Tomislav Sekur[*]
Katarina Marošević[**]

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EFFECTS OF THE CONCENTRATION OF MANUFACTURING INDUSTRY ON CROATIAN REGIONAL GROWTH

Spatial concentration of economic activity is a phenomenon that has important implications for the development potential of the local, regional and national economy. This statement stems from two facts: first, there is a tendency of people and economic activity to concentrate in major cities and regions; and second, similar and connected companies sometimes agglomerate together at a particular location to take advantages of the external economies. This paper examines the effects of spatial concentration of manufacturing industry on Croatian regional growth. The industrial concentration (especially of the manufacturing sector) improves competitiveness among firms, enhances knowledge spillovers and increases the demand for labor and industrial products, leading ultimately to potentially higher growth rates. To examine the effects of concentration of manufacturing industry on Croatian regional growth, a panel analysis is conducted combining spatial (21 Croatian counties) and time (16 time periods) dimensions. The best way to measure concentration is by using the location formula to calculate location quotients weather on the basis of employment or gross value added. Therefore, the location quotients are independent variables of interest in the model whereas GDP, GDP p.c. and Gross value added of manufacturing

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[*] T. Sekur, PhD, Assistant Professor, University of Zagreb, Faculty of Economics and Business Zagreb (e-mail: tsekur@efzg.hr).

[**] K. Marošević, PhD, Assistant Professor, University of Osijek, Faculty of Law Osijek (e-mail: kmarosev@pravos.hr). The paper was received on 21.10.2019. It was accepted for publication on 21.10.2020. This work has been supported by the Croatian Science Foundation under the project no. 6785.

sector are dependent variables and they serve as the measures of total output, regional economic prosperity and industrial output, respectively. Based on the results of the panel analysis it can be concluded that manufacturing industry is still an important factor of regional growth in Croatia, although its relative significance in Croatian economy is continuously declining over the last two decades.

Keywords: *concentration of manufacturing industry, Croatian regional growth, panel data analysis*

INTRODUCTION

The issue of regional development gained political and economic significance immediately after the end of the Second World War. The governments of different countries implemented various interventionistic measures to promote equally distributed growth across the entire national territory. Regions participate in growth and have effects on economic performances of national economy. Natural and human resources have tendency of concentrating and regional possibilities of using local factors, mobilizing resources and developing competitive environment determine development capacity of a region. Given that growth is often deployed to only a few regions within a given country, concentration of economic activity can have long-term effects on national growth. Of all economic activities, the manufacturing has a prominent role. This is the most significant activity in medium-income countries such as Croatia. As industry represents the core of economic development, regions with a strong industrial base are the drivers of national development. An industrial base is defined by the number of industrial companies and workers in some area but this alone does not explain dynamic process of economic growth (and development). What lies in the core of the economic development are the agglomeration economies. They are the main economic force that drives workers and companies to concentrate in one or few particular areas in which they benefit from the spatial proximity that cause advantages such as technological and knowledge spillovers, large pool of specialized workers, lower transaction costs for intermediate goods, etc. These areas then represent hubs of economic activity and are the most dynamic part of a country. In recent decades, special case of industrial concentration has attracted attention of economic scientists, namely, the Marshallian industrial district. According to Capello (2016, pp 208), the term denotes "a local area with a strong concentration of small and medium-sized firms, each specialized in one or a few phases of the production process serving the needs of the area's principal sector". The phenomenon of industrial district emerged in Italy and it is known as the model "Third Italy" and it is often hailed as a new form of capitalist economic development (Capello, 206). It was this model of economic development that motivated writing of this paper. We strongly believe that industry, and especially manufacturing, still plays major role in economic development and that comparative advantages in global economy are connected to local ways of production and specific skills and knowledge that are difficult to transfer elsewhere.

In the context of the interdependence of industry and regional development, the spatial concentration of the Croatian manufacturing industry and its impact on Croatian regional development is the main topic of this manuscript. By conducting a panel econometric analysis we combine relevant data for 21 Croatian counties (spatial component) in 16 years (temporal component) to examine to what extent concentration of manufacturing industry explains the differences in economic output among Croatian regions. Therefore, we investigate whether the concentration of manufacturing industry has a positive impact on Croatian regional growth. The best way to measure concentration is by using the location formula to calculate location quotients weather on the basis of employment or gross value added. Therefore, the location quotients are independent variables of interest in the model whereas total output (GDP), regional economic prosperity (GDP p.c.) and industrial output (Gross value added of manufacturing) are dependent variables, respectively.

LITERATURE REVIEW

Numerous studies have demonstrated that concentration of industrial activity (especially manufacturing) plays decisive role in (regional) development (Braunerhjelm and Borgman, 2004: Wandel, 2009; He, Wei & Pan, 2007; Dinc, 2015; Haraguchi, Fang Ching Cheng & Smeets, 2016; Rosenfeld, 2017). Harris (1987) deals with theoretical importance of manufacturing to the growth of regional output, pointing out that for most theories (demand-side, growth-pole, cumulative causation) manufacturing is the natural base for growth potential. Szirmai and Verspagen (2015) examine the role of manufacturing as a driver of growth in developed and developing countries in the period 1950–2005 and conclude that there is moderate positive impact of manufacturing on growth. Similar conclusion is drawn for India. Katuria and Raj (2009) test manufacturing as an "engine of growth" for the Indian states and conclude that more industrialized regions grow more rapidly. On the other hand Timmer and Vries (2009) compared the service and manufacturing sector for 19 countries in Asia and Latin America from 1950 to 2005 using growth accounting techniques. They conclude that services and manufacturing are major contributors during growth accelerations, but market services appear to be the more important source. Other authors investigate the relationship between manufacturing and service sector and generally conclude that service sector plays more important role at higher levels of income per capita but it is still very dependable on the manufacturing sector (Szirmai, 2015; Park and Chan, 1989; Park, 2009; Guerrieri and Melciani, 2005).

Geographic concentration is a feature of many industries and is recorded in most countries and at all spatial levels. Known examples of concentrations include high-tech agglomerations such as the Silicon Valley, Boston Route 128, the research triangle park of North Carolina or Sophie Antipolis in France. But the phenomenon is not limited to the previous examples. There are cases related to the "old" industry and include examples such as the carpet industry in Dalton in the United States, the ceramic industry around Stoke-on-Trent in England and the lace industry located in Nottingham (Devereux et al., 2004). Understanding this process has attracted attention of academia and politics for more than a century. The beginning of research in this area is usually attributed to Marshall (1890) who identified three types of positive externalities caused by the geographical concentration of the companies– proximity to suppliers and consumers, flexible and specialized labor markets and knowledge transfer. Relying on Marshall externalities, the main theorist of New economic geography Krugman (1991a) used various variants of the Gini coefficient to measure geographic concentration. According to him, the geographical concentration of production is the consequence of increasing returns. The model (1991b) he proposed is based on the interaction of rising returns, transport costs and demand. Krugman (1991a, b) was not entirely focused on growth but more on explaining centripetal and centrifugal forces that drive agglomeration, i.e. concentration of economic activity. Studies that deal with the relationship between agglomeration and growth include: Waltz (1996), Baldwin (1999), Black and Henderson (1999), Martin and Ottaviano (1999, 2001) and Baldwin et al. (2001). Ellison and Gleaser (1997) have developed the theoretical framework for the analysis of geographic concentration using the dartboard metaphor to explain "random" agglomeration. This led them to find two new "natural" indices for measuring industrial localization and relative forces of agglomeration among different industries. Using series of data on US manufacturing industry 1972-1992, Dumais et al. (1997) found out that the geographic concentration of the industry mildly dropped and that the location of industrial agglomeration could change over time. In his paper, Brülhart (1998) provided an extensive classification of seminal papers and models that are used for the explanation of industrial location and concentration. Midelfart Knarvik et al. (2000) have explored changes in industrial locations in Europe over the last few decades and compared them to the US. They concluded that industries with low skilled labor became more concentrated while significant dispersion occurred among medium sized and large technological industries. Devereux, et al. (2004) and Campos (2012) concluded that in the United Kingdom, the geographically most concentrated industries are low-tech industries. Maurel and Sédillot (1999) identified three typed of highly-localized industries in France. The first type refers to industries whose location is determined by access to raw materials and other natural resources (for example mining and quarrying industry); For the traditional industry, such as textiles, the initial location was determined during the industrial revolution, but some later external effects have affected staying at the same location; finally, the third type refers to high-tech industries characterized by significant knowledge spill-over. An interesting conclusion is given by Dekle (2002) who examined the impact of dynamic externalities at the regional level. The results show that externalities do not exist for manufacturing industry but are present for the finance, services, wholesale and retail. The impact of dynamic externalities on regional manufacturing growth in India was in the focus for Sharma (2017). Similar as Dekle (2002), he concludes that dynamic agglomeration externalities have no effect on the growth on manufacturing productivity. Braunerhjelm and Borgman (2004) empirically examined the degree of concentration of production of goods and services, the relationship between concentration and regional growth, and the role of regional entrepreneurship in Sweden from 1975 to 1999. In general, they confirmed the notion that Swedish service and industrial sectors display clear pattern of spatial concentration but more importantly, they found out that there is a positive and significant relationship between geographic concentration and labor productivity growth.

He, Wei and Pan (2007) examine the geographical concentration of manufacturing industries in China. They conclude that natural advantages, agglomeration economies, and institutional changes together determine the spatial patterns of industries in China. Trejo (2009) examines determinants of the regional concentration of particular industries in Mexico. Data for the period 1988-2003 show that on average the industries have become more dispersed in terms of production and employment. Among the most concentrated industries are those closely related to international markets and are mostly located in traditional industrial regions.

ANALYSIS OF THE EFFECTS OF CONCENTRATION OF MANUFACTURING INDUSTRY ON CROATIAN REGIONAL GROWTH

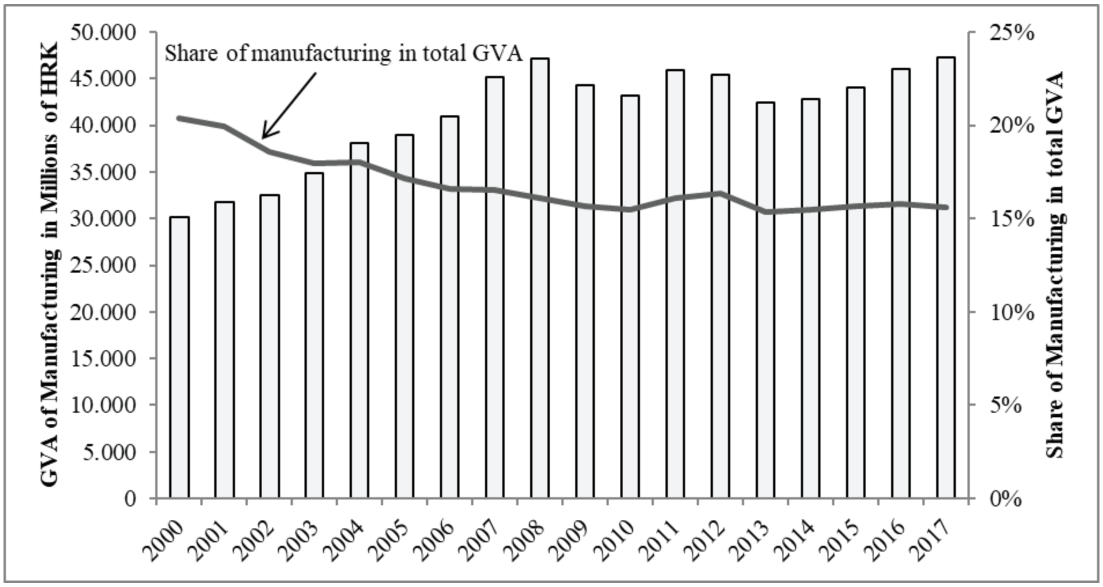
The notion that concentration of manufacturing industry has positive effects on Croatian regional growth in terms of higher economic output, the standard of living and manufacturing output represent the main hypothesis of this paper. The main rationale behind this assertion is that concentration of industry, and especially manufacturing increases the level of competitiveness among firms, knowledge spillover and demand for labor and industrial products which leads to higher regional (or local) output. According to Porter (1990), the competitiveness of a nation or a region primarily depends on the competitiveness of industry and related companies that form industrial cluster in some area. In that case, industrial cluster is the source of employment, income, export growth and innovations.

The role of industry in economic development can be explained through several aspects. Industrialization has enabled employment growth, shorter working hours, greater availability of (new) products but also a change in the structure of human labor in favor of intellectual labor. It is believed that the development of industry had the greatest impact on the growth of living standard, i.e. that industrialization is the engine of growth of economic development (more on that in Kovačević et al., 2016).

Manufacturing represents the most important segment of industry and it is the core of industrial development (Louri and Pepelasis Minoglou, 2001, pp 408). Data on Croatian manufacturing industry show that its share in the total industrial output (as measured with gross value added (GVA)) is declining from 20.4% in 2000 to 15.6% in 2017. Still, in absolute terms, gross value added of manufacturing has increased with ups and downs from 2000 to 2017 (Graph 1). This means that manufacturing still plays an important role in Croatian economy but its influence over time is decreasing.

Graph 1

GROSS VALUE ADDED (GVA) OF MANUFACTURING AND ITS SHARE (%) IN TOTAL GROSS VALUE ADDED OF CROATIA (2000-2017)



Source: authors' calculations on DZS (2019) data

The examination of the effects of the concentration of manufacturing industry on regional economic growth comprises of qualitative and quantitative aspects of analysis. The qualitative aspect relates to the analysis of factors that determine the spatial concentration of the manufacturing industry, their contribution to regional economic growth and the implications they have on economic policy at regional and national level. On the other hand, quantitative analysis refers to the measurement of the spatial concentration index in each region (county) using the location quotient which will attempt to determine the effects of spatial concentration of manufacturing industry on development differences among Croatian regions (counties). The analysis will be carried out using an econometric model with panel data, i.e. the spatial and time dimensions will be combined.

The location quotient as a concentration index is one of the most frequently used measures in the studies on industrial concentration and specialization. It is commonly used in quantifying and comparing industry concentrations in a given area, making it easier to comprehend economic strengths and weakness of a particular area. This is a relative measure used for the comparison of industrial composition of a region to the rest of the country. In other words, if the location quotient is calculated on the basis of the number of employees, the location quotient is a ratio of the shares that specific industry has in regional and national employment, respectively. If the location quotient is greater than one (LQ>1), a region has proportionally more workers in the specific industry then the rest of the country. Location quotient can also be calculated on the basis of gross value added (GVA). In any case, the location formula can be written as follows:

$$LQ = \left(\frac{E_{ij} / E_j}{T_i / T} \right) \quad 1.1$$

Where:

$\boldsymbol{E_{ij}}$– employment (or GVA) in industry i in county j;

$\boldsymbol{E_j}$– total employment (or GVA) in county j;

$\boldsymbol{T_i}$– employment (or GVA) in industry i in the country;

$\boldsymbol{T}$– employment (or GVA) in the country;

Models to be constructed in this paper have the primary task to determine whether the concentration of manufacturing industry explains development differences among Croatian regions. Therefore, the focus will be on variables that capture spatial concentration of manufacturing and that is the locational quotient calculated on the basis of the number of employees and gross value added. A total of 6 models will be constructed for the period 2000-2016 with the LQ variable, i.e. location quotient calculated on the basis of the number of employees and gross value added, as a variable of interest. In the first two models, the dependent variable will be GDP of a county which is a measure of county's total output. Other variables such as gross investments in fixed assets and employment will be included as explanatory variables, that is, they are not directly related to the concentration index but have an impact on GDP. Apart from the GDP, impact of the concentration of manufacturing industry on the regional GDP p.c. will also be examined. Therefore, all models will be based on following functions:

$$Y = f\{INV, L, LQ\} \quad 1.2$$

$$Ypc = f\{INV, L, LQ\} \quad 1.3$$

Where gross investment in fixed assets (INV), number of employees (L) and the concentration index (LQ) are the function of county's GDP (Y) in the equation 1.2 and county's GDP p.c. (Ypc) in the equation 1.3. Both equations can be written in the form of Cobb-Douglas production function:

$$Y = A * INV^{\alpha 1} L^{\alpha 2} LQ^{\alpha 3} \quad 1.4$$

$$Ypc = A * INV^{\alpha 1} L^{\alpha 2} LQ^{\alpha 3} \quad 1.5$$

Furthermore, apart from the impact on regional GDP, the effects of the concentration of manufacturing industry on manufacturing output itself will be tested. In that case, the dependent variable will be gross value added (GVAmnfc) of the manufacturing industry, while independent variables are the location quotient (LQ) measured by the employment and gross value added, employment in the manufacturing industry (Lmnfc) and gross investment in fixed assets of manufacturing industry (INVmnfc). The production function of the model can be written:

$$GVAmnfc = f\left\{INVmnfc, Lmnfc, LQ\right\} \quad 1.6$$

The equation 1.6 can also be written in Cobb-Douglas form:

$$GVAmnfc = A * INVmnfc^{\alpha 1} Lmnfc^{\alpha 2} LQ^{\alpha 3} \quad 1.7$$

Once the models have been constructed in which LQ variable is accepted as an independent variable of interest, the final step is to specify the model using panel data which combines time series data (16 years) and cross-section data (21 county) that will give 294 observations:

$$Y_{it} = \alpha_0 + \alpha_1 INV_{it} + \alpha_2 L_{it} + \alpha_3 LQ_{it} + e_{it} \quad 1.8$$

$$Ypc_{it} = \alpha_0 + \alpha_1 INV_{it} + \alpha_2 L_{it} + \alpha_3 LQ_{it} + e_{it} \quad 1.9$$

$$GVAmnfc_{it} = \alpha_0 + \alpha_1 INVmnfc_{it} + \alpha_2 Lmnfc_{it} + \alpha_3 LQ_{it} + e_{it} \quad 1.10$$

Where:

$i = 1,2,3,\ldots,21$ (i denotes i-th spatial unit)

$t = 1,2,3,\ldots,16$ (t denotes t-th time period)

It is expected that all coefficients in the specified models (α_1, α_2, α_3) will be positive, meaning that all variables have positive effects on county's GDP, GDP p.c. and manufacturing output. Since each county is observed over the period of 12 years, and data for dependent variables are available for each year, a balanced model will be used (each spatial unit will be combined with each observation of the time series).

Generally, linear panel data can be modeled in three ways (Asteriou and Hall, 2007, 345-348):

1. The Pooled OLS model (with constant regression parameters) assumes there is no difference in data of spatial dimension (N). In other words, the model estimates a common constant for all spatial units (a constant is equal for all counties). The main problem with this type of model is that it does not make differences among counties.
2. The Fixed effects model allows for the existence of heterogeneity or individuality among the counties so that all spatial units have different constants. The essential feature of a Fixed effects model is the ability to capture all effects that are specific to a particular individual or group and which do not vary over time. For example, if there is a panel of countries, fixed effects will capture common characteristics such as geographic factor, natural endowment or any other factor that vary between countries but nut over time. Fixed effects model is very useful for smaller samples and in the case of larger datasets where N is a very large number, it is recommended to use the Random effects model.
3. The Random effects method is an alternative method of estimating the model. The main difference to Fixed effects model is that the constants of each individual or a group are not fixed but random parameters. The main disadvantage of the Random effects model is a series of specific assumptions that must be made about the distribution of the random component. Also, if the unobserved effect specific to a group is correlated to the explanatory variable, the estimates are biased and inconsistent.

All suggested models have their advantages and disadvantages. Therefore, it is necessary to determine which model fits the data best. The most convenient way to do that is by using the Hausman test which is statistical tool designed to select between Fixed effects and Random effects model. Hausman test is based on the idea that, under the hypothesis of no correlation (H_0 – no correlation), OLS and GLS are consistent, but OLS is inefficient, while under the alternative hypothesis, OLS is inconsistent but GLS is not. In the case of panel data, the choice between Fixed and Random effects model consists of testing whether the regressors are correlated with the individual (mostly unobserved) effect. If H_0, which states that individual effects are not correlated with other regressors, is not discarded, the Random effects model is more appropriate (Asteriou and Hall, 2007, pp. 348-349). In this paper Hausman test will be applied to all models specified above (1.8-1.10).

A summary of the variables used in the models, their explanation and the description is given in Table 1.

Table 1

SUMMARY OF VARIABLES, THEIR DESCRIPTION AND DATA USED IN PANEL MODELS

Variable	Description	Data
Y	Output	GDP at county level in current Croatian kunas for period between 2000 and 2016.
Ypc	Development indicator	GDP p.c. at county level in current Croatian kunas for period between 2000 and 2016.
GVAmnfc	Output of manufacturing industry	Gross value added at county level in current Croatian kunas for period between 2000 and 2016.
INV	Investment	Gross investment in fixed assets at county level in current Croatian kunas for period between 2000 and 2016.
INVmnfc	Investment in manufacturing industry	Gross investment in fixed assets in manufacturing industry at county level in current Croatian kunas for period between 2000 and 2016.
L	Employment	Persons employed in legal entities at county level for period between 2000 and 2016. Situation as on 31 March.
Lmnfc	Employment in manufacturing industry	Persons employed in legal entities at county level in manufacturing industry for period between 2000 and 2016. Situation as on 31 March.
LQ	Location quotient	The measure of geographical concentration of industry. It is calculated as the ratio of the shares that manufacturing industry has in regional and national employment (or GVA).

One of the main limitations in using panel data model is the occurrence of cross section dependence. This can arise in panel data models primarily due to spatial or spillover effects or could be due to unobserved (or unobservable) common factor (Baltagi and Pesaran, 2007). There are three general approaches to handle cross-sectional dependence (Moundigbaye et al., 2017, pp.1): one of the most common ways is to model the error-variance covariance matrix in the framework of Seemingly Unrelated Regression (SUR). Here the common estimator is Feasible Generalized Least Squares (FGLS), where the cross-sectional covariances are typically modelled parametrically. The second approach is to model the cross-sectional dependencies “spatially”. This typically involves modelling the dependencies across units as a function of distance, in either a continuous or binary fashion. The third alternative is to model cross-sectional correlation as a function of time-specific common factor which is very popular in the macro panel literature. It is important to notice that ignoring cross-sectional dependence can lead to inconsistent estimators, in particular when T is finite and N tends to infinity (Hsiao and Tahmiscioglu, 2005). Furthermore, the estimator of the coefficients in panel data models could be biased and inconsistent if one or more relevant explanatory variables are omitted from the regression equation (Elhorst, 2009).

RESULTS OF THE PANEL ANALYSIS

In order to examine the effects of the concentration of the manufacturing industry on Croatian regional development panel data set is formulated for 21 cross-sections (Croatian counties) and 16 time periods (2000-2016). All data in this paper were collected from the Croatian Bureau of statistics (DZS) and the software used for the analysis is Stata 13.

The validation of the models has been carried out in several steps. The first step is to examine if there is a multicollinearity problem among independent variables. One of the mostly used diagnoses of multicollinearity is VIF (Variance inflation factor) method. The name derives from the fact that in the case of a high correlation of the independent variable x_j with other independent variables resulting in a coefficient of determination of nearly one, the variance of β_j increases ("inflates"). A serious problem of multicollinearity is present if $VIF_j>5$ (Bahovec and Erjavec, 2009). Another way to detect the multicollinearity problem is by using a correlation matrix which displays the correlation between M variables in the model. In that case, a symmetrical matrix $M*M$ is constructed whose ij-th element is equal to the correlation coefficient rij between i-th and j-th variable. The diagonal elements (correlation of the variable to itself) are always 1.00. In this paper, the correlation matrix will be used to spot if there is a problem of multicollinearity among independent variables. It is expected that this problem will arise, but if the variable of interest (LQ) is not correlated with other independent variables, the multicollinearity problem will not be dealt with. According to Allison (2012), the multicollinearity is not a problem if only control independent variables are mutually correlated. If the variable of interest is correlated to other independent variables in this paper, the problem will be solved by removing the "problematic" control variable that is correlated with the variable of interest (i.e. the LQ variable).

Furthermore, the Breusch-Pagan test is conducted for all models to determine whether there is a problem of heteroscedasticity. The procedure consists of several steps. First, the following model is assumed:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \beta_k X_{ki} + u_i$$

Where $var(u_i) = \sigma_j^2$, $\hat{u}_i$ are error residuals. Secondly, additional regression is introduced:

$$\hat{u}_i^2 = a_1 + a_2 Z_{2i} + a_3 Z_{3i} + \ldots + a_p Z_{pi} + v_i$$

Where Z_{ki} is a set of variables that determine the error variance. Thirdly, the null and alternative hypotheses are formed where the null hypothesis of homoscedasticity is:

$$H_0 : a_1 = a_2 = \ldots = a_p = 0$$

Fourthly, LM statistics is calculated, i.e. $LM=nR^2$ (where n is the number observation used to estimate additional regressions in the second step, and R^2 is the coefficient of determination). Heteroscedasticity exists if the null hypothesis is rejected, i.e. if the LM statistics is above the critical value. Alternatively, the *p-value* is calculated and the null hypothesis is rejected if the *p-value* is less than the level of significance α (usually α=0.05) (Asteriou and Hall, 2007).

The Wooldridge test will serve to identify autocorrelation in models. First order autocorrelation will be tested and if the null hypothesis is accepted that means there is no autocorrelation in the model (Drukker, 2003).

Pesaran test is also performed to determine if there is a cross-sectional interdependence in the model. According to Hoyos and Sarafidis (2006) many models that use panel data have this problem and the possible cause is the presence of common shocks and unobserved components. Also, over the last few decades, a growing trend of economic and financial integration among countries implies a strong interdependence between spatial units. In this paper, the focus is on Croatian counties and therefore, it is expected that the interdependence of spatial units exist which will later be confirmed by the Pesaran test. Driscoll and Kraay (1998) suggest a method that simultaneously corrects standard errors but the estimators of Fixed and Random effects models (FE/RE) can still be used. Their estimator can solve problems of spatial interdependence, heteroscedasticity and autocorrelation and is also suitable for balanced and unbalanced panels (Hoechle, 2007).

The first two panel models in this paper refer to the examination of the effects of the concentration of manufacturing industry on county's GDP by using the location quotient (LQ) as the measurement of the concentration. For the model 1, the LQ is calculated on the basis of number of employed whereas for the model 2, the LQ is calculated by using the data on Gross value added (GVA). Model 1 and model 2 can be written as follows:

$$log(y)_i = B_0 + B_1 \log(inv)_i + B_2 log(empl)_i + B_3 log(lqc\_empl)_i + u_i \qquad 1.11$$

$$log(y)_i = B_0 + B_1 \log(inv)_i + B_2 log(empl)_i + B_3 log(lqc\_gva)_i + u_i \qquad 1.12$$

The dependent variable *y* represents the logarithmic value of the GDP of a particular county. Control variable *inv* represents gross investment in fixed assets in a particular county whereas *empl_county* is also a control variable which stands for total employment in a particular county. The variable of interests *lqc* is in the model 1 (eq. 1.11) calculated on the basis of employment, and in the model 2 (eq. 1.12) it is calculated on the basis of GVA. Following the model specification and the required tests to assure the validity of the models, the results of the panel analysis are given in Table 2 and Table 3 with calculated parameter estimates (bold) and standard errors (in brackets).

Table 2

RESULTS OF THE PANEL MODEL 1 WITH THE DEPENDENT VARIABLE GDP AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF EMPLOYMENT

		Model 1
constant	β	3.881
	σ	**2.873**
	p-value	(0.192)
inv	β	0.127
	σ	**0.069**
	p-value	(0.080)
empl	β	1.560
	σ	**0.183**
	p-value	(0.000)
lqc_empl	β	0.155
	σ	**0.082**
	p-value	(0.072)
Number of observations	357	
F-statistics	25.71	
Prob (F-staticstics)	0.000	
R^2	0.6078	

Source: authors' calculations on DZS (2019) data

Table 3

RESULTS OF THE PANEL MODEL 2 WITH THE DEPENDENT VARIABLE GDP AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF GVA

		Model 2
constant	*β*	4.840
	σ	**2.484**
	p-value	(0.066)
inv	*β*	0.129
	σ	**0.064**
	p-value	(0.058)
empl	*β*	1.467
	σ	**0.171**
	p-value	(0.000)
lqc_gva	*β*	0.167
	σ	**0.032**
	p-value	(0.000)
Number of observations	357	
F-statistics	68.05	
Prob (F-staticstics)	0.000	
R^2	0.6310	

Source: authors' calculations on DZS (2019) data

The results in Tables 2 and 3 show that the concentration of the manufacturing industry as measured by the location quotient calculated both on the basis of employment and GVA has the expected sign but in the Model 1, the variable location quotient calculated on the basis of employment is not statistically significant whereas in the Model 2.

The next two models (Model 3 and Model 4) differ from previous two models (Model 1 and Model 2) so that instead of the GDP as a dependent variable, they us the GDP p.c. For the model 3, the LQ is calculated on the basis of number of employed whereas for the model 4, the LQ is calculated by using the data on Gross value added (GVA). Model 3 and model 4 can be written as follows:

$$log\left(y\_pc\right)_i = B_0 + B_1 \log\left(inv\right)_i + B_2 log\left(empl\right)_i + B_3 log\left(lqc\_empl\right)_i + u_i \qquad 1.13$$

$$log\left(y\_pc\right)_i = B_0 + B_1 \log\left(inv\right)_i + B_2 log\left(empl\right)_i + B_3 log\left(lqc\_gva\right)_i + u_i \qquad 1.14$$

As for previous models 1 and 2, and here were performed necessary test, namely correlation matrix, Peasaran test of cross-sectional dependence and Wooldridge test for autocorrelation. The results of the panel analysis with the GDP p.c. as dependent variable are presented in Table 4 (where independent variable of interest LQ is calculated on the basis of employment) and Table 5 (where independent variable of interest LQ is calculated on the basis of GVA).

Table 4

RESULTS OF THE PANEL MODEL 3 WITH THE DEPENDENT VARIABLE GDP P.C. AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF EMPLOYMENT

		Model 3
constant	*β*	-7.098
	σ	**3.330**
	p-value	(0.046)
inv	*β*	0.130
	σ	**0.763**
	p-value	(0.105)
empl	*β*	1.455
	σ	**0.230**
	p-value	(0.000)
lqc_empl	*β*	0.311
	σ	**0.076**
	p-value	(0.001)
Number of observations	357	
F-statistics	14.46	
Prob (F-staticstics)	0.000	
R^2	0.5257	

Source: authors' calculations on DZS (2019) data

Table 5

RESULTS OF THE PANEL MODEL 4 WITH THE DEPENDENT VARIABLE GDP P.C. AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF GVA

		Model 4
constant	*β*	-5.642
	σ	**2.809**
	p-value	(0.058)
inv	*β*	0.129
	σ	**0.068**
	p-value	(0.071)
empl	*β*	1.320
	σ	**0.215**
	p-value	(0.000)
lqc_gva	*β*	0.262
	σ	**0.040**
	p-value	(0.000)
Number of observations	357	
F-statistics	170.41	
Prob (F-staticstics)	0.000	
R^2	0.5732	

Source: authors' calculations on DZS (2019) data

The results in Tables 4 and 5 show that the concentration of the manufacturing industry as measured by the location quotient calculated both on the basis of employment and GVA is statistically significant and has expected sign in both Model 4 and Model 5 which means that higher concentration of manufacturing in a particular county is associated with the higher level of development as measured with GDP p.c.

And finally, panel data models are constructed to examine the effects of the concentration of manufacturing industry on the industrial output itself. Therefore, in Models 5 and 6 a dependent variable is county's industrial output as measured by gross value added of manufacturing industry. For the Model 5, the LQ is calculated on the basis of number of employed whereas for the model 4, the LQ is calculated by using the data on Gross value added (GVA). Model 5 and model 6 can be written as follows:

$$log\left(gva\_mnfc\right)_i = B_0 + B_1 \log\left(inv\_mnfc\right)_i + B_2 log\left(empl\_mnfc\right)_i + B_3 log\left(lqc\_empl\right)_i + u_i \quad 1.15$$

$$ln(gva\_mnfc)_i = B_0 + B_1 \log(inv\_mnfc)_i + B_2 log(empl\_mnfc)_i + B_3 log(lqc\_gva)_i + u_i \quad 1.16$$

Where *gva_mnfc* represents gross value added of manufacturing industry (industrial output of a county *i*); *inv_mnfc* is gross investment in fixed assets of manufacturing sector; *empl_county_mnfc* is total employment of manufacturing sector in county *i*). As with previous models here were also performed necessary tests for validation of the analysis, namely correlation matrix, Pesaran test of cross-sectional dependence and Wooldridge test for autocorrelation. The results of the panel analysis with the GVA of county's manufacturing output as dependent variable are presented in Table 6 (where independent variable of interest LQ is calculated on the basis of employment) and Table 7 (where independent variable of interest LQ is calculated on the basis of GVA).

Table 6

RESULTS OF THE PANEL MODEL 5 WITH THE DEPENDENT VARIABLE GVA OF COUNTY'S MANUFACTURING SECTOR AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF EMPLOYMENT

		Model 5
constant	*β*	24.340
	σ	**3.130**
	p-value	(0.000)
inv_mnfc	*β*	0.178
	σ	**0.043**
	p-value	(0.000)
empl_mnfc	*β*	-0.777
	σ	**0.339**
	p-value	(0.033)
lqc_empl	*β*	1.488
	σ	**0.332**
	p-value	(0.000)
Number of observations	294	
F-statistics	17.78	
Prob (F-staticstics)	0.000	
R^2	0.2355	

Source: authors' calculations on DZS (2019) data

Table 7

RESULTS OF THE PANEL MODEL 6 WITH THE DEPENDENT VARIABLE GVA OF COUNTY'S MANUFACTURING SECTOR AND INDEPENDENT VARIABLE OF INTEREST LQ CALCULATED ON THE BASIS OF GVA

		Model 6
constant	*β*	22.044
	σ	**1.913**
	p-value	(0.000)
inv_mnfc	*ν*	0.076
	Σ	**0.033**
	p-value	(0.032)
empl_mnfc	*β*	-0.287
	σ	**0.194**
	p-value	(0.154)
lqc_gva	*β*	1.151
	σ	**0.081**
	p-value	(0.000)
Number of observations	294	
F-statistics	205.48	
Prob (F-staticstics)	0.000	
R^2	0.7680	

Source: authors' calculations on DZS (2019) data

Results in Tables 6 and 7 confirm that manufacturing output as measured by GVA of the manufacturing industry on county level is significantly related to the location quotient which measures concentration of manufacturing industry on a particular area.

CONCLUSION

Regional economic inequalities are present in all countries and Croatia on this issue is no exception. The role of the industry in creating and eliminating these inequalities is unquestionable and its contribution to economic development has been reflecting in the increase of output, income, employment and productivity.

Industrialization is generally considered essential for the economic growth and long-term poverty reduction. As industry is one of the key factors of regional development, the spatial concentration of the manufacturing industry and its impact on Croatian regional growth was the main topic of this paper. Industrial concentration was measured by the location quotient which is one of the most widely used measures in the studies on industrial concentration and specialization.

To examine the effects of concentration of manufacturing industry on Croatian regional growth, a panel analysis was conducted combining spatial (21 Croatian counties) and time (16 time periods) dimensions. We used the location formula to calculate location quotients on the basis of employment and gross value added. They were used as the independent variables whereas GDP, GDP p.c. and Gross value added of manufacturing sector were used as dependent variables and they served as the measures of total output, regional economic prosperity and industrial output, respectively. The analysis showed that in the case of using both types of location quotients (calculated on the basis of employment and GVA) there is mostly a positive correlation with the dependent variable, whether it is GDP, GDP p.c. or industrial output (GVA of manufacturing industry). The only exception was the parameter of LQ calculated on the basis of employment in Model 1 which is not statistically significant at common 5% level of significance. Based on these results it can be concluded that manufacturing industry is still an important factor of regional growth in Croatia, although its relative significance in Croatian economy is continuously declining over the last two decades. Nevertheless, economic policy makers should not be neglecting this phenomenon and should make efforts to implement policies that aim to expand share of Croatia and its regions in international division of manufacturing labor. One of the main limitations of this paper is the lack of data on disaggregated level. Because of that, future research on this topic should be based on bottom-up approach which would reflect specific needs and advantages of particular industry and/or area. From the methodological point of view, future researches should take into the consideration issues such as cross-sectional dependence and possibility of biased and inconsistent estimators when dealing with the spatial panel data models.

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UČINCI KONCENTRACIJE PRERAĐIVAČKE INDUSTRIJE NA REGIONALNI RAST HRVATSKE

Sažetak

Prostorna koncentracija gospodarske aktivnosti je fenomen koji ima važne implikacije na razvojni potencijal lokalnog, regionalnog i nacionalnog gospodarstva. Ova tvrdnja proizlazi iz dvije činjenice: prvo, postoji tendencija da se ljudi i gospodarske aktivnosti koncentriraju u većim gradovima i regijama; i drugo, slična i povezana poduzeća se koncentriraju na određenom mjestu kako bi iskoristili prednosti eksternih ekonomija. Ovaj rad istražuje učinke prostorne koncentracije prerađivačke industrije na hrvatski regionalni rast. Koncentracija industrije (posebno prerađivačke industrije) povećava konkurentnost među poduzećima, poboljšava širenje znanja i povećava potražnju za specijaliziranim radnicima i industrijskim proizvodima, što u konačnici dovodi do potencijalno većih stopa rasta. Da bi se ispitali učinci koncentracije prerađivačke industrije na hrvatski regionalni rast, u radu se provodi panel analiza kombinirajući prostornu (21 hrvatska županija) i vremensku (16 godina) dimenziju. Najbolji način za mjerenje koncentracije je pomoću lokacijske formule za izračunavanje lokacijskih kvocijenata bilo na temelju zaposlenosti ili bruto dodane vrijednosti. Stoga su u modelima lokacijski kvocijenti nezavisne varijable od interesa, dok su BDP, BDP p.c. i bruto dodana vrijednost proizvodnog sektora zavisne varijable koje služe kao mjera ukupne proizvodnje, regionalnog životnog standarda, te industrijske proizvodnje. Na temelju rezultata panel analize može se zaključiti da je prerađivačka industrija još uvijek važan čimbenik regionalnog rasta u Hrvatskoj, iako njezin relativni značaj u hrvatskom gospodarstvu kontinuirano opada tijekom posljednja dva desetljeća.

Ključne riječi: koncentracija prerađivačke industrije, hrvatski regionalni rast, panel ekonometrijska analiza