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Effects of technological changes and trade liberalisation on industrial development in the Western Balkan Countries

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ABSTRACT
The transition process in the Western Balkan Countries (W.B.C.) is followed by efforts focused on modernisation and industrial manufacture growth. However, industries in these countries are still under the pressure of the need for restructuring and the rules of an open market. Opening towards the world and transferring new technologies are related processes. Although they are of the same importance, adoption of new technologies is a process which is more demanding than trade liberalisation process. Technological and trade openness pander to other factors of development and contribute to higher efficiency of investments. Industrial manufacture growth spurs economic growth. Furthermore, share of industrial production in G.D.P. as dependent variable represents the scope and quality of industrial development. The hypothesis is that the share of industrial production in G.D.P. is affected by: Technological readiness, Manufacture value added and Merchandise trade as well as Gross investments and Innovations. Results of panel analysis indicate that Technological readiness, Manufacture value added and Gross investments have positive and significant impact on industrial development. Negative coefficient of merchandise trade liberalisation in the panel model implies slowdown of industrial development, and one of the reasons is continuously high merchandise trade deficit in W.B.C.

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1. Introduction

The characteristics of global trends are rapid technological changes and growth of service sector. However, it is the industrial sector that initiates total economic development. Neither industrial nor developing countries achieve growth, higher export and employment, unless they develop strong industry (Fontagné & Harrison, 2017). Post-transitional countries are developing market economy, liberalising trade,

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restructuring industry, investing and endeavouring to increase export and employment in parallel. Some 'promoters of the development era' and fast-growing sectors ignore the importance of industry, but it is nonetheless a prerequisite for faster G.D.P. growth and general welfare. Balassa (1980) analyses industrial growth and alternative industrial strategies. He researches Inward and Outward-oriented industrial development strategies, as well as the process of selection of development strategy for industrial and developing countries. The hypothesis that there can be no developed countries without strong industry has been proven by Friedman (2002). In terms of developed industry, he sees strength and capacity in the U.S.A. Ruttan (1998) sees technological changes as a prerequisite for economic growth, finding them to be even more important than the classical factors. In his work, he determines the contribution of such changes to the competitiveness of certain branches of the U.S.A. industry. In a later paper, Ruttan (2000) proves that technology is a growth factor and emphasises institutional innovations. Freeman (2013) researches technological changes and global development. He analyses economic growth, new technologies and innovations for O.E.C.D. and E.U. countries. Industry innovations are a growth factor as well.

Technological progress as the new industrial paradigm has been researched by Solow (1956), Lucas (1988) and others. Popović et al. (2019) reduce it to technological readiness, research, development and innovations. Technologically forward industries are more attractive for local and foreign investments.

Industrial development in the era of globalism asks for a commercial philosophy based on liberalism and negation of customs, non-customs and other barriers. Most regional economic integrations are characterised by the transfer of technologies, investments, joint ventures, etc. These processes are inconceivable without liberalisation. Merchandise trade stimulates production, in contrast to closure within national frameworks and industrial protectionism. The last several decades have in fact been marked by de-industrialisation processes. For Lauridsen (2018), it afflicts those forward, post-industrial economies. Industrialisation and income ratio is inversely proportional, whereby industrialisation is measured by employment or production rate. Therefore, he claims that lower income rate countries have more potential for industrialisation. In contrast to Asia, Latin America is being afflicted by de-industrialisation. The developed countries are losing work posts in industry, particularly those low-qualified, poorly paid jobs, since globalisation relativises production places.

Report on Industrial Development (2018) states that the world manufacturing value added more than doubled from 1990 to 2016, including the share of developing countries industries in the world M.V.A., which increased from 21.7% to 44.6%. At the same time, the share of developed industrial countries in the world M.V.A. decreased from 78.3% to 55.4%. China's share in the world manufacturing value added is the greatest. It doubled from 12.6% in 2006 to 24.4% in 2016, while the M.V.A. for the U.S.A. dropped from 20% to 16%, making it the second largest global participant. Finally, the world M.V.A. grew somewhat faster than G.D.P., due to strong growth of developing countries M.V.A.

The E.U. has developed industry, with Germany, France, Italy and other countries at the forefront. Western Balkan Countries (W.B.C.) traditionally depend on

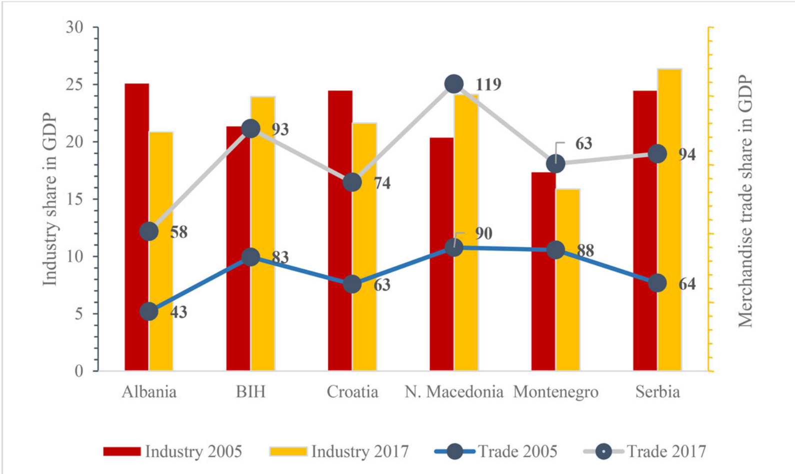

Figure 1. Merchandise trade and industry share in G.D.P., W.B.C., 2005–2017.
Source: Authors' work in Excel, based on Industrial Development Report (Industrial Development Report (IDR), 2018).

developed European economies (Osbild & Bartlett, 2019). Bartlett (2008) sees the Western Balkans (W.B.) as countries of the former S.F.R. Yugoslavia, (-) Slovenia, (+) Albania. For the E.U., W.B. is part of the Balkan Peninsula which is not within its composition (The European Parliament, 2019).

Developed Europe impacts on W.B.C. industry through Euro-integration processes, by way of investment attraction and commercial opening (Popović & Erić, 2018). Stabilisation and Association Agreement (S.A.A.) liberalises trade between E.U. and W.B.C. The Agreement encompasses industrial cooperation by way of industry modernisation and restructuring, as well as through investments promotion and protection.

The W.B.C. has continuous trade deficits, as well as lack of savings and investment. The global financial crisis (2009–2013) has slowed down positive economic trends. The average share of merchandise trade is almost equal to the achieved G.D.P., and all the observed countries have recorded an increased foreign trade exchange (Figure 1). The economic structure of the W.B. countries is similar, and the average growth in the industry share in G.D.P. from 2005 to 2017 has been accomplished by the following countries: Bosnia and Herzegobina (B.&H.), Northern Macedonia and Serbia. The reason for these tendencies are worse initial positions of the listed countries in the observed period.

The structure of the W.B.C. industrial production features the food and drink production, metal production, chemical and non-metal mineral production, etc. The existing differences in their production arise out of the state of technological equipment and availability of natural resources. Thus, for example, the production of machines and equipment is highly significant for Croatia; B.&H. and Montenegro rely on the production of forest assortment, while Albania relies on leather industry and Serbia on the production of rubber, plastic and other (Industrial Development Report (IDR), 2018). Therefore, there is no significant presence of highly technological industries in the W.B.C. In other words, it is mainly about 'traditional' production without higher levels of processing, i.e., about resource-oriented production.

On the basis of the above stated, it can be concluded that the state of W.B.C. industry is significantly lagging behind the European Union average.

European industry offers high-technological products, prefers higher processing stages, whilst mainly importing primary products and raw materials (Penava & Družić, 2015). It is oriented towards traditional manufacturing of higher value added. Further, technological potential ensures external industry competitiveness. Today, with Germany in the forefront, the E.U. is developing standards and architecture for the Fourth Industrial Revolution (I.R.4.), whereby it is necessary that the environment and climate change are not affected. The Union and some member states like France are leaders in those fields. Through EU2020 Strategy, the aims of which are not binding, but are relevant for W.B.C. industrial policy creation, they are trying to affirm sustainable, smart and inclusive growth (Popović, 2016).

Analysis of global aspects of G.D.P. and industry growth shows that Europe is one of the leading participants in the total world manufacturing, even though its share in M.V.A. dropped from 40.3% to 25.1% in 1990–2016. The Asian and Pacific region has been growing continuously, making up remarkable 49.5% of the world M.V.A. in 2016, and causing enormous growth rates. Rodrik (2004) believes that the condition for continuous growth of 4.5% in the period of at least three decades is fast industrialisation. He classifies the relevant countries geographically in two categories: the European periphery from the 1950s and 1960s (Spain, Portugal, Israel), as well as countries of East Asia from 1960s and 1970s (South Korea, Taiwan, Malaysia). Exceptions are small countries that are rich in resources. Rodrik proposes two directions of economic growth based on: (1) accumulation of skills and development of institutions; and (2) structural transformation based on industrialisation. The first direction is characterised by slow to moderate growth, whereas the second one is marked by industrialisation and rapid convergent growth.

An industry share in G.D.P. depends on scope, while the height of value added represents industrial production quality. There are numerous factors that influence the quantity and quality of industrial production. This article researches the combined influence of technological and commercial indicators that determine the position of W.B.C. industries: Technological readiness, Manufacturing value added, Merchandise trade, as well as Gross Investments and Innovations. The first three indicators (independent variables) have direct impact on industrial production and represent independent variables. The last two are control variables. Thus, the aim of this research is to determine the effects of economic transition on the industrial development of the W.B.C. It is about quantifying the impact of technological changes and trade liberalisation, which strongly determines the growth tempo and the industrial structure of the whole region.

In order to assess the impact of predictor variables on the dependent variable, the authors have used the econometric analysis by means of the fixed and random effect panel model. The analysis covers the time series of balanced data for the period 2005–2017. The observation units in this analysis are the following W.B. countries: Albania, B.&H., Croatia, Montenegro, North Macedonia and Serbia. The first phase of the analysis considers Croatia, which has been an E.U. member since 2013. From this period onwards, this country does not officially belong to the W.B.C.

Accordingly, the second phase contains a panel analysis without Croatia. The obtained results have been used for the purpose of discussion and furthermore, a comparison with the results of the current stated researches has been made, following which conclusions and recommendations have been given.

2. Previous research

Landes (2003) researches technological changes and the industrial development of Europe since the middle of the eighteenth century, using Great Britain, France and Germany as examples. Europe's economy depends on the continuity of industrial revolution. Researching industrial development, technological changes and long-term growth, Peretto (1999) has observed differences between developed and developing countries. He has laid down the hypothesis that only developed countries invest great assets into industrial growth and research. Technological progress stimulates development at the end of the industrial cycle. Robinson (2009) sees arguments for industrial policy, the success of which depends on political power, industrial development goals and stimuli. He suggests authentic industrial policies, as opposed to classical industrialisation, to poor countries. Haque (2007) does not recommend the universal model to underdeveloped countries, but original and innovative industrial policies. For Malerba and Cantner (2006), the evolution of industrial structure, together with rapid technological and institutional changes, leads to growth. Researching technological progress and growth following the 2008/2009 crisis, Aghion and Antonin (2018) observe that structural and macro-policies are complementary.

Experiences of Asia are invaluable for developing countries. Fan and Watanabe (2006) research technological policies of Japan and China. They place an emphasis on an active role of governments and respect for specificities and technological import. Shapiro (2007) researches industries and growth of Latin American and East Asian countries. Due to changed instruments, governments tend to create new industrial policies. Cimoli et al. (2009) research East Asian and Latin American industry. Technological readiness and technological learning are the basis for industrial development.

Tomić and Stjepanović (2017) analyse industrial production and the sub-sector structure of Croatian industry. Comparison of A.R.I.M.A. industry and sub-sector model shows that technological changes are occurring with different intensities in different branches, with greatest changes happening in industry, services and I.C.T. sector. Using Albania as an example, Jadoon and Ali (2018) assess by linear regression (Ordinary least squares method) the relationship between the industrial and economic growth in the period 1999–2013. They believe that the economic growth is accompanied by a more vulnerable industry in this country. Tomljanović et al. (2018) make use of descriptive analysis to research the industrial sector perspectives in the ambience of de-industrialisation in Montenegro. They have identified an increase in the inflow of foreign investments, a fall in employment in the industrial sector, a continuous incurring of trade deficits and relative de-industrialisation in Montenegro. Using Croatia as an example, Družić et al. (2012) analyse structural effects of de-industrialisation. They prove that in the era of transition there was a collapse of the

Croatian traditional industry, whereby no fast restructuring and modernisation of the industrial sector followed. Therefore, the authors point to negative effects of a 'late' industrialisation, particularly in terms of structural unemployment. Tomić (2012) researches the relation between technological progress and economic growth. Technological progress stimulates growth, which depends on the intensity of technological shocks. Croatia at the beginning of new millennium has been researched by Bezić and Karanikić (2014). They have observed the importance of foreign direct investment (F.D.I.) for technological readiness and transfer of technologies and proven positive correlation between the transfer of technologies, F.D.I. and growth rates. Mićić (2015) and Savić (2009) investigate structural changes and industrialisation. They prove that Serbian non-competitive industry cannot realise export and growth.

Soete (1981) researches the relation between technological changes and foreign trade with the aim to prove that foreign trade of O.E.C.D. countries depends on technological achievements and innovations in industry. Later, Soete (1987) upgrades the hypothesis about the impact of technological innovations on international trade. Technological changes and industrial innovations strengthen the competitiveness of O.E.C.D. countries. Technological and commercial openness are equally important for trade growth. Dosi et al. (1990) prove that technological changes stimulate growth of global externalities. The results are G.D.P., liberalisation and international trade growth. Trade growth is a way of depreciating the 2008/2009 crisis. In the post-crisis period Croatia relied on export, with industrial products at the forefront (Basarac-Sertić et al., 2019; Basarac Sertić et al., 2015; Buturac et al., 2019). Competitiveness, trade liberalisation and international exchange for the Croatian industry from 2003 to 2012 have been researched by Gjini (2017). He starts from the hypothesis about negative connection between productivity and tariffs and proves an inverted connection between the Total Factor Productivity (T.F.P.) and tariffs. Export-oriented companies are more productive. In this period, Croatia shows tendency towards import, negative trade balance and increased openness towards the E.U. Bezić et al. (2011), and later Pervan et al. (2019) have researched the competitiveness of processing industry in Croatia. They analysed the index of foreign trade openness, competitive advantage and the structure of processing industry, and concluded that there are some competitive advantages. In terms of export competitiveness growth, they suggest structural changes in the processing industry. Škare and Tomić (2014) research innovations and productivity growth for O.E.C.D. countries (1950–2013). Technological innovations stimulate G.D.P. growth. Further, Acemoglu (2015) places his review of Atkinson and Stiglitz's view on innovations and technological changes (1969) in the context of current induced innovations and directed technological change. Innovations and economic growth for C.E.E. countries are researched by Pecea et al. (2015). They prove positive correlation between economic growth and innovations. Richer countries invest more in the development of industry and technologies. Kesici Çalışkan (2015) observes that inequalities in income arise from differences in science and technology, while Hekkert et al. (2007) see innovations as a factor in technological changes. Technological changes and positive externalities are analysed by Freeman and Soete (2009). They see science and technology (especially informatics) as development factors. Further, industrial evolution and computer industry as a prerequisite for faster growth is researched by Malerba et al. (1999).

Total investments are a prerequisite for industrial development, whereby foreign investments have all the greater role in the world (Popović & Erić, 2018). Thus, Barrios et al. (2005) prove the relation between industrial development, F.D.I. and competitiveness. Using Ireland as an example, they prove F.D.I. contribution to development of the local industry and positive externalities. According to Markusen and Venables (1999), foreign investments are an important factor of industrial development. They represent 'catalyst' for the development of local companies and industries. Sinha and Sengupta (2019) apply Comparative Dynamic Panel Analysis and find that F.D.I. inflows significantly promote industrial growth in developed and developing countries. The work by Maroof et al. (2019) is particularly important in terms of more recent empirical researches. Using Granger's Causality Test and Panel A.R.D.L. technique to determine significant predictors of industry development in South Asian economies, they found that Governance, Foreign direct Investment, Equity Openness and Inflation are significant contributing factors in industrial development.

3. Methodology

This research makes use of panel data analysis. Panel data typically refer to data containing time series observations across a number of individuals. Therefore, observations in panel data involve at least two dimensions: a cross-sectional dimension, and a time series dimension (Hsiao, 2007). However, panel data could have a more complicated structure. In this research panel data analysis is used to assess the impact of selected predictor and control (explanatory) variables on industrial growth. There are a number of advantages of panel analysis over cross-sectional or time series data (Baltagi, 2015; Hsiao, 2014; Hsiao, 2007): more accurate inference of model parameters, greater capacity for capturing the complexity of human behaviour than with a single cross-section or time series data, simplifying computation and statistical inference and others. Further distinction can be made between the pooled panel model, and fixed and random effect models. This article explains fixed and random effect panels whereas the pooled model will not be presented due to numerous restrictions.

Fixed effect model is a linear one and is defined as follows:

$$Y_{it} = \alpha_i + \beta_1 \cdot x_{it1} + \beta_2 \cdot x_{it2} + \ldots + \beta_k \cdot x_{itk} + \varepsilon_{it} i = 1, \ldots, N; t = 1, \ldots, T \quad (1)$$

where N denotes the number of observation units, T the number of periods x_{itk}, $k = 1, \ldots,$ k the value of k-independent variable, i-the observation unit in the period t. Parameter α_i is the constant member which differs for every observation unit, and $\beta 1$, $\beta 2, \ldots, \beta_k$ are parameters to be estimated. Parameter ε_{it} denotes estimation error of i-observation unit at the moment t, whereby it is assumed that ε_{it} are independently and identically distributed random variables across observation units and time, with the mean zero and the constant variance σ^2_{ε}. Likewise, it is assumed that all the x_{itk} are independent, with ε_{it} for all i, t, k. The fixed effect model can be formulated by means of dummy variables of analytic form:

$$Y_{it} = \sum_{j=1}^{N} \alpha_J \cdot d_{ij} + \beta_1 \cdot x_{it2} + \ldots + \beta_k \cdot x_{itk} + \varepsilon_{it} i = 1, \ldots, N; t = 1, \ldots, T \tag{2}$$

Whereby $d_{ij}=1$ if $i=j$, and otherwise $d_{ij}=0$. Hence it can be concluded that the estimation of fixed effect model requires assessment of N parameters $\alpha_1, \alpha_2, \ldots, \alpha_n$ with N dummy variables. The method of least squares for the estimation of fixed effect model is called *Least Square Dummy Variables (L.S.D.V.)*. Estimator properties change with respect to the sample size, that is, with regard to the number of periods and units of observation included. Loss of great degree of freedom due to estimation of the constant member for every observation unit, occurrence of multicollinearity between independent variables due to great number of dummy variables, impossibility of estimation of a huge number of observation units as well as impossibility of use in case of variables that do not depend on time, are main deficiencies of this method.

Random effect model implies a simple linear model in which assumptions that observation units have been selected randomly, as well as that differences between them are random, are valid. Accordingly, random effect model can be expressed as follows:

$$Y_{it} = \mu + \beta_1 \cdot x_{it1} + \beta_2 \cdot x_{it2} + \ldots + \beta_{k1} \cdot x_{itk} + \alpha_i + \varepsilon_{it} i = 1, \ldots, N; t = 1, \ldots, T \tag{3}$$

Where μ denotes the common constant member for all observation units, and α_i random effect for every observation unit. Thereby, this model assumes that α_i are independently and identically distributed random variables across observation units, with the mean zero and variance $\sigma^2{}_\varepsilon$, whereas $\beta_1, \beta_2, \ldots, \beta_k$ are parameters to be estimated. The following assumption is reflected in ε_{it} being independently and identically distributed random variables across observation units and time, with the mean 0 and variance σ_ε.

3.1. Data sources and explanation of variables

The database referred to the most is World Development Indicators (W.D.I.), from which data on industry value added, merchandise trade and gross investments has been taken. Data on the progress of technological readiness and innovativeness rank has been taken from the official reports of W.E.F. on the Global Competitiveness Report. Data on the manufacturing value added has been taken from the official Industrial Development Report by the United Nations Industrial Development Organisation (U.N.I.D.O.) (Table 1).

(A) Dependent variable.

1. Industry, value added (% of G.D.P.). Reference to industry is made in ISIC divisions 10–45. Industry involves value added in mining, manufacturing, construction, electricity, water and gas. Value added represents net output of a sector when all outputs have been added up, and all intermediary inputs subtracted. It comes from calculation that makes no deductions for depreciation of fabricated assets or depletion and degradation of natural resources. ISIC revisions 3 or 4 establish the origin of value added. Source: World Development Indicators

Table 1. Dependent, explanatory and control variables for the analysis and data sources.

Variable	Mark in the model	Source
(A) Dependent variable		
1. Industry (including construction), value added (% of GDP)	INDPARTICGDP	World Bank - WDI
(B) Explanatory variables		
2. Merchandise trade (% of GDP)	MERCHANDISETRADE	World Bank - WDI
3. Technological readiness	TECHREADINESS	The Global Competitiveness Report, World Economic Forum (WEF)
4. Innovation Rank	INNOVATIONRANK	The Global Competitiveness Report, World Economic Forum (WEF)
(C) Control variables		
5. Manufacture value added	MANUFACTVADD	Industrial Development Report (IDR) (2018)
6. Gross fixed capital formation (formerly gross domestic fixed investment)	GROSSCAPFORMATION	World bank

Source: Created by the authors, using data from the World Bank (2019), World Economic Forum (2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017), United Nations Industrial Development Organisation (UNIDO, 2018).

(B) Explanatory variables.

2. Merchandise trade as a share of G.D.P. represents the sum of exports and imports of merchandise, divided by G.D.P. value, all in current U.S. dollars. Source: World Development Indicators
3. Innovation Rank is 12th pillar in the Global Competitive Report. This index is represented as rank, where greater number means worse position on the world competitive scale. Source: G.C.R. in W.E.F.
4. Technological readiness stands for Efficiency enhancers subindex Techreadiness in the Global Competitive Report. This index is represented as score, whereby larger score means better position on the world competitive scale. Source: G.C.R. in W.E.F.

(C) Control variables.

5. Manufacture value added. Manufacturing refers to industries found in I.S.I.C. divisions 15–37. Value added represents net output of a sector when all outputs are added up, and all intermediary inputs subtracted. It comes from calculation that makes no deductions for depreciation of fabricated assets or depletion and degradation of natural resources. I.S.I.C. revision 3 establishes the origin of value added. Note: For V.A.B. countries, gross value added at factor cost is used as denominator. Source: Industrial Development Report.
6. Gross fixed capital formation comprises land improvement; plant, machinery, and equipment purchases; construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to 1993 S.N.A., capital formation also includes net acquisitions of valuables. Source: World Development Indicators

Data on all variables was collected for W.B.C. from 2005 to 2017.

4. Results

Panel regression analysis assesses the impact of selected variables on industrial development. The number of observation units in the first model is equal to the number

Table 2. Correlation matrix for pairs of explanatory variables, INDPARTICGDP – dependent variable.

	Indpartic gdp	Merchandise trade	Tech readiness	Inovation rank	Manufactv add	Gross capformation
Indpartic gdp	1.000					
Merchandise trade	−0.058	1.000				
Tech readiness	−0.148	0.004	1.000			
Innovation rank	0.394	−0.038	−0.334	1.000		
Manufactv add	0.629	0.348	0.144	0.006	1.000	
Gross capformation	0.057	−0.306	−0.411	0.081	−0.523	1.000

Source: Authors' calculations in Eviews programme.

of analysed W.B.C. ($i = 6$) from 2005 to 2017 ($t = 13$). Thus, the first model was applied to W.B.C., including Croatia. On the other hand, five countries were analysed in the second model, excluding Croatia. Prior to the formation of the econometric model, the correlation between pairs of explanatory variables was examined due to possible collinearity. This problem can disrupt estimation of parameter values, their significance and the direction of their impact on the dependent variable. To date, there exists no adequate test for discovering multicollinearity in panel models. According to Baltagi (2008, 2015), in empirical works that use panel models for discovering multicollinearity, use is made of correlation coefficients between pairs of potential independent variables (Table 2).

Correlation test shows that pairs of explanatory variables should not cause multicollinearity as the correlation in all cases is extremely weak.

The following table shows results of the two panel models. The first case, which includes Croatia, reveals fixed effect panel model as more adequate for estimation. The second case, which does not include Croatia, reveals random effect model as adequate for statistical inference.

4.1. Model comparison

Hausman's test is used when comparing estimated coefficients of fixed effect and random effect models (Hausman, 1978). If the null hypothesis is not rejected, one reaches the conclusion that the random effect estimator is more efficient. But if it is rejected, one arrives at the conclusion that the random effect estimator is not consistent, that is, reference is made to the fixed effect estimator. The results of Hausman test in the first model show the value of 186,09. Calculated test probability is significantly below 5%. This implies rejection of the null hypothesis; hence the fixed effect model is accepted as adequate in explaining variations of the dependent variable with predictor variables (Table 3).

The results of the Hausman test in the second model show the value of 1,195. Calculated test probability is significantly above 5%. This result implies confirmation

Table 3. Results of Hausman test – Croatia included.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	186.09	5	0.0000

Source: Authors' calculation in Eviews programme.

Table 4. Results of Hausman test – Croatia excluded.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	1.195	3	0.7543

Source: Authors' calculation in Eviews programme.

of the null hypothesis; hence the random effect model is accepted as adequate in explaining variations of the dependent variable with predictor variables (Table 4).

4.2. First model

The results of applying fixed effect model for 2005–2017 (six W.B.C. including Croatia) show that the parameters of variables Techreadiness, Merchandisetrade, Manufactvadd, Grosscapformation in the model have been assessed as statistically significant in explaining industrial development. Merchandisetrade has negative prefix in explaining variations of the dependent variable at the significance level of 5%, while Techreadiness, Manufactvadd and Grosscapformation are variables with positive prefix of industrial development impact. Innovativeness rank in the model has not been assessed as statistically significant in explaining the dependent variable of industrial development. Impact of Innovation rank has not been assessed as statistically significant because the probability of t-statistics is significantly above the cut-off 5% value. Determination coefficient (R^2 =0, 93) implies that 93% of industrial development variations (Indparticgdp) is explained in terms of variables in the fixed effect model. Explanatory variables realise their significant simultaneous impact on the dependent variable by the calculated value of F-statistics (significance level of 5%).

4.3. Second model

Analysis period is 2005–2017 and observation units are five W.B.C.: Albania, B.&H., Macedonia, Montenegro and Serbia. The table shows the results of random effect panel model, which was assessed as more adequate for estimation. Due to lower number of units the number of variables was reduced too. The model keeps Merchandise trade, Technological readiness and Gross investments as the control variable.

The results of applying random effect model show that the parameters of Merchandise trade and Gross Investments variables were assessed as statistically significant in explaining industrial development, whereby the connection between merchandise trade and industrial development is positive. Although positive, technological readiness is not significant for explaining variation of the dependent variable at the significance level of 5% (Table 5).

Table 5. Results of panel analysis.

Variable	Fixed effect model Prob	Fixed effect model t-Statistic	Random effect model++ Prob	Random effect model++ t-Statistic
c	0.0007	3.538681	0.0000	8.248359
Merchandisetrade	0.0007*	−3.556013	0.0026*	3.138315
Techreadiness	0.0088*	2.696770	0.2122	1.260763
Innovationrank	0.1810	1.351626	–	–
Manufactvadd	0.0000*	8.487695	–	–
Grosscapformation	0.0000*	7.105238	0.0130*	2.558716
R-squared	0.94		0.89	
Adjusted R-squared	0.93		0.87	
F-statistic	102.9		64.9	
Prob (F-statistic)	0.00000		0.00000	

Notes: ++Random effect model is calculation without Croatia in the sample. Exclusion of Croatia means that three reference explanatory variables have been kept. * denotes 5% significance.
Source: Authors' calculation in Eviews programme,.

5. Discussion and conclusion

Results of research for the first model show that the combination of selected variables Techreadiness, Merchandisetrade, Manufactvadd, Grosscapformation in the model is statistically significant and relevantly explains the industrial development model.

At 5% significance level, Merchandise trade has negative parameter prefix in explaining variations of the dependent variable, i.e., these variables stand in opposite proportion. This means that trade liberalisation has negative impact on industrial production share in G.D.P. This is explained by the fact that W.B.C. have undergone transition processes and have radically liberalised trade with the world in the last decade or two. It should be added that industrial structure changes more slowly too. Growth in productivity and competitiveness seems discouraging, while this region's markets are interesting for foreign goods. The results are long-term trends of foreign trade deficit caused by high aptitude towards import. As the most developed country, Croatia has somewhat better results. Research done by Bezić et al. (2011), who established that certain industries have competitive advantages and that the structure of processing industry should be changed if export competitiveness is to be increased, has been partially confirmed. The results have confirmed part of the research done by Gjini (2017), who established growth in openness towards E.U., which is characteristic of all W.B.C. Signing the S.A.A. has an impact on total opening of W.B.C., which ultimately leads to faster growth of import in relation to export of industrial products.

Technological readiness, Manufacture value added and Gross Investments variables have positive prefix in relation to the impact on Industrial production share in G.D.P. Positive impact of Techreadiness is explained by relatively preserved industrial infrastructure and trained workforce, as resources of the W.B. region that existed even before the transitional processes. These results are similar to those stated in the previous research in the W.B.C. The works coincide with the research carried out by Savić (2009), Mićić (2015), Jadoon and Ali (2018), Tomljanović et al. (2018) and Družić et al. (2012) who recommend structural changes and modernisation of industry in the countries of this region. Similarly, these results converge with the research that sees the technological progress and technological readiness as factor of industrial development and, ultimately, economic growth. Research done by Ruttan (1998) to the effect that technological changes cause economic growth has been confirmed too. Importance of technology in industry has been confirmed by Tomić and Stjepanović (2017), and Tomić (2012) as well.

The results of the relation between Manufactvadd and Industrial production share in G.D.P. show positive correlation, i.e., they confirm tendencies from U.N.I.D.O. Report (2018) on Rapid Growth of World M.V.A. (1990–2016) in developing countries. The hypothesis laid by Rodrik (2004) to the effect that rapid industrialisation impacts on continuous economic growth has been confirmed too.

The results of the variable Grosscapformation show that industrial development depends on investments that are mainly realised and multiplied in the industrial sector.

Impact of Innovationrank on Industrial production share in G.D.P. is not statistically significant because the probability of t-statistics is significantly above the cut-off 5% value. It has been shown that the W.B. region does not possess sufficient innovation potential. Innovationrank has proven to be the only insignificant variable in the model, implying that results obtained by Škare and Tomić (2014) to the effect that technological innovations stimulate G.D.P. growth in Croatia have not been confirmed, and neither have those by Acemoglu (2015), to the effect that innovations impact on technological changes, nor those by Pecea et al. (2015), who prove positive correlation between economic growth and innovations, or Hekkert et al. (2007), who consider innovations to be factor of technological changes. Disagreement between this research and the up-to-now results for Croatia can be explained by the fact that underdeveloped W.B.C. have 'disrupted' average values of Innovationrank variable.

Generally, the observed model is scientifically significant and practically relevant because it explains key tendencies of important constituents of industrial development. Through determination coefficient (R^2=0, 93), even 93% of variations of the industrial development (Indparticgdp) was explained in fixed effect model. This particularly pertains to joint impact of all variables. With the value of F-statistics (the significance level of 5%), explanatory variables exercise significant simultaneous impact on Industrial production share in G.D.P.

The results of research for the second (reduced) model show that combination of selected variables Techreadiness, Merchandisetrade and Grosscapformation is statistically significant and relevantly explains industrial development model. Smaller number of units conditioned smaller number of variables. The model kept merchandise trade, technological readiness and gross investments as the control variable. Results show that Merchandisetrade and Gross investments variables parameters were assessed as statistically significant in explaining industrial development, whereby the connection between merchandise trade and industrial development in this model is positive. Given that exclusion of Croatia means income per capita in W.B.C. decreases, the relation of that group of countries to trade openness changes as well. In combination with positive impact of investments, Merchandise trade shows different character. Slower export and greater import in these underdeveloped countries obviously stimulates Industrial production share in G.D.P. This confirms research done by Markusen and Venables (1999) to the effect that foreign investments are prerequisite for faster industrial growth and development of local companies.

Even though Malerba and Cantner (2006) and Ruttan (2000) see technology as a growth factor, technological readiness, though positive, is not significant in explaining variations of the dependent variable at the significance level of 5%. Countries included in the second model have low level of economic and technological development, which is why this result is expected. Transitional processes have slowed down the development of science, technology and research. Innovativeness is at low level, which is reflected in insignificant impact of technological readiness on industrial development. Results of random effect panel model using Hausman test were assessed as more adequate for estimation.

In general, the model concords with the research works that see in the industrial development the strength of the total economy, and therefore recommend industrial strategies (Balassa, 1980). Finally, technological readiness should be strengthened and adjustments and alignments with the global market standards should be made (Ruttan, 1998; Freeman, 2013).

The W.B. region is oriented towards the E.U., and merchandise exchange with Germany, Italy, Austria and other E.U. countries is growing. Economic relations between W.B.C. and E.U. are developing through Euro-integration processes. Some segments of research have confirmed the impact of E.U. economy on W.B.C., particularly signing S.A.A. and trade liberalisation, as well as technical-technological cooperation.

The E.U. countries have a traditionally strong and technologically advanced industry, and have been global leaders in some industrial branches from the first industrial revolution to I.R.4. A production and technology giant, the Union dominates the global supply of industrial products together with the U.S.A. and China. In future, European and W.B.C. industries will face new challenges: growth of global competitiveness, climate changes, deficits of non-renewable resources, transformation towards the I.C.T. sector, implementation of I.R.4. and other. Hence further growth of trade, as well as greater investments and improvement in technological cooperation between E.U. and W.B.C. in the area of industrial development are to be expected.

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No potential conflict of interest was reported by the authors.

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