Sources of productivity differentials in manufacturing in post-transition urban South-East Europe

Bačić, Katarina; Rašić Bakarić, Ivana; Slijepčević, Sunčana

Source / Izvornik: **Radni materijali EIZ-a, 2017, 5 - 44**

Journal article, Draft version
Rad u časopisu, Radna verzija

Katarina Bačić, Ivana Rašić Bakarić and Sunčana Slijepčević

Sources of productivity differentials in manufacturing in post-transition urban South-East Europe

Studeni . November 2017

Radni materijali EIZ-a . EIZ Working Papers

HR EXCELLENCE IN RESEARCH

ekonomski institut, zagreb

Br . No EIZ-WP-1706

Radni materijali EIZ-a
EIZ Working Papers
EIZ-WP-1706

Sources of productivity differentials in manufacturing in post-transition urban South-East Europe

Katarina Bačić, PhD
Knowledge Network Ltd.
Makančeva 16, 10 000 Zagreb, Croatia
Phone: ++ 385.1.4669540
E-mail: bacic.keti@gmail.com

Ivana Rašić Bakarić, PhD
The Institute of Economics, Zagreb
Trg J. F. Kennedyja 7, 10 000 Zagreb, Croatia
Phone: ++ 385.1.23.62.000
Fax: ++ 385.1.23.35.165
E-mail: irasic@eizg.hr

Sunčana Slijepčević, PhD
The Institute of Economics, Zagreb
Trg J. F. Kennedyja 7, 10 000 Zagreb, Croatia
Phone: ++ 385.1.23.62.000
Fax: ++ 385.1.23.35.165
E-mail: sslijepcevic@eizg.hr

www.eizg.hr

Zagreb, November 2017

IZDAVAČ / PUBLISHER:
Ekonomski institut, Zagreb / The Institute of Economics, Zagreb
Trg J. F. Kennedyja 7
10000 Zagreb
Croatia
T. 385 1 2362 200
F. 385 1 2335 165
E. eizagreb@eizg.hr
www.eizg.hr

ZA IZDAVAČA / FOR THE PUBLISHER:
Maruška Vizek, ravnateljica / director

e-ISSN 1847-7844

Contents

Sources of productivity differentials in manufacturing in post-transition urban South-East Europe

Abstract

The paper analyses the effects of urbanization and localisation economies on manufacturing firms' productivity across urban landscapes in post-transition South-East European (SEE) countries. Fixed-effects panel data estimations on a large sample of firms show that the factors accounting for productivity advantages of manufacturing firms in urban post-transition SEE are related to the firms and to the environment in which these firms operate. Firms located in diversified cities benefit from a productivity premium generated in this type of agglomeration, while no evidence was found that the relative specialization across industries has any effect on firm productivity levels.

Keywords: city, manufacturing, total factor productivity, post-transition South-East Europe

JEL classification: D24, R00, R12

Istraživanje razlika u produktivnosti poduzeća u prerađivačkoj industriji u gradovima posttranzicijskih zemalja jugoistočne Europe

Sažetak

U radu se analiziraju učinci urbanizacije i lokalizacijske ekonomije na produktivnost poduzeća u prerađivačkoj industriji u gradovima posttranzicijskih zemalja jugoistočne Europe. Procjene modela s fiksnim učincima na velikom uzorku poduzeća pokazuju da je produktivnost poduzeća u prerađivačkoj industriji u gradovima posttranzicijskih zemalja jugoistočne Europe u najvećoj mjeri povezana sa samim poduzećem i okružjem u kojem djeluje. Rezultati pokazuju da poduzeća smještena u diversificiranim gradovima ostvaruju koristi od produktivnosti ostvarene u tom tipu aglomeracije. S druge strane, nema dokaza da relativna specijalizacija po djelatnostima industrije ima učinaka na razinu produktivnosti poduzeća.

Ključne riječi: grad, prerađivačka industrija, ukupna faktorska produktivnost, posttranzicijska jugoistočna Europa

JEL klasifikacija: D24, R00, R12

1. Introduction[1]

Recent research on the local productivity advantages of Italian manufacturing firms (Di Giacinto et al., 2014) has found urban areas more beneficial for manufacturing than other types of firm agglomeration. It appears that manufacturing firms in urban areas accrue productivity advantages over firms in other types of agglomerations. The literature suggests that firms in larger cities tend to be more productive, and after ruling out localised natural advantages, this can be attributed to agglomeration economies and stronger firm and worker selection (Combes et al., 2012). When it comes to type of agglomeration, cities may be diversified or specialised, and these particular settings may also influence firm performance. Cities often remain specialised in a particular industry throughout larger periods.

Throughout South-East Europe (SEE), particularly in the pre-transitional period, there has been a tradition of specialisation in manufacturing throughout the urban space, often under the shield of protectionist trade policies and government subsidies. The economic structure of entire economies and their cities in transitional Europe has been transformed by transitional processes, including trade liberalisation, since the early 1990s and by European Union (EU) integration processes. However, the results of these changes to cities' economic structure are not well documented. Post-transition SEE consists mostly of countries that have not attracted sufficient attention of researchers as most are considered "late reformers". These countries are mostly underperforming compared to the "early bird club" of economies that joined the EU by 2004 and have appropriated significant development advantages by attracting foreign direct investments (FDI) and facilitating increase in trade flows (Botric et al., 2015). The economic importance of cities in SEE countries is unrivalled. World Bank data show that in

[1] This research was supported by a grant from the CERGE-EI Foundation under a program of the Global Development Network. All opinions expressed are those of the author(s) and have not been endorsed by CERGE-EI or the GDN.

2014 over half of the population in most SEE countries resided in urban areas. The effects of joining the unified economic space can be observed through liberalisation of trade and capital flows. In the economic literature, the effects of economic integration on spatial distribution of activity are predicted by the new economic geography (NEG) concept (Fujita, Krugman, 2004). Stronger specialisation of spatial units is expected to occur as a result of trade liberalisation.

The goal of this paper is to contribute to understanding the effects of urbanisation and localisation economies on firm productivity differences. Industries are "mapped" across 98 cities in six post-transitional SEE economies: Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Bulgaria and Romania. In these post-transitional economies, the processes of deindustrialisation and reindustrialisation have occurred simultaneously over the last two decades. Previous research on various aspects of industrial activity in transitional Europe focuses mostly on regions as spatial units; the role of cities as locations of manufacturing firms in SEE is still largely unexplored.

The countries differ with respect to size, geographic position, stage of EU integration and development level. Slovenia, Croatia, and Bosnia and Herzegovina are smaller countries, while Serbia, Bulgaria and Romania are larger ones. Slovenia and Croatia are the closest to the European core, while Bulgaria and Romania are the most peripheral. Slovenia has also been the most successful in converging to the EU development level. This paper looks into the results of structural changes that have formed these cities' present industrial profiles. Research questions that are raised are: Firstly, do localisation and urbanisation economies play an equally important role as industry or firm traits in firm performance? Secondly, what have been the effects of localisation economies on firm performance in the post-2008 period?

In order to answer the first question, the structural traits of urban economies are considered as a factor that can be supportive of productivity growth. Industries are mapped across cities with over 50,000 inhabitants, a population threshold that is in line with previous literature and with the limitations of the dataset used in this research. The intention is to discover what type of economic structure is more conducive in creating positive local externalities that can lead to productivity advantages. The second question deals with the issue of exposure to economic shocks. NEG predicts that, with the rise of specialisation across the EU space, these specialised locations will be more exposed to asymmetric shocks. Given the fact that the period of observation also includes the time of the 2008 economic recession, brought on by the global financial crisis, this prediction can be tested on a micro scale.

The empirical analysis in this paper consists of two building blocks. The mapping of productivity differentials across firms relies on methodologies for estimating firms' total factor productivity (TFP). Sources of firm-level TFP differences are estimated in a panel data setting. An econometric model is built with the purpose of integrating firm, industry and agglomeration factors that can have an effect on firm performance. By "mapping" industries across urban spaces and assessing the importance of different types of agglomeration economies for firm efficiency in European post-transitional economies, this paper contributes to the current body of research on transitional economies.

The paper is structured as follows: Section 2 provides a literature overview on city specialisation issues and reflects on them as a source of TFP growth; Section 3 describes the dataset and city sample, and discusses representativeness issues; Section 4 provides the results of TFP estimation; Section 5 introduces the econometric model; Section 6 deals with robustness checks; Section 7 offers conclusions.

2. Literature review

There is scarce empirical evidence on changes in the economic structure occurring through European integration across urban areas of transitional Europe. The literature that does exist points to a growing economic polarisation between capital cities and other cities in national urban hierarchies. Broad evidence on the state of cities in transitional Europe was gathered by Lintz et al. (2007), who report that market forces have spurred city development, but this is largely limited to metropolitan regions, as the most attractive agglomerations. At the same time, many old industrial cities, coined “cathedrals in the desert”, that hosted important industrial plants have experienced a setback. Lintz et al. explain the context of this setback through a lower business start-up rate of the local population. Furthermore, the attraction forces of metropolises have drawn in foreign investors, enabling capital cities to strengthen their position within the national urban hierarchy. Dogaru et al. (2014) have found that capital city regions in transitional Europe have received more greenfield FDIs and attracted a wider variety of investments, both in terms of sectors and functions. Largely, these findings would imply that “core” locations at the national level are better integrated through trade and capital flows than the rest of the urban areas in European transitional countries.

Through trade liberalisation and EU integration processes, post-transitional Europe has become open to structural changes. These processes can lead to an increase in specialisation across key manufacturing locations, including cities.

Increasing returns to scale (RTS) are the fundamental reason why firms would concentrate their sites and why large plants would concentrate their production in a single location rather than in different locations (Ascani et al., 2012). Importantly, in NEG external economies are considered a source of industry localisation and resonate with Marshall's agglomeration externalities—labour market pooling, availability of specialised intermediates and technological spillover effects (Krugman, 1991). Agglomeration externalities are the result of non-market interactions that produce increasing returns that are external to firms (paraph., Fujita, Thisse, 2009). Home market effects also play an important role in NEG models and can be explained in terms of a core-periphery setting. Through circular causation of forward linkages (related to the workers'/consumers' incentive to be close to producers of consumer goods) and backward linkages (related to the producers' incentive to concentrate in larger markets), a centripetal force is generated that reinforces concentration in the industrial core (Fujita, Mori, 2005), and thus also reinforces specialisation in the core.

Furthermore, in light of NEG, Krugman (1991) has predicted that the removal of trade barriers and European integration will bring about more industrial specialisation (or concentration) across EU and, as a consequence, more exposure to asymmetric economic shocks. Evidence from the incumbent EU members over the last two decades was not supportive of this prediction, at least at the regional level (OECD, 2004). However, Longhi et al. (2014) argue that the metropolitan areas and major regional centres of larger EU countries may accumulate the most benefits from European integration, using NEG as a theoretical foundation of their work. Longhi et al. (2014) have shown that specialisation has increased and that sectoral structures have become more similar in services. Moreover, the integration, coupled with development, positively influences specialisation in the sense that the positive effect of development on specialisation is stronger in metropolitan areas that are better integrated with the EU.

Cities are considered centres of economic activity and, presumably, they remain attractive locations for manufacturing firms so long as the benefits of agglomeration economies prevail over the costs of agglomeration diseconomies. Agglomeration economies attract firms and labour to co-locate, while agglomeration diseconomies push firms and labour to relocate to decentralised locations (Richardson, 1995). All cities are characterised by being either specialised or diversified, depending on whether their economic activity is concentrated in similar or dissimilar types of production—and larger cities tend to be more diversified (Duranton, Puga, 2000). Evidence on the productivity advantages that firms can appropriate by locating in larger cities and in more diversified locations can be found in the empirical literature. Firms in larger cities are overall more productive than firms in smaller cities (Combes et al., 2012; Rosenthal, Strange, 2004), due to a number of reasons, including foremost the agglomeration economies, but also localised natural advantage, and stronger worker and firm selection (Combes et al., 2012). Furthermore, productivity advantages of firms located in cities as more diversified locations are noted over firms in more specialised industrial-district-type of areas (Di Giacinto et al., 2014 provide convincing evidence for Italy).

On a micro scale, agglomeration forces influence firm performance through indivisibility, synergy and proximity. Namely, as summarised by Capello (2009): a) *indivisibilities* emerge through economies of scale and are industry-specific; b) when firms cooperate and achieve market interactions, *synergy* is created through outsourcing and flexibility in production which allows for minimization of transaction and production costs, in turn leading to greater firm productivity; c) g*eographic proximity*, i.e., the spatial concentration of firms is supportive of both indivisibilities and synergy. Syverson (2011) provides an extensive overview of research on sources of differences in productivity levels of firms. As a starting point, productivity differences among firms are found to be persistent, even in narrowly defined industries. While some of the factors are firm-related, such as management practices or intangible capital, many are embedded in firm environment, for example competition, demand structure, regulation, etc. In the case of emerging economies, Syverson refers to the literature that recognises that firm inefficiencies arise from inadequate allocation of resources in production.

FDI is considered a channel of economic integration for transitional Europe that may bring knowledge transfer, restructuring of local firms and integration into global value chains through exporting activities on a micro scale. All of these activities should lead to higher efficiency of foreign-owned firms in SEE, while the effects on other local firms do not necessarily have to be positive. Early evidence from Central and Eastern European (CEE) economies has revealed that with the advent of multinational firms, there has been some integration of local firms into global production networks, but these effects have been limited to their subsidiaries (Kaminski and Smarzynska, 2001). Zukowska-Gagelmann (2000) and Hamar (2001) report on the emergence of a two-tier economy in Poland and Hungary, where enterprises that have received FDI dominate the economy, while local enterprises only try to catch up. Konings (2001) did not find any positive spillover in Bulgaria, Poland and Romania from foreign-owned enterprises to local firms in the period of 1993–1997. Newer evidence is provided by Stojcic and Orlic (2015), who use the spatial Durbin model to show that horizontal and backward spillovers in the same region were negative, suggesting that local firms do not meet the quality standards of multinational corporations. At the same time, urbanisation externalities and firm size, in the case of larger firms, were found to be important factors for improving the productivity of local firms. Botric et al. (2015) tackle the issue of inter-relatedness of trade and FDI in SEE, including all countries observed in this paper apart from Slovenia. Using econometric estimates on data for the 2001–2013 period, the authors confirm a long-run relationship between FDI and trade, suggesting that countries that have received more FDI are more trade-orientated, and thus more integrated into global value chains. Drawing on these findings for transitional Europe, positive effects of FDI appear largely limited to firms in foreign ownership since positive spillovers to local firms are not verified.

3. Dataset description

The empirical analysis was conducted on a large unbalanced panel of 63,506 manufacturing firms observed over the period of 2006–2013. The data were obtained from Bureau Van Dijk's Amadeus firm-level database, containing, most importantly, balance sheet data and profit-and-loss account data for CEE. The unit of analysis is the firm defined as a legal entity, as opposed to individual plants. This procedure yielded a total of 98 "cities" in SEE, covering 35.3 percent of the total SEE population (Census data, 2011[2]). The number of cities in each country and their share in the total national population are as follows: Bosnia and Herzegovina: 12 cities or 35.6 percent of the 2011 population; Bulgaria: 18 cities or 44.7 percent of the 2011 population; Croatia: nine cities or 35.4 percent of the 2011 population; Romania: 38 cities or 32.8 percent of the 2011 population; Serbia: 17 cities or 35.7 percent of the 2011 population; Slovenia: four cities or 24.8 percent of the 2011 population.

To address the issue of incumbent and new firms, assumptions were made on firm entry and exit: a) firms that were recorded in the database at the beginning of the observed period are

[2] Available at national statistical offices' websites.

assumed incumbent, while firms that appear in later years are assumed to be new firms, and b) firm exit is assumed if data for the firm cease to be recorded or if information on its status indicates that it is dissolved. The share of firms that were observed over the entire sample period is 42.5 percent. The analysis is focused on the manufacturing industry alone because measuring and estimating productivity in services raises additional methodological challenges. The dataset includes 414,052 observations. To simplify summary analysis and reporting, the thirty separate manufacturing industries identified by two-digit NACE codes were grouped into ten industry groupings[3].

To produce the city-size-class ranges, the total population of the city area was used. The highest number of observations, 37.1 percent, refers to firms located in large cities (cities with more than 500,000 inhabitants), followed by firms located in cities with 100,000 to 249,000 inhabitants (24.2 percent of the observations) and firms located in cities with 50,000 to 99,000 inhabitants (Table 1). About 63 percent of the observations refer to three industry groups: food, beverages and tobacco industry; furniture and other manufactured goods; and textiles, apparel and leather industry (Table 1).

[3] Coke and refined petroleum products as the eleventh industry grouping were dropped from further analysis due to insufficient number of observations.

Table 1: The sample—number of observations

	City size class				
	Less than 99,000	100,000–249,000	250,000–499,999	More than 500,000	Total
Food, beverages, tobacco	17,715	16,315	10,997	23,840	68,867
Textiles, apparel, leather	15,783	16,292	9,947	20,677	62,699
Wood, cork, paper, printing, recorded media	11,792	11,053	8,759	22,474	54,078
Chemicals, pharmaceuticals, rubber, plastic	7,943	8,336	5,647	14,308	36,234
Other non-metallic mineral products	4,196	4,111	2,239	6,184	16,730
Basic metals, metal products	14,855	15,772	9,871	19,796	60,294
Machinery and equipment	3,161	3,909	2,738	6,399	16,207
Computer, el. and optical products, el. equipment	3,469	5,490	3,317	12,056	24,332
Transport equipment	1,534	2,407	1,087	2,483	7,511
Furniture, other manufactured goods	12,588	16,506	12,491	25,515	67,100
Small firms (less than 50 employed)	82,554	88,543	60,258	139,648	371,006
Medium-sized firms (50–250 employed)	7,596	8,548	4,556	9,612	30,312
Large firms (more than 250 employed)	2,886	3,100	2,279	4,472	12,734
Total	93,036	100,191	67,093	153,732	414,052

Sources: Amadeus, national statistical offices.

Since data on the number of firms in manufacturing were not publicly available for all of the selected cities, the total number of manufacturing firms in the country is resorted to as another option for assessing data coverage (Table 2). Thus, coverage is considered as the share of firms from the sample in the firm population in the country, and also as the share of employment in the sample in total country employment. Romanian and Bulgarian firms prevail in the sample, and clearly this can be attributed to the higher number of cities from these countries that are represented in the sample. Coverage rate in terms of number of firms ranges from about 11 percent in Slovenia to 60 percent in Romania. A parallel can be drawn with population data in these cities, as they range from 24.8 percent in Slovenia to 44.7 percent in Bulgaria, displaying varying patterns of agglomeration that are quite likely to be reflected in firm agglomeration as well. Coverage in terms of number of employees is quite stronger, as expected, ranging from 19.2 percent in Slovenia to 56.1 percent in Romania. Lower coverage of Croatian and Slovenian data is striking if we consider this fact in terms of small vs. large country differences, and may shed some light on the geographical distribution of manufacturing activity in smaller economies. Obviously, a greater part of manufacturing industries is located outside the selected cities in these two small economies.

Table 2: Coverage of countries' firm population

Country	Total coverage, in terms of:	
	Number of firms	Number of employees
Bosnia and Herzegovina	39.9%	38.9%
Bulgaria	49.9%	54.5%
Croatia	22.7%	36.9%
Romania	60.1%	56.1%
Serbia*	50.3%	53.7%
Slovenia	11.0%	19.2%

Sources: Authors, Amadeus, Eurostat, * national statistical office.

Examining the data on the population of manufacturing firms in capital cities also provides a way to address the issues of sample representativeness. Capital cities keep their own statistics of city-related economic data, but this is not the case with other cities (Table 3). Coverage in Croatia's capital, Zagreb, is quite encouraging as 91 percent of manufacturing firms are included in the sample. In the case of Bosnia and Herzegovina's capital city, Sarajevo, 71.8 percent of the population of manufacturing firms are covered by the sample, while for the Slovenian capital of Ljubljana the coverage rate is 71.8 percent. For Belgrade, the Serbian capital city, data are less detailed, yet the coverage is 66 percent[4]. Consideration must be given to less detailed data from city statistics on the firm population in Belgrade that does not include information on whether firms are active or not. If both categories are included in the population, then data coverage is even higher. Overall, these additional checks of data coverage appear rather satisfactory and the sample can be considered representative.

[4] Data for Bulgarian and Romanian cities are not available.

Table 3: Coverage of capital cities' population of manufacturing firms

Capital city	Total coverage
Sarajevo (BA)	74.5%
Sofia (BG)	n.a.
Zagreb (HR)	91.0%
Bucharest (BG)	n.a.
Belgrade (RS)	66.0%
Ljubljana (SI)	71.8%

Sources: Authors, Amadeus, capital cities' statistical offices.

When city-level data from the Amadeus database are compared to data from the official statistics, it is evident that employment in manufacturing has fallen dramatically in the selected countries and cities, a phenomenon referred to as "deindustrialisation". During the 1989–2012 period, employment in manufacturing declined from about 56 percent in the case of Croatian and Serbian cities to about 75 percent in the case of Bosnian and Herzegovinian cities[5].

Looking at the capital city level, for which data are available in the capital cities' statistics, more than half of industrial jobs were lost over the 1989–2012 period in the Croatian capital of Zagreb, while in the Serbian capital of Belgrade the loss amounted to 56 percent[6]. After the Second World War, forced industrialisation was the main source of economic growth in Croatia and other former Yugoslav republics, of which Slovenia, Bosnia and Herzegovina and Serbia are included in this research. Industry was dominated by a number of socialist "giants" that employed a substantial number of workers. Former Yugoslav republics experienced strong growth after the 1940s until the beginning of the 1980s, and manufacturing accounted for about 40 percent of gross product in the late 1970s (Kukić, 2015).

[5] Detailed data for Bulgarian and Romanian cities are not available.
[6] 1989–2013 period for Belgrade.

Generally, since the beginning of the economic transition, SEE countries have experienced a rapid deindustrialisation process marked by a sharp contraction of industrial employment. The deindustrialisation process was linked to difficulties within the manufacturing sector and to the economy as a whole. Additionally, in the case of the former Yugoslav countries, decrease in manufacturing jobs was supported by shocks to the system caused by the 1990–1995 war. The strong contraction in the 1990s was followed by a slow recovery of industry until the latest financial crisis (in 2008) that resulted in a sharp industrial decline. The deindustrialisation process was further supported by the privatisation process. Namely, large public industrial enterprises—such as the metal industry, shipyards, utilities and railways—were difficult to privatise, so they largely remained public and dependent on public aid.

4. Production function estimation

This part of the analysis is based on an estimation of TFP dynamics for manufacturing industries and firms using panel data on manufacturing firms in the period of 2006–2013. To calculate TFP we employ a general formation of a Cobb-Douglas production function:

$$Y_{iut} = A_{iu} K_{iut}^{\alpha} L_{iut}^{\beta} \ , \tag{1}$$

where Y is output measured by real value added, K stands for total fixed asset value, L for number of employees, while A represents TFP. The index i stands for firm, u for city and t for period of time. A log linearization of (1) yields the following estimation equation for a three dimensional panel:

$$y_{iut} = a_{iu} + \alpha k_{iut} + \beta l_{iut} + \varepsilon_{iut} \ , \tag{2}$$

where small letters indicate variables in logs. TFP is estimated as the production function residual using the approach developed by Levinsohn and Petrin (2003). TFP reflects the productivity gains that emerge independently of changes in capital and labour inputs. The estimation of firm-level TFP from the Cobb-Douglas production function with capital and labour inputs is undertaken separately for individual industry groups by each country in order to capture the heterogeneity arising from different production technologies, quality and intensity of inputs used in the production. The Levinsohn-Petrin (2003) methodology introduced intermediate inputs in the model as opposed to the previously developed methodology by Olley and Pakes (1996) in which the investment variable is used as the proxy for unobserved productivity. In our production function, output was proxied with gross value added (GVA) obtained by subtracting intermediate inputs from turnover. Capital is measured with the stock of tangible fixed assets (TFA) by book value and labour with number of employees. As a proxy for intermediate input in applying the Levinsohn-Petrin methodology, we use data on material costs. All financial variables in our model were deflated using industry producer price deflators obtained from Eurostat or from national statistical offices[7] at either the two- or three-digit NACE level.

Firms with zero or one employee were omitted from the sample due to the noisiness of the data, as well as all firms that were in bankruptcy or in liquidation, so the final dataset includes 414,042 observations. Basic characteristics of the data used in the productivity estimations across countries are reported in Table 4.

[7] In the case of Serbia and Bosnia and Herzegovina.

Table 4: Summary statistics, manufacturing firms by countries

	N	Employment per firm (in %)	Total employment	rGVA (in million EUR)	rGVA/Emp	rTFA (in million EUR)	rGVA/rTFA
Bosnia and Herzegovina	1,896	25.4	48,067	422.6	8,791.0	1,602.1	0.26
Bulgaria	15,056	21.0	316,634	4,617.6	14,583.3	4,616.4	1.00
Croatia	5,198	20.0	104,002	3,443.8	33,112.8	2,936.4	1.17
Romania	30,835	23.3	717,758	14,547.5	20,268.0	15,577.6	0.93
Serbia	8,628	21.4	184,222	2,787.1	15,129.1	4,653.3	0.60
Slovenia	1,893	21.2	40,147	2,160.9	53,823.7	1,799.8	1.20

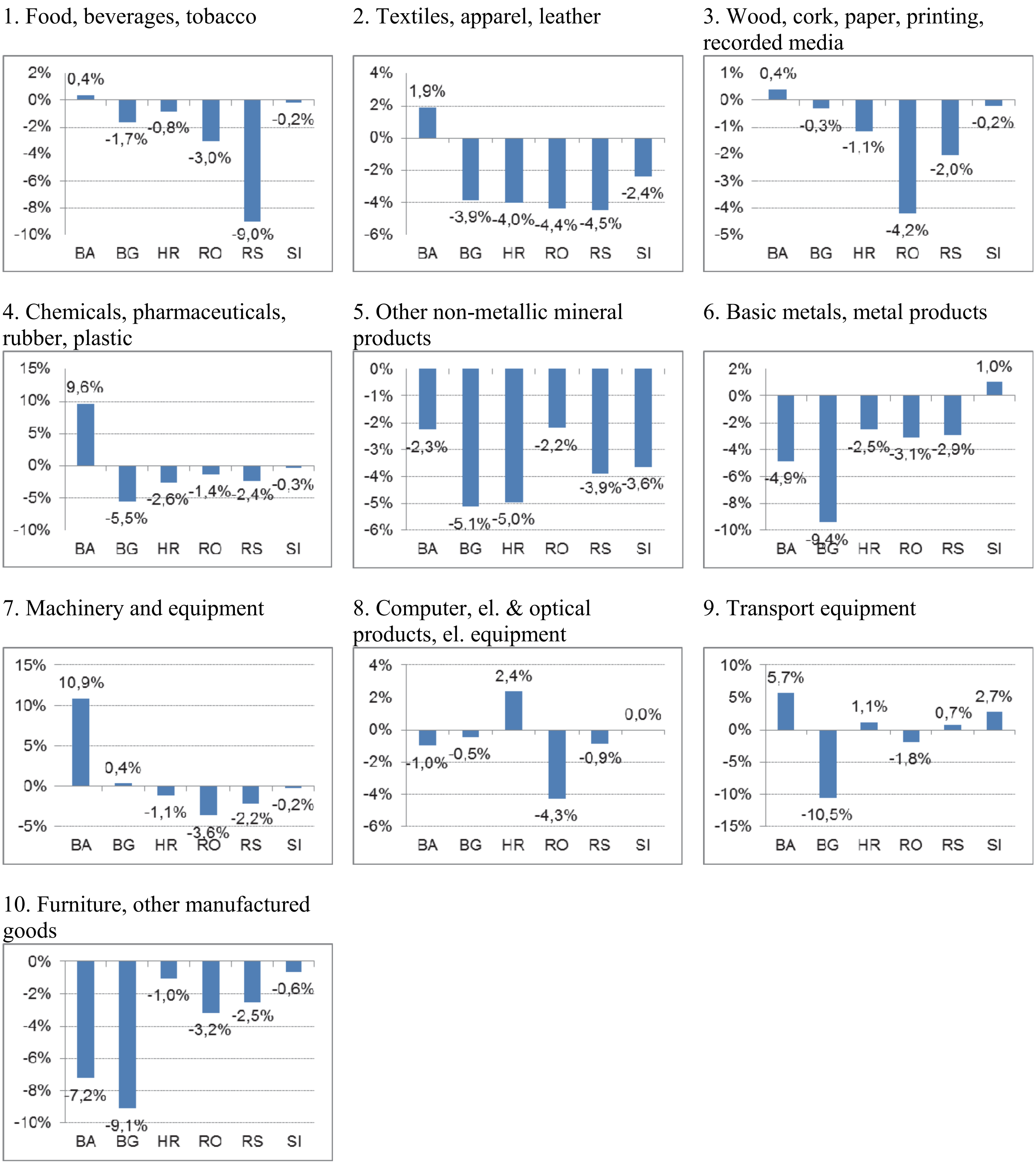
Note: Average data calculated for the 2006–2013 period.
Sources: Authors, Amadeus.

Total annual real GVA ranged from 422.6 million euro in Bosnia and Herzegovina to 14,547.5 million euro in Romania. There are no particular patterns in manufacturing employment, which, on average, ranged between 25 employees per firm (in Bosnia and Herzegovina) and 20 (in Croatia), while both capital and labour productivity follow the pattern of development, as they are highest in Slovenian manufacturing firms and lowest in Bosnian and Herzegovinian manufacturing firms.

The results obtained using the Levinsohn-Petrin methodology indicate that constant RTS could not be confirmed across a large number of industry groups. Moreover, many industry groups in the analysed countries are operating under decreasing RTS. Although these results may appear surprising, they are in line with previous research focused on post-transition economies. Lizal et al. (2001) and Dobrinsky et al. (2008) also find decreasing RTS for the Czech Republic, Bulgaria and Hungary and explain it as a transitional path dependence outcome that is more related to small firms. Galuščák and Lizal (2011), who use a panel of Czech manufacturing firms to measure firm-level production function in the 2003–2007 period, show that the majority of industries in the Czech Republic show constant or decreasing RTS when applying the standard Levinsohn-Petrin methodology. Moreover, Gao and Kehring (2016) explain, using US data, how lower RTS across industries is not necessarily related to inefficiency, but may reflect wider dispersion of productivity in an industry. Apart from the "transition" argument, the literature points to other factors such as country size and industry specifics in explaining decreasing RTS. For example, Briguglio's (1998) analysis of 43 countries shows that there is a link between the country size and RTS and that manufacturing firms in larger countries achieve more positive effects from increasing RTS than those in smaller countries. Bos et al. (2010) analyse 21 manufacturing industries in six EU countries in the period of 1980–1997 and find that less technologically advanced industries exhibit decreasing RTS.

The results on firm-level TFP were aggregated to industry group level using surviving firms' data. Summarising the results on industry group-level TFP growth, it is evident that the recession has affected all industry groups across most countries, but the magnitude of this negative effect has been diverse. Bosnia and Herzegovina stands out with an exceptional recovery effect, but also with a relatively low TFP level, while TFP-level and TFP-growth disparities are the lowest in the most developed economy—Slovenia.

Figure 1: TFP change by sector and by country



Note: Average growth rate calculated for the 2006–2013 period.
Source: Authors' estimation.

The recession period in some of the observed economies has been researched on the micro level, revealing the most likely causes of the TFP backdrop in manufacturing. Aprahamian and Correa (2015) identified the low rate of firm entry and exit as the cause of low productivity of Croatian firms during the recession period, supported by market characteristics which eliminate firms that are potentially more productive from the market, or conversely, prevent the entry of more productive firms. Perić and Vitezić (2016) analysed the impact of the economic crisis on firm growth in Croatia and showed that employment in surviving manufacturing firms was affected by the crisis, resulting in a 15 percent decrease, while turnover growth was positively associated with company size. Similarly to Croatia, the low firm-entry rates also exert a negative impact on manufacturing productivity in Bulgaria, along with significant misallocation of resources, where productive firms remain small, while unproductive firms employ a large share of the labour force (World Bank, 2015).

Given the specific period under consideration in this research, there can be no *a priori* expectations regarding the results of the model estimation of firm-level productivity differences given in the next section.

5. The econometric analysis

5.1. Model specification

A model is constructed to explain the TFP differences across firms in the observed cities, in line with broader theoretical foundations and in line with the findings from previous empirical research. Drawing on TFP firm-level estimates obtained in the previous section, the baseline model can be specified as follows:

$$\begin{aligned} \ln TFP_{it} &= \beta_1 \ln diversification_u + \beta_2 \ln specialisation_{ut} + \beta_3 \ln humancapital_{ut} \\ &+ \beta_4 university_u + \beta_5 \ln concentration_{st} + \beta_6 \ln firmsize_{it} + \beta_7\, intellectualproperty_{it} \\ &+ \beta_8 foreignown_{it} + FE_c + FE_s + FE_t + \varepsilon_{it} \end{aligned} \quad , \qquad (3)$$

where subscript i denotes firm, u denotes city, s denotes industry and t denotes time, while the $diversification_u$ variable represents *urbanisation economies*. The variable is included as the relative diversification index (RDI) value. RDI is the inverse of the sum of the absolute values of the difference between each sector's share in a city's employment (denoted as x_{ij}) and its share in national employment (denoted as x_j) for each city over all sectors (Duranton and Puga, 2000), at the NACE 2-digit level. RDI is given as:

$$RDI_{uj} = 1 \Big/ \sum_j \left| x_{uj} - x_j \right| \ , \tag{4}$$

where the $specialisation_{ut}$ variable represents *localisation economies* and, similarly to the urbanisation variable, it is represented with the specialisation index calculated as the ratio of each industry's share (at the NACE 2-digit level) in a city's employment and the corresponding share at the national level. The specialisation index is given as:

$$SI_{ij} = \frac{x_{uj}}{x_j} \ , \tag{5}$$

where the $humancapital_{ut}$ variable is included as the share of employed persons in high-technology manufacturing in total city employment in manufacturing; $university_u$ is a bivariate variable indicating the presence of a university in a city, taking the value of 1 if university presence is established, and 0 otherwise; the $concentration_{st}$ variable represents concentration across industry branches in a city; it is constructed as the share of turnover in an industry (at the NACE 2-digit level) in a city's manufacturing turnover. The turnover of the leading firm in an industry is excluded. The $intellectualproperty_{it}$ variable represents the firm's intellectual property and is included as the value of intangible assets; the $firmsize_{it}$ variable represents firm size measured by number of employees; $foreignown_{it}$ is a dummy variable representing foreign ownership, where firms with presence of a foreign owner in their capital structure are assigned the value of 1. $FE_{country}, FE_{industry}, FE_{time}$ are country, industry (at the NACE 2-digit level) and year fixed effects; ε_{it} is an error consisting of two independent random terms, as it is assumed that errors are not normally distributed. Error is included as a sum of a city term and of an idiosyncratic residual, as follows:

$$\varepsilon_{it} = city_u + \gamma_{it} \quad . \tag{6}$$

Presence of universities in cities was established using national websites, while all the other data were calculated using the Amadeus database.

Accounting for unobserved country fixed effects allows cross-country assessment of TFP levels, while time and industry effects are expected to capture changes in the economic dynamics. Industries may differ in the way they function, in terms of input and technology requirements, for example. If these effects are not accounted for, they may easily translate into biased model estimation.

The estimation of model (3) was carried out with errors clustered at the city level. The model is estimated using, as the dependent variable, firm-level TFP based on Levinsohn-Petrin and OLS procedures. The estimation results are reported in Table 5. Independent variables that were found significant carry the same sign in all estimations of the model. This attests to the robustness of the TFP estimations carried out with different methods. With the purpose of obtaining additional observations, missing data for labour and material costs were imputed using simple algorithms and then used in TFP estimation. The imputation procedure allowed for 1,239 extra observations to be regressed in the panel data model[8]. However, using non-imputed data results in less satisfactory goodness of fit, so the preferred model estimation is

[8] Since only 43.4 percent of the firms in the sample reported the value of material costs and 50 percent of the firms reported the employment figures, imputation methods were introduced to overcome the gaps in the data in these two series. The missing values were imputed as averages of adjacent observations as the first step. In the case of missing values of number of employees, in the second step, the missing value was replaced by the reported values in the year before or after the year with the missing value.

the one based on the original dataset. Further on, interpretations of the model estimations are based on Levinsohn-Petrin's TFP estimates. Both city- and firm-related variables are found significant in explaining the differences across TFP levels.

Table 5: Results of estimation with lnTFP as dependent variable

		Original data		Imputed data
		Model I	Model II	Model I
	Levinsohn-Petrin[a]	Ordinary least squares[b] (OLS)	Levinsohn-Petrin[a]	Levinsohn-Petrin[a]
City-related variables:				
Diversification	0.310*** (0.055)	0.236*** (0.047)	0.351*** (0.049)	0.343*** (0.057)
Specialisation	-0.029 (0.021)	0.006 (0.008)	-0.027 (0.020)	-0.039 (0.024)
Human capital	0.025* (0.013)	0.020* (0.010)		0.019 (0.013)
University	0.101** (0.049)	0.088 (0.034)	0.127** (0.049)	0.107** (0.050)
Industry-related variable:				
Concentration	-0.011 (0.022)	0.000 (0.012)	-0.009 (0.020)	-0.023 (0.023)
Firm-related variables:				
Intellectual property	0.055*** (0.007)	0.034*** (0.006)	0.056*** (0.007)	0.052*** (0.008)
Firm size	0.225*** (0.019)	-0.046*** (0.007)	0.224*** (0.018)	0.228*** (0.017)
Foreign ownership	0.103*** (0.018)	0.072*** (0.013)	0.106*** (0.018)	0.094*** (0.017)
Number of observations	61,386	62,617	63,927	62,625
Adjusted R-squared	0.461	0.071	0.460	0.373

Notes: [a] Standard errors (in brackets) are corrected by clustering at city level.
[b] Model estimations based on TFP estimates obtained using OLS do not include industry fixed effects and thus result in low R-squared value.
***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

Results of the model estimation show that a diversified composition of economic activities is translated into productivity advantages of firms in urban SEE. A diversified economic structure of cities raises the productivity level of firms by 31 percent, on average. This clearly indicates the workings of urbanisation economies, which create an environment that is more conducive to externalities. On the other hand, as RDI and city size (in terms of population and labour market size) are well correlated, home market effects cannot be ruled out. This confirms the finding of Traistaru et al. (2002) that in EU accession countries, industries tend to locate where production factors are abundant. No evidence is found that localisation economies have any effect on firm-level productivity in the sample. If positive effects were confirmed, this would indicate a greater level of integration and that local firms were already integrated into global value chains. Traistaru et al. (2002) have found that changes in specialisation occurred in regions closer to the EU market or closer to large local markets.

Agglomeration economies are associated with externalities that may include knowledge spillovers, business communications, face-to-face communication, and other spatial externalities (Fujita, Thisse, 2008). Human capital, indicating the possibility of knowledge spillovers, was found significant in explaining the differences in TFP levels, and it raised the TFP level by 2.5 percent. The mean value of human capital share in the sample of cities was 5.2 percent, and the highest shares were mostly observed in capital cities and regional centres. Nevertheless, city size and human capital share are not particularly correlated in the sample as the correlation coefficient is 0.21. Presence of human capital in cities is considered an advantage for firms, as knowledge spillovers tend to be localised. Well-educated labour force is attracted to cities as centres of economic activity as they are assumed to provide more employment opportunities for individuals who are also attracted to the various amenities available compared to other locations. Overall, cities are considered to be locations that enable better matching in the labour market due to firm and worker agglomeration. Stronger presence of human capital would suggest that there are more opportunities for innovation, through exchange of ideas and knowledge spillover. Thus, human capital is one of the most researched sources of productivity advantages in the literature, but its positive role in local firm performance is not always confirmed. Di Giacinto et al.'s research for Italy (2014) shows that the role of human capital tends to be location- and industry-specific in the sense that manufacturing firms in specialised locations of industrial-district-type benefit more from skilled labour force, while firms in diversified urban locations benefit more from educated labour force. Another channel for generating productivity advantages may be inter-institutional externalities. Universities may be observed as an element of location institutional infrastructure that may generate positive spillovers for firms through local networking. The results of model estimations in this research indicate that the presence of a university is supportive of firm performance. University presence improves firm performance in the sample by 11.6 percent, on average. The positive effect that universities exert on firms most likely takes place through cooperation between universities and public institutions aimed at supporting the development of local firms and their specific activities. The inter-institutional cooperation is directed toward the joint design of public policies and programmes. By providing expert knowledge, universities are indirectly supporting firms' capacities.

A possible industry-related source of TFP differences that was assessed is concentration, but this variable was found insignificant, and with a negative coefficient sign. Thus, it appears that there is no evidence that concentration generates productivity advantages for firms, at least not in the SEE city-context. This is contrary to the NEG prediction that economic integration would result in concentration of economic activity across locations, leading to increasing RTS; otherwise effects on firm efficiency would be confirmed. The predicted increase in concentration and associated positive effects might be occurring throughout regions and not in cities *per se*. Furthermore, this finding can also indicate intra-industry heterogeneity with respect to product quality, so that firms belonging to the same industry are not directly competing in the same price or quality segment. Also, previous findings point to low firm entry and exit dynamics and associated inefficient reallocation mechanisms in some of the observed economies in SEE. Iooty et al. (2014), using Eurostat and FINA[9] data, find that firm exit rates prevail over entry rates in Romania and Croatia, while the opposite is true for Bulgaria and Slovenia. For the former countries, this process can be considered weak and economies less dynamic.

Firm-level sources were found highly significant in explaining productivity advantages of firms. The most important firm-related variable is firm size, positively correlated with TFP and measured with number of employees. On average, relatively larger firms generate 22.5 percent larger TFP, other things being equal. This finding is not surprising as it is in line with evidence from the empirical literature. Larger firms have more capacities than smaller firms to be directed into achieving efficiency goals, e.g., professional management and better organisation practices or, for example, already developed know-how. According to research on the importance of managerial talent and practices, these appear important for firm performance (Syverson, 2011). Research by Bloom et al. (2012) on management practices in transition economies has shown that managerial practices in some transition countries are close to those of Western European countries. Bulgaria's score on management practices was the highest, closely followed by Serbia, while Romania's score was the lowest among eight European transition countries.

Another source of productivity advantages is observed through the value of intangible fixed assets, representing firms' intellectual capital. To be precise, intangible fixed assets refer to the value of intellectual property, including copyrights, patents, trademarks, franchise and licensing agreements. By investing into intellectual property, firms can increase their value

[9] Croatian financial agency.

added and achieve more dynamic productivity growth and higher TFP levels. In knowledge-based economies of today, developing innovation activities is considered an important factor in creating and sustaining competitiveness of firms and locations. The results of the model estimation confirm that intellectual property of firms raises their TFP level by 5.5 percent on average, obviously creating a competitive advantage for those firms.

Finally, the model estimation results confirm that foreign ownership of local firms creates a productivity premium, by 10.3 percent on average. There is plenty of evidence of positive effects of foreign ownership throughout the literature, and in brief, these include restructuring, transfer of technology and know-how, and upgrading of employee skills.

Attention can also be devoted to the specific period under consideration, which includes a recession episode for the observed countries brought on by the global financial crisis in 2008. Crisis spread to the observed economies, resulting in recessions with different cross-country duration, and the recession is correctly picked up by time fixed effects that display negative values over the 2009–2013 period.

5.2. Robustness checks

Capital cities' economies

A number of specific traits relate to capital cities alone. A common factor is their centrality and size. Capital cities represent the economic "core", being the largest firm and worker agglomeration in the observed countries, thus also representing the key home market. Hence, they are front-ranked cities in each of the countries. The institutional infrastructure of capital cities is superior, as they often host all or most major national public institutions. Moreover, capital cities are the main location for headquarters of large firms and investors. Data on foreign investment inflows in transition economies mostly show that capital cities (or capital city/metropolitan regions) attract the bulk share of capital flows due to their superior business infrastructure and concentration of resources (Lintz et al., 2007; Dogaru et al., 2014). For these reasons a robustness check is performed by excluding manufacturing firms located in capital cities from the sample. The purpose is to eliminate the influence of capital cities' economies in the model estimation. By doing so, the number of observations drops by 23,790, roughly over a third of the total number of observations.

The model is re-estimated using the remaining 37,596 observations. Goodness of fit drops from 0.461 to 0.407, but it can still be considered satisfactory (Table 6). Estimations of the model on this smaller sample with cities of regional and local importance mainly yield results similar to the main estimates—the signs in front of the coefficients remain consistent and the strength of influence is basically unchanged. Localisation economies do not emerge as relevant with the re-estimation. Perhaps the only point of difference worth elaborating is the magnitude of influence that urbanisation economies have in creating a productivity premium for firms. By excluding the influence of the large agglomerations of capital cities, the productivity premium for firms in diversified cities drops from 31 to 21.2 percent, thus implying that capital cities were driving the productivity premium of firms in urban SEE upwards quite strongly. Overall, re-estimation of the model on a smaller sample yields results that are consistent with the main estimates, as another proof of robustness of the main results.

Table 6: Results of model estimations using a sample of firms located outside capital cities

	Model I	Model II
	Levinsohn-Petrin[a]	Levinsohn-Petrin[b]
City-related variables:		
Diversification	0.212** (0.095)	0.258** (0.088)
Specialisation	-0.017 (0.015)	-0.014 (0.014)
Human capital	0.026** (0.013)	
University	0.120** (0.041)	0.142*** (0.038)
Industry-related variable:		
Concentration	-0.031 (0.020)	-0.026 (0.019)
Firm-related variables:		
Intellectual property	0.040*** (0.005)	0.047*** (0.005)
Firm size	0.220*** (0.010)	0.218*** (0.010)
Foreign ownership	0.119*** (0.023)	0.121*** (0.022)
Number of observations	37,596	40,138
Adjusted R-squared	0.407	0.406

Notes: [a] Standard errors (in brackets) are corrected by clustering at city level.

[b] Model estimations based on TFP estimates obtained using OLS do not include industry fixed effects and thus result in low R-squared value.

***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

Multiplant firms and headquarter-plant separation

Data from the Amadeus database are legal-entities data, i.e., data on firms, not data on plants. With this type of data, issues of multiplant firms arise. The question that appears is: Where is the economic activity of such firms registered? Placed into the context of the data used in this research, it is possible that some firm data are actually headquarter data with plants existing in another location, or that single-firm data in fact contain information on multiple plants/firms. Including these firms into the model estimation may push the coefficients of some city-related variables upwards, as the headquarters of these firms will most likely be located in larger, more diversified cities. This issue can be addressed simply by excluding firms that are suspected to have headquarters and plants separated in different locations and/or by excluding firms that are a part of company groups. The Amadeus database contains both information on the number of companies in a company group and information on the location of the domestic ultimate firm owner (DUFO). Using this information, firms that are a part of a company group are easily omitted from the sample and the model is re-estimated using data on the remaining firms (Table 7, column a). The separated headquarters issue is tackled using data on the location (city) of the DUFO. Suspecting that there might be a functions separation issue in cases when the manufacturing firm and DUFO are not located in the same city, the sample is additionally reduced and the model re-estimated (Table 7, column b). As differences in the number of observations between the two reduced samples are trivial, the model re-estimates are close. The goodness of fit is similar to that of the main model. The variables that had consistently explained the variation in the dependent variable, and those are diversification economies and firm-level variables, remain significant. A disadvantage of taking this approach is that data on firms in foreign ownership are entirely lost. This is the principal reason why foreign ownership does not continue to account for variation in firm productivity. Principally, the new estimates are in line with the main findings despite the pronounced loss of observations.

Table 7: Results of model estimations using a sample of firms assumed to be non-multiplant and non-separated

	a)	b)
	Sample of firms assumed to be non-multiplant	Sample of firms assumed to be non-multiplant and non-separated
City-related variables:		
Diversification	0.293*** (0.058)	0.293*** (0.058)
Specialisation	-0.005 (0.022)	-0.005 (0.022)
Human capital	0.006 (0.013)	0.006 (0.013)
University	0.154* (0.058)	0.156* (0.058)
Industry-related variable:		
Concentration	-0.045* (0.027)	-0.045* (0.027)
Firm-related variables:		
Intellectual property	0.042*** (0.011)	0.042*** (0.011)
Firm size	0.223*** (0.016)	0.223*** (0.016)
Foreign ownership	0.098 (0.172)	0.195 (0.172)
Number of observations	24,809	24,782
Adjusted R-squared	0.433	0.433

Notes: Standard errors (in brackets) are corrected by clustering at city level.
***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

Period-specific effects

The period of estimation is specific due to a recession episode across the observed economies. As pointed out, time fixed effects have correctly captured the negative effects arising from the economic downturn. Due to the period specifics, the model is re-estimated for two separate periods, one being the pre-recession period and the other being the recession period. In observing the period of crisis separately from the growth period, there is a possibility that specialisation could arise as a determinant of TFP differences because overly-specialised cities are more exposed to economic changes (Cuadrado-Roura et al., 1998;

Longhi et al., 2014). Performing this robustness check also allows us to test the hypothesis of pronounced risk exposure of specialised locations on a micro scale. The results of the re-estimation for the 2009–2013 period carried out on 36,685 observations presented in Table 8 are consistent with the results of the main estimations. Firm size, as the major firm-level determinant of firm performance, generates a larger premium for larger firms, amounting to 26 percent in the crisis period compared to the 16.6 percent premium estimated for the positive growth period of 2006–2008. Evidently, larger firms were successful in sustaining productivity advantages over the economic crisis period, post-2008. Moreover, these findings also suggest that the productivity gap between larger and smaller firms deepened over the crisis period, so that exposure of smaller firms to risks associated with the crisis was greater. Diversification economies still enabled firms to maintain their productivity premium, but these effects were less pronounced than during the period of economic upturn. Firms located in diversified cities were affected by the crisis and the productivity gap between firms in diversified and firms in non-diversified cities decreased, by approximately 4.8 percentage points. Specialisation does not appear to affect TFP levels at all during the crisis period, suggesting that there has not been overexposure. The role of human capital in assuring knowledge spillovers remains important in both periods. While these effects are not large, 2.8 percent over the average TFP in the crisis period, they are indicative of the stronger potential of firms located in cities with higher shares of human capital, to overcome periods of economic downturn compared to firms in other locations.

Table 8: Results of model estimations for the selected periods

	2006–2008			2009–2013	
	Model I	Model II		Model I	Model II
City-related variables:					
Diversification	0.341*** (0.056)	0.373*** (0.049)		0.293*** (0.060)	0.340** (0.052)
Specialisation	-0.024 (0.024)	-0.023 (0.023)		-0.031 (0.021)	-0.028 (0.020)
Human capital	0.021* (0.012)			0.028* (0.015)	
University	0.107** (0.050)	0.125** (0.043)		0.100* (0.052)	0.127* (0.046)
Industry-related variable:					
Concentration	-0.037 (0.022)	-0.030 (0.021)		0.000 (0.025)	-0.000 (0.023)
Firm-related variables:					
Intellectual property	0.067*** (0.009)	0.069*** (0.008)		0.049*** (0.006)	0.049*** (0.006)
Firm size	0.166*** (0.021)	0.163*** (0.020)		0.260*** (0.018)	0.260*** (0.017)
Foreign ownership	0.122*** (0.023)	0.125*** (0.023)		0.100*** (0.018)	0.102*** (0.017)
Number of observations	21,701	22,597		39,685	41,330
Adjusted R-squared	0.421	0.420		0.483	0.483

Notes: Standard errors (in brackets) are corrected by clustering at city level.
Model estimations based on TFP estimates obtained using OLS do not include industry fixed effects and thus result in low R-squared value.
***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

Noisiness of the data

As discussed earlier, TFP estimations were obtained using data on firms with two or more employees, i.e., excluding firms with less than two employees due to noisiness of the data. Excluding these data was an expendable loss as it enabled us to obtain acceptable TFP estimations. However, data on firms with a small number of employees tend to be noisy and it is common practice for firms with less than ten employees to be omitted from the samples used in model estimations. This type of exercise is carried out in this section with the intention to exclude the possibility of spurious data affecting the model estimates. By excluding firms with less than ten employees, the number of observations drops to 18,348. The new estimation yields similar results with regard to the variables' statistical significance and the estimated coefficient signs (Table 9). Goodness of fit was more favourable in the main estimation, so including smaller firms from the start has proven to be a more feasible option.

Table 9: Results of model estimations for the sample of firms with over ten employees

	Levinsohn-Petrin	
	Model I	Model II
City-related variables:		
Diversification	0.349*** (0.078)	0.349*** (0.068)
Specialisation	-0.034 (0.027)	-0.031 (0.026)
Human capital	-0.003 (0.017)	
University	0.156 (0.013)	0.141* (0.050)
Industry-related variable:		
Concentration	-0.013 (0.031)	-0.011 (0.028)
Firm-related variables:		
Intellectual property	0.052*** (0.009)	0.052*** (0.009)
Firm size	0.290*** (0.032)	0.291*** (0.031)
Foreign ownership	0.161*** (0.033)	0.155*** (0.032)
Number of observations	18,348	19,095
Adjusted R-squared	0.377	0.376

Notes: Standard errors (in brackets) are corrected by clustering at city level.
Model estimations based on TFP estimates obtained using OLS do not include industry fixed effects and thus result in low R-squared value.
***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

Country heterogeneity

In the main model estimation, country fixed effects were included among the controls to account for unobserved country factors. Yet country heterogeneity, if not properly picked up by fixed effects, may result in biased model estimations. This issue is addressed by successively removing firms coming from an individual country out of the sample, and then re-estimating the model again. The results show that firm-related variables and urbanisation economies across all estimations remain highly significant (Table 10), even in the estimation where data for Romania are excluded. The observations on Romanian firms bring the highest risk of estimation bias as their share in total observations is the highest. The university variable is interchangeably significant, and small-versus-large country differences are the most likely cause. There is insufficient variation in university data in smaller countries because they are represented with fewer cities. When firm data from small countries are dropped from the sample, the university variable is found significant. Thus, these findings should not be taken as a lack of evidence of positive externalities related to intra-institutional cooperation in small countries, but rather as the result of the limitations of the methodological approach.

Table 10: Results of model estimations for SEE, with individual country data excluded

	Sample with BA data omitted	Sample with BG data omitted	Sample with HR data omitted	Sample with RO data omitted	Sample with RS data omitted	Sample with SI data omitted
City-related variables:						
Diversification	0.318*** (0.056)	0.304*** (0.059)	0.304*** (0.056)	0.422*** (0.155)	0.269*** (0.054)	0.321*** (0.053)
Specialisation	-0.031 (0.021)	-0.030 (0.021)	-0.024 (0.021)	-0.063 (0.056)	-0.018 (0.023)	-0.023 (0.016)
Human capital	0.026** (0.013)	0.021 (0.014)	0.026* (0.014)	0.021 (0.029)	0.030*** (0.013)	0.020 (0.014)
University	0.091* (0.050)	0.132 (0.054)	0.095* (0.051)	0.069 (0.075)	0.089 (0.054)	0.112** (0.049)
Industry-related variable:						
Concentration	-0.017 (0.024)	-0.022 (0.018)	-0.002 (0.025)	-0.047 (0.049)	0.002 (0.023)	-0.030 (0.023)
Firm-related variables:						
Intellectual property	0.057*** (0.007)	0.051*** (0.008)	0.057*** (0.007)	0.046*** (0.010)	0.058*** (0.007)	0.056*** (0.008)
Firm size	0.225*** (0.019)	0.233*** (0.023)	0.207*** (0.011)	0.258*** (0.029)	0.222*** (0.021)	0.220*** (0.019)
Foreign ownership	0.094*** (0.017)	0.108*** (0.021)	0.117*** (0.017)	0.097*** (0.027)	0.096*** (0.020)	0.108*** (0.018)
Number of observations	60,033	50,506	55,817	27,766	54,108	58,700
Adjusted R-squared	0.484	0.494	0.402	0.504	0.484	0.394

Notes: Standard errors (in brackets) are corrected by clustering at city level.
***, ** and * denote statistical significance at 1, 5 and 10 percent, respectively.

6. Conclusion

The main goal of this paper was to study the sources of productivity advantages of manufacturing firms located in urban post-transition SEE, with a particular interest in the role of the structure of the urban economy. More precisely, the role of localisation (or specialisation) economies and of urbanisation (or diversification) economies was examined. Based on the population threshold, and also taking into consideration data limitations, 98 cities with a population above 50,000 inhabitants were included in the sample. The industry data were aggregated from firm data obtained from Bureau van Dijk's Amadeus database for Central and Eastern Europe for the 2006–2013 period.

Firm productivity differences were assessed using TFP estimation techniques for the entire period. The important sources of local productivity advantages of firms were found to be firm-related factors and city diversification, while there was no evidence of localisation economies producing any effect. This implies that diversified cities, found to be correlated with large labour markets, constitute an environment that is more conducive to agglomeration externalities. Furthermore, in the context of NEG, this also reinforces the importance of home market effects for manufacturing firms in urban SEE. Firms located in cities with higher shares of human capital (the share of persons employed in high-technology manufacturing) benefit from knowledge spillovers, while at the same time, having a university in the urban location can indirectly be supportive of firms' capacities, probably through the university's involvement in designing local policies and programmes. Firm size, foreign ownership and intangible assets were found to be important sources of productivity advantages. Since industry concentration and city specialisation were not found relevant in explaining firm efficiency, it can be assumed that within-industry heterogeneity at this level of aggregation (at the NACE 2-digit level) is greater than expected or, alternatively, the economic integration at the city level has not been deep enough to produce positive effects on TFP levels. However, the possibility that concentration of manufacturing is occurring outside cities, across regions, cannot be excluded.

The model was also estimated for the period of economic crisis (2009–2013), and relative city specialisation across industries was not found to influence TFP negatively. Thus, larger relative specialisation in a particular industry in an urban location in SEE does not lead to overexposure on a micro scale. On the contrary, city diversification was found to create and sustain productivity advantages for firms, even during this recession episode. Model estimates have remained robust to various checks, performed to address the issues of multiplant firms and headquarter separation, period specifics, heterogeneity of countries and data noisiness.

The implications of this research can be important for local policies. Policies that encourage initiating economic activities that are entirely new to cities, in particular in knowledge-intensive industries, can be placed on the local agenda. This type of policy direction can also be beneficial for firms working in the industry that the city is specialised in, as knowledge transfer can emerge from the new business activities. The findings from this research suggest that cities already have the appropriate tools to reach these types of goals, as inter-institutional cooperation has shown to be an important channel for positive externalities. Firms can obviously indirectly capitalise on the strengthening of local institutional networks. Implications can also be drawn for entrepreneurial policies to design mechanisms of support for small firms during economic recessions, as they appear more vulnerable than larger firms during these times.

References

Aprahamian, A., P.G. Correa (2015): Smart Specialization in Croatia: Inputs from Trade, Innovation, and Productivity Analysis, June, Washington D.C.: World Bank Group.

Ascani, A., R. Crescenzi, S. Iammarino (2012): New Economic Geography and Economic Integration: A Review., SEARCH working paper, 01. http://www.ub.edu/searchproject/wp-content/uploads/2012/02/WP-1.2.pdf

Bloom, N., H. Schweiger, J. Van Reenan (2012): The land that lean manufacturing forgot? Management practices in transition countries, *Economics of Transition*, 20(4), 593–635. DOI: 10.1111/j.1468-0351.2012.00444.x

Bos, J.W.B., C. Economidou, M. Koetter (2010): Technology clubs, R&D and growth patterns: Evidence from EU manufacturing, *European Economic Review*, 54, 60-79.

Botric, V, K. Bacic, S. Slijepcevic (2015): FDI, trade and growth in the "late reformers'" post transition, *Theoretical and Applied Economics*, XXII (II); 269-280.

Briguglio, L.P. (1998): Small Country size and returns to scale in manufacturing, World Development, 26(3), 507-515.

Capello, R. (2009): Indivisibilities, synergy and proximity: The need for an integrated approach to agglomeration economies, *Tijdschrift voor Economische en Sociale Geografie*, 100(2), 145–159.

Combes, P.-P., G. Duranton, L. Gobillon, D. Puga, S. Roux (2012): The productivity advantages of large cities: Distinguishing agglomeration from firm selection, *Econometrica*, 80(6), 2543–2594. DOI: 10.3982/ECTA8442

Cuadrado-Roura, J. R., L. Rubalcaba-Bermejo (1998): Specialization and Competition amongst European Cities: A New Approach through Fair and Exhibition Activities, Regional Studies, 32:2, 133-147. DOI: 10.1080/00343409850123026

Di Giacinto, V., M. Gomellini, G. Micucci, M. Pagnini (2014): Mapping local productivity advantages in Italy: industrial districts, cities or both?, Journal of Economic Geography, 14 , 365–394. doi:10.1093/jeg/lbt021

Dobrinsky, R., G. Körösi, N. Markov, and L. Halpern (2006): "Price Markups and Returns to Scale in Imperfect Markets: Bulgaria and Hungary." Journal of Comparative Economics 34, pp. 92–110.

Dogaru, T., M. Burger, B. Karreman, F. van Oort (2014): Functional and Sectoral Division of Labour within Central and Eastern European Countries: Evidence from Greenfield FDI, GaWC Research Bulletin 433. http://www.lboro.ac.uk/gawc/rb/rb433.html.

Duranton, G., D. Puga (2000): Diversity and specialization in cities: Why, Where and When does it matter? *Urban Studie*s, 37(3), 533–555.

Eurostat (2016): Database, http://ec.europa.eu/eurostat/.

Fujita, M., J.-F. Thisse (2009): New Economic Geography: An appraisal on the occasion of Paul Krugman's 2008 Nobel Prize in Economic Sciences, *Regional Science and Urban Economics*, 39, 109–119.

Fujita, M., P. Krugman, (2004): The new economic geography: Past, present and the future, Papers in Regional Science, 83, 139–164.

Fujita, M., T. Mori (2005): Frontiers of the New Economic Geography, *Papers in Regional Science*, 84(3), 377–405. DOI: 10.1111/j.1435-5957.2005.00021.x

Galuščák, K., L. Lizal (2011): “The impact of capital measurement error correction on firm-level production function estimation”, November, Working paper series 9, Czech National Bank.

Gao, W., M. Kehring (2016): Returns to Scale, Productivity and Competition: Empirical Evidence from U.S. Manufacturing and Construction Establishments, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2731596

Hamar, J. (2002): FDI and Industrial Networks in Hungary, Working paper, 13, Centre the Study of Economic and Social Change in Europe, University College London.

Iooty, M., P. Correa, S. Radas , B. Škrinjarić (2014): Stylized Facts on Productivity Growth, World Bank Policy Research Working Paper, 6990.

Kaminski, B., B. K. Smarzynska (2001): Integration into Global Production and Distribution Networks through FDI: The Case of Poland, *Post-Communist Economies*, 13(3), 265-288.

Konings, J. (2001): The effects of foreign direct investment on domestic firms - Evidence from firm-level panel data in emerging economies, *The Economics of Transition*, 9(3), 619 - 634.

Krugman, P. (1991): Geography and Trade, Leuven University Press (Lueven) and The MIT Press (Cambridge, Massachusetts; London).

Kukić, L. (2015) Socialist Growth Revisited: Insights from Yugoslavia, presented at The tenth Young Economists’ seminar to the twenty-first Dubrovnik Economic Conference organized by the Croatian National Bank. http://old.hnb.hr/dub-konf/21-konferencija/yes/kukic.pdf

Levinsohn, J., A. Petrin (2003): Estimating production functions using inputs to control for unobservables, *The Review of Economic Studies*, 70(2), 317-341.

Lintz, G., B. Müller, K. Schmude (2007): The future of industrial cities and regions in central and eastern Europe, *Geoforum*, 38, 512–519.

Lizal, L., M. Singer, and A. Baghdasarian (2001): "An Estimation of Euler's Equation of a Profit Maximising Firm: The Case of Czech Republic 1992–1995," in Kari Liuhto, ed.: Ten Years of Economic Transformation, Lappeenranta University of Technology, Lappeenranta, Finland, Vol. 2, pp. 126–142.

Longhi, C., A. Musolesi, C. Baumont (2014): Modelling structural change in the European metropolitan areas during the process of economic integration, *Economic Modelling*, 37, 395–407. doi:10.1016/j.econmod.2013.10.028.

OECD (2004): Economic Surveys: Euro Area, Vol. 2004/05, September, 124-126 (Accessed on 14 March 2013).

Olley, S., A. Pakes (1996): The Dynamics of productivity in the telecommunications equipment industry, *Econometrica*, 64(6), 1263-1297.

Perić, M., V. Vitezić (2016): Impact of global economic crisis on firm growth, *Small Business Journal*, 46, 1-12.

Richardson, H. W. (1995): Economies and Diseconomies of Agglomeration, in Giersch, H. (Ed.), Urban Agglomeration and Economic Growth, Springer, Berlin and Heidelberg.

Rosenthal, S.S., W.C. Strange (2004): The Determinants of Agglomeration, *Journal of Urban Economics*, 50, 191-229. doi:10.1006juec.2001.2230.

Stojcic, N., E. Orlic (2014): Regional FDI spillovers and productivity of local firms in new EU member states, GDN research paper. https://www.cerge-ei.cz/pdf/gdn/rrc/RRC13_66_paper_01.pdf

Syverson, C. (2011): What Determines Productivity?, *Journal of Economic Literature*, 49:2, 326–365. http:www.aeaweb.org/articles.php?doi=10.1257/jel.49.2.326

Traistaru, I., P. Nijkamp, S. Longhi (2002): Regional specialization and concentration of industrial activity in accession countries, ZEI working paper, 16, http://hdl.handle.net/10419/39633 (06.03.2013.).

World Bank (2015): "Productivity in Bulgaria: Trends and Options", June, http://www.worldbank.org/content/dam/Worldbank/document/eca/Bulgaria/Bulgaria-Productivity-6-26-15-eng-web.pdf.

Zukowska-Gagelmann, K. (2000): Productivity Spillovers from Foreign Direct Investment in Poland, *Economic Systems*, 24(3), 223-256.

e-ISSN 1847-7844
9 771847 784002