate the value added in the production but one can also think of these import products as they give access to a variety of productive knowledge that might not be present in the region beforehand. However following Hidalgo et al. (2007) and Boschma and Iammarino (2009), one might expect the variety of new knowledge to have an effect on growth when it is somewhat compatible with the existing productive knowledge portfolio of the region, represented in its export mix. Thus, in Model 4 we consider related and similar trade flows only (RELTRADVAR and TRADESIM, respectively)[16]. The findings seem to support the argument to some extent that import related to export activities is beneficial for employment growth, thus Hypothesis 2 might be accepted. However, similarity of import and export activities in this regard is also positive and strongly significant; and even more, TRADESIM has stronger effect on growth than RELTRADVAR. Therefore, one might think that employment grew the most in those Hungarian regions where production combines imports into exports within the same product category, thus suggesting low value added. The finding is plausible in the context of the Hungarian economy. Namely, large foreign firms are known to install only a very limited scope of their value chain into the region and the value added of their production is relatively low in less developed regions.

To get a clearer picture about the above conjecture we turn to the models structured along ownership in Table 3, in which we specifically look at employment growth in domestic-owned firms. In this step we assessed whether relatedness of trade activities within or between ownership groups matters for the growth of employment in domestic export firms. Once again our models are statistically significant based on the F-statistic. Among the controls REGPROD (export volume-employee ratio) and CAPPERLAB (equity capital-employee ratio) show consistent and significant negative effect on employment growth. This is in line with the economics literature, since the higher productivity of firms lead to more efficient use of production factors like labour. Furthermore manufacturing firms might be combining more and more capital with less and less labour due to high factor cost of the latter.

[16] Unrelated variety between import and export activities was also calculated, but was subsequently omitted from the models due to multicollinearity.

Table 3 Related trade variety and export employment growth in Hungarian microregions, structured by ownership, between 2000 and 2007

	Model (1) ($REGEMP^D$)	**Model (2)** ($REGEMP^D$)	**Model (3)** ($REGEMP^D$)	**Model (4)** ($REGEMP^D$)	**Model (5)** ($REGEMP^D$)
$\ln VARIETY^F_{t-1}$	–0.022				
	(0.220)				
$\ln VARIETY^D_{t-1}$	0.053				
	(0.275)				
$\ln RELVAR^F_{t-1}$		0.006			
		(0.299)			
$\ln RELVAR^D_{t-1}$		0.036			
		(0.252)			
$\ln UNRELVAR^F_{t-1}$		–0.027			
		(0.255)			
$\ln UNRELVAR^D_{t-1}$		0.027			
		(0.292)			
$\ln RELFDIVAR_{t-1}$		0.032			
		(0.243)			
$FDISIM_{t-1}$		0.087**			
		(0.0223)			
$\ln IMPVAR^F_{t-1}$			0.019		
			(0.187)		
$\ln IMPVAR^D_{t-1}$			0.113***		
			(0.222)		
$\ln RELTRADVAR^D_{t.}$				0.053**	
				(0.188)	
$\ln RELTRADVAR^F_{t.}$				0.026	
				(0.164)	
$TRADESIM^{DD}_{t-1}$				0.103***	
				(0.0262)	
$TRADESIM^{FD}_{t-1}$				0.105**	
				(0.0236)	
$\ln RELTRADVAR^D_{t.}$					0.019
					(0.196)
$\ln RELTRADVAR^F_{t.}$					–0.004
					(0.227)
$TRADESIM^{DF}_{t-1}$					0.146***
					(0.0171)
$TRADESIM^{FF}_{t-1}$					–0.019
					(0.0263)
CONTROLS	YES	YES	YES	YES	YES
N	925	868	923	873	864
R–squared	0.085	0.108	0.105	0.151	0.120
Adj. *R*–squared	0.078	0.096	0.098	0.142	0.111
F	6.08	7.25	6.57	9.74	7.10
Sig.	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***

Notes: standardized beta coefficients; standard errors in parentheses; * p<0.1,** p<0.05,*** p<0.01
Source: own construction

Model 1 shows that variety in itself is statistically insignificant in either ownership group. Unrelated productive activities, as well as relatedness within or to the foreign subgroup have no significant effect on the employment of domestic firms. This shows on the one hand that while foreign firms have the dominant share in export employment, domestic firms benefit from foreign firms only when they export similar products, leading us to accept Hypothesis 3a. On the other hand, the host economy does not seem to receive new productive knowledge through spillovers between the ownership groups, when it comes to technological relatedness. This gives further support to the concerns regarding the existence and impact of knowledge spillovers between foreign and domestic firms in transition economies, and the technological gap between them.

In Model 3 and 4 the impact of international trade linkages along ownership are structured. $IMPVAR^{D}$ in Model 3 suggests that the variety of products imported by domestic firms in particular is benefit regional growth. Furthermore results of Model 4 show first that relatedness between import and export of domestic firms has a positive and significant effect. This means that we can expect new combinations of productive knowledge and employment growth in the host region (seen in Table 2) specifically when import of domestic firms is related to the export of those firms. This further supports the findings across Model 1 to 3 that spillovers between foreign and domestic firms are a rarity, and that the domestic firms can combine productive knowledge with other domestic firms more easily. Second, similarity of products has a stronger positive effect on domestic regional employment either when foreign or domestic firms import those products. The relative strength of the similarity indicators points towards the strong dependence of domestic firms on international value-chains and less from inter-industry knowledge spillovers, thus we accept Hypothesis 3b. Model 5 reinforces this finding showing strong significance in the case of similarity of trade between the import of domestic and the export of foreign firms.

5. Conclusions and further research

In this paper we set out to estimate (1) the impact of related variety in export activities on regional employment growth; (2) the impact of technological relatedness between import and export activities on regional employment growth; (3) the impact of technological relatedness between the trade activities of foreign and domestic firms on the employment of the host economy, to assess the role of knowledge spillovers between foreign and domestic

trade activities. To do this, we relied on a panel of Hungarian microregions between 2000 and 2007 provided by the Hungarian Central Statistical Office, and we used a fixed-effect panel regression method. Based on our results, a number of conclusions can be drawn regarding the role of foreign firms in the regional employment growth of the transition economy of Hungary.

First, our findings support the claims made in evolutionary economic geography that related variety of productive knowledge is beneficial for regional employment growth. Indeed, Hungarian regions with higher related variety of export activities had higher employment growth, and the variety in import products was also beneficial when related to the export. Second, these knowledge spillovers based on the related variety of productive knowledge are more likely to occur between trade activities of domestic firms, while these kinds of benefits do not spill over ownership groups. This seems to underline that learning between the trade activities of foreign and domestic firms are not widely available to all firms of the host economy. Fourth, the host economies of Hungarian regions depend heavily on international value-chains. It seems that in Hungary, characterized by the dominance of assembly activities in manufacturing, growth is driven by the access to these value-chains represented by foreign firms. This accentuates the vulnerability of Hungarian regions: the sources of growth are largely dependent on external factors.

Naturally there are ways in which we can continue our investigation. First, it might shed further light on our findings if relatedness is measured by other means. Proximity of products (Hidalgo et al. 2007) or revealed relatedness (Neffke – Henning 2008) are ways in which we could open the "black boxes" of regions. Second, it seems that value-chain connections are central factors in our investigation, therefore they could be controlled for by the means of regionalized input-output networks.

Acknowledgements

We thank Ron Boschma, Imre Lengyel, and Attila Varga for their suggestions. László Czaller provided further help. Useful comments have been received at the Annual Conference of Hungarian Regional Science Association and the 2nd workshop on Evolutionary Economic Geography in Central and Eastern Europe in 2015.

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Appendix

Appendix 1 Empirical findings on the effect of related variety on regional economic growth.

Study	Value-added growth	Productivity growth	Employment growth
Bishop – Gripaios (2010)			–, 0, +
Boschma – Iammarino (2009)	+	+	+
Boschma et al. (2012)	+	0	0, +
Boschma et al. (2014)		+	+
Brachert et al. (2013)			+
Frenken et al. (2007)		–	+
Hartog et al. (2012)			0, +
Lengyel – Szakálné Kanó (2013)			–, +
Mameli et al. (2012)			+
Quatraro (2010)		+	
Quatraro (2011)		+	
Van Oort et al. (2013)			+
Wixe – Andersson (2016)		–	+

Notes: „+" means positive effect, „–" means negative effect, „0" means not significant.
Source: own construction

Appendix 2 Descriptive statistics of variables.

Variable	Operationalization	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
REGEMP	Total employees in export.	1264	3385.963	10564.94	22	154701
$REGEMP^D$	Total employees in export in the foreign group.	1142	1460.801	4111.453	12	56805
CAPPERLAB	Total capital equity of export firms in a region, divided by the number of total employees.	1264	2283.78	2703.075	56.58331	18268.05
REGPROD	Export volume in a region, divided by the number of employees.	1349	3906846	7571658	10911.79	1.74e+08
FHHI	Herfindahl-Hirschman concentration index of export shares of firms.	1382	.4491339	.2597107	.0406871	1
POPDENS	Total population of a region divided by its area.	1400	1.17041	2.565051	.2272712	34.49655
INVEST	Total gross investments of export firms in a region.	1220	2362080	8945369	0	1.17e+08
VARIETY	Export variety at the 4-digit level.	1382	.7913579	.3461715	0	1.984503
RELVAR	Related variety of export.	1382	.2215595	.1703468	0	1.101889
UNRELVAR	Unrelated variety of export.	1382	.5697984	.2566	0	1.31828
IMPVAR	Import variety at the 4-digit level.	1381	1.215775	.3983954	0	2.327487
RELTRADVAR	Regional aggregate of related import variety around 4-digit export activities.	1393	.2788165	.2161586	0	1.038014
TRADESIM	Regional aggregate of the products of import and export volumes of the same 4-digit productive activity.	1331	17.85982	2.11518	9.158642	23.97404
$VARIETY^F$	Export variety at the 4-digit level within the foreign group.	1248	.6314327	.3481615	0	1.851883
$VARIETY^D$	Export variety at the 4-digit level within the domestic group.	1349	.7014436	.3627017	0	2.106802
$RELVAR^F$	Related variety of export within the foreign group.	1248	.179615	.1612395	0	1.018179
$RELVAR^D$	Related variety of export within the domestic group.	1349	.2083952	.1823647	0	1.101889
$UNRELVAR^F$	Unrelated variety of export within the foreign group.	1248	.4518177	.2612471	–5.18e-08	1.269581
$UNRELVAR^D$	Unrelated variety of export within the domestic group.	1349	.4930483	.2765822	0	1.384719

Appendix 2 Continued.

Variable	Operationalization	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
$RELFDIVAR$	Regional aggregate of related export variety of foreign firms around 4-digit export activities of domestic firms.	1382	.0624881	.1154143	0	.7777508
$FDISIM$	Regional aggregate of the products of foreign and domestic firms' export volumes of the same 4-digit productive activity.	1063	16.05489	2.34662	7.89124	21.25196
$IMPVAR^F$	Import variety at the 4-digit level within the foreign group.	1253	1.107353	.3826809	0	2.234524
$IMPVAR^D$	Import variety at the 4-digit level within the domestic group.	1348	1.033011	.4551112	0	2.375059
$RELTRADVAR^{DD}$	Regional aggregate of related import variety of domestic firms around 4-digit export activities of domestic firms.	1375	.183731	.203143	0	1.056609
$RELTRADVAR^{FD}$	Regional aggregate of related import variety of foreign firms around 4-digit export activities of domestic firms.	1382	.1225798	.173071	0	.9615453
$TRADESIM^{DD}$	Regional aggregate of the products of domestic firms' import and domestic firms' export volumes of the same 4-digit productive activity.	1222	16.24803	1.912362	8.678443	21.8191
$TRADESIM^{FD}$	Regional aggregate of the products of foreign firms' import and domestic firms' export volumes of the same 4-digit productive activity.	1109	15.66478	2.206719	6.695993	21.69215
$RELTRADVAR^{DF}$	Regional aggregate of related import variety of domestic firms around 4-digit export activities of foreign firms.	1381	.0929558	.1561285	0	.9443666
$RELTRADVAR^{FF}$	Regional aggregate of related import variety of foreign firms around 4-digit export activities of foreign firms.	1273	.2637417	.2180385	0	1.039627
$TRADESIM^{DF}$	Regional aggregate of the products of domestic firms' import and foreign firms' export volumes of the same 4-digit productive activity.	1064	15.54789	2.251326	7.056135	21.49665
$TRADESIM^{FF}$	Regional aggregate of the products of foreign firms' import and foreign firms' export volumes of the same 4-digit productive activity.	1207	17.83709	2.195492	7.269616	23.97402

Source: own construction