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CONVERGENCE AND PRODUCTIVITY GROWTH: EVIDENCE FROM THE REPUBLIC OF SRPSKA

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The paper is mainly aimed at identifying the sources of total factor productivity (TFP) growth within the framework of convergence for the Republic of Srpska (RSRP). The main research question is what it is that drives technological progress for a small transition country. The current study focuses on the RSRP, as the follower, and the Republic of Serbia (RSRB), as the technological leader. The analysis carried out in this research study confirms the presence of convergence at the industry level, which means that the farther away from the technological frontier a country is, the higher the TFP growth rate. The research results enable policymakers to design and implement policies capable of enhancing domestic development and increase productivity growth.

Keywords: total factor productivity, productivity convergence, trade, research and development, human capital

JEL Classification: D24, F43, O38, O47

INTRODUCTION

The RSRP and the RSRB signed the Agreement of Special Parallel Relations on 26th September 2006. The Dayton Peace Agreement enabled the entities within Bosnia and Herzegovina to establish special parallel relations with adjoining countries. Although the Agreement of Special Parallel Relations between the RSRP and the RSRB was signed in the early 2000s, the RSRP still lags far behind the RSRB in terms of productivity and efficiency. The World Bank has described Bosnia and Herzegovina as an upper-middle-income country with incomplete transition to the market economy. Therefore, the RSRP shares the same economic characteristics as Bosnia and Herzegovina.

The main research question is what it is that drives technological progress of a small transition country. More importantly, what is it that affects a country's ability to absorb superior technologies developed somewhere else? According to M. Abramovitz (1986), less industrialized countries were focused on the adoption of technology developed somewhere else during the second half of the 20th century. Productivity growth in a specific country can be explained by the adoption of the currently existing

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more efficient technologies (Havik, Mc Morrow, Röger & Turrini, 2008).

This paper is intended to contribute to the extant literature on productivity convergence. This research study is focused on conditional convergence at the industry level between the two candidate states characterized by a similar history, speaking both economically and politically. The results obtained in this study provide an insight into the variables affecting the convergence process at the industry level, which is vital for policymaking. The focus of the analysis conducted in this research study is on the RSRP, as a country which falls behind the technological frontier, and the RSRB, as the technological leader. To the best of the authors' knowledge, this research study is the first to investigate the productivity gap measured by TFP between the RSRP and the RSRB at the industry level.

The technological change rate, i.e. the technological progress growth rate is measured by the TFP growth rate. The differences in TFP between rich and poor countries are the main force driving the differences in income *per capita* (Klenow & Rodriguez-Clare, 1997; Hall & Jones, 1999; Gallardo-Albarran & Inklaar, 2021). This study explores the productivity growth sources for the RSRP's industry with a special focus on technological catchup. The main idea is that the farther the RSRP's productivity falls behind the technological frontier (the RSRB), the higher the potential for a technology transfer, which leads to higher productivity growth.

The selection of the analyzed countries is not arbitrary. The RSRB is one of the RSRP's major trading partners and, considering the Agreement of Special Parallel Relations, the research is done in whether trade can facilitate a technology transfer or not. The research goal is threefold. Firstly, the productivity gap at the industry level between the RSRP and the RSRB is estimated by applying growth accounting in order to obtain the measure of TFP, which is the approximation of technology. Secondly, whether there is productivity convergence at the industry level between the RSRP and the RSRB or not is determined. Thirdly, econometric analysis is applied so as to evaluate the impact of various determinants on TFP growth. This paper mainly focuses on trade and research and development (R&D). This research study also considers human capital. Following A. Gehringer, I. Martínez-Zarzoso and F. N. L. Danzinger (2015), the independent variables used in this study are a combination of the country-level (R&D) and sector-level variables (trade and human capital).

Due to a lack of data for the research study's sample, it was not possible to collect all data at the industry level. The two main hypotheses of this study to be tested read as follows:

H1: Trade has a positive impact on the productivity growth of the RSRP at the industry level.

H2: The productivity gap at the industry level between the RSRB and the RSRP is closing.

According to R. Griffith, S. Redding and J. Van Reenen (2004), R&D and trade can boost productivity growth in two ways. First, they can enhance a country's absorptive capacity. Second, R&D and trade foster learning and innovation. In order to test the two main hypotheses, the panel fixed effect estimator is applied, complemented with dynamic panel analysis and the feasible generalized least squares estimator.

This paper is organized into five more sections following the Introduction. Section 2 discusses the existing literature and gives some theoretical background. Section 3 provides information on the model specification and the applied methodology. Section 4 presents the data. Section 5 contains the empirical results and discussion. Section 6 is the conclusion of the paper.

LITERATURE REVIEW

Productivity convergence means that the productivity gap between countries/industries is narrowing. According to W. J. Baumol, R. R. Nelson and E. N. Wolff (1994), (productivity) convergence is tantamount to diminution in the degree of economic inequality among countries (Baumol *et al*, 1994).

As the function of technological transfer, the productivity growth model was initially developed by A. B. Bernard and C. I. Jones (1996) only to be used later by R. Griffith *et al* (2004), G. Cameron (2005) and T. S. Khan (2006). A. B. Bernard and C. I. Jones (1996) found that, when the OECD countries are concerned, cross-country convergence to the USA was mostly because of the services sector. G. Cameron (2005) stressed that R&D was the main driving force for productivity convergence in the 19 sectors of the United Kingdom's manufacturing and for Japan, where the productivity gap between Japan and the USA was closing at the industry level. The productivity growth of Japan was slowing down mainly because the possibility of imitation was exhausted. T. S. Khan (2006) pointed out the fact that the R&D and trade of technologically advanced economies were lagging behind the productivity growth of France but were not speeding up convergence towards the USA.

A research study conducted by R. L. Bruno, E. Douarin, J. Korosteleva and S. Radosevic (2019) confirmed the divergence process within the EU manufacturing sector. Productivity polarization productivity is noticed between the South and the East, on one hand, and the rest of the sample, on the other. The recent COVID pandemic has caused negative productivity growth for the EU, while the USA has achieved productivity convergence within its industries (de Vries, Erumban & van Ark, 2021; Fedajev, Radulescu, Babucea, Mihajlovic, Yousaf & Milićević, 2021).

Productivity convergence at the industry level between the "new" and the "old" EU countries was investigated by D. Radicic, Z. Borovic and J. Trivic (2023) over the period from 2000-2019. Their results confirm the convergence process for all the three industries (ICT-producing sector, market services, and manufacturing). Even though R&D investments are not statistically significant for all market segments, the R&D gap term speeds up convergence in two out of the three market segments. Switching to the R&D stock for all the three market segments and almost for all the model specifications generates a positive impact of the R&D stock on productivity growth, whereas the R&D stock gap term speeds up the convergence process. Productivity convergence for the same sample was confirmed at the country level, where the role of institutions is stressed as the main driving force behind productivity convergence (Borovic & Radicic, 2023).

The positive impact of R&D on productivity growth is well documented in many studies (Griliches, 1980; Griliches & Lichtenberg, 1982; Grifith *et al*, 2004; Männasoo, Hein & Ruubel, 2018). Investments in R&D can affect productivity growth in more than one way. M. Spence (1984), and D. T. Coe and E. Helpman (1995) stated that a country that fell behind the technological frontier might enhance its productivity through its own R&D activity. According to the same authors, a country that falls behind the technological frontier may enhance its productivity by imitating the R&D outcomes of the technologically most advanced economy. Foreign R&D can be broadly utilized in technologically inferior countries through the import of capital or raw intermediate materials (Keller, 1998).

On the other hand, according to K. Männasoo *et al* (2018), only the most productive regions can reap the benefits of R&D investments. Their results prove that, in the Central European countries (CEE), R&D has a negative impact on their TFP growth. Export is another channel that enables a country that falls behind the technological frontier to enhance its productivity and efficiency. According to the learning-by-exporting hypothesis, domestic exporters are involved with best international practices. Yet it remains unclear whether this hypothesis can be supported empirically or not.

RESEARCH METHODOLOGY AND DATA

Following R. R. Nelson and E. S. Phelps (1966), A. B. Bernard and C. I. Jones (1996), G. Nicoletti and S. Scarpetta, (2003), K. Havik *et al* (2008), K. Mc Morrow, R. Werner and A. Turrini (2010), I. Bournakis (2011), and D. Radicic *et al* (2023), this research study applies the standard technology transfer model. In this study, the RSRB is the leading country, the technological frontier, the country with the highest TFP, with the technology level X. The RSRP is the following country, with the technology level Y. Therefore, based on the foregoing, it follows that X > Y. The level of efficiency in each industry is determined by the factors such as the country's characteristics and the industry's characteristics, as well as technology and organizational transfer from the technology-leading country. If the technological leader experiences higher productivity growth rates, then the country which falls behind the leader will also experience a higher productivity growth rate through the adoption of the innovation and knowledge that have been developed in the technologically most advanced country (Havik *et al*, 2008; Mc Morrow *et al*, 2010). For each industry, the technology transfer scope is defined by the distance from the technological frontier.

As is mentioned in the Introduction, TFP represents the measure of technology i.e. productivity. In this paper, TFP is calculated by applying the growth accounting deterministic approach, in which way TFP is calculated as the Solow residual (Solow, 1957) in a log-linear form:

$$\Delta logY = \Delta logA + \alpha\Delta logK + \beta\Delta logL \quad (1)$$

where Y stands for industry-specific gross value added (GVA), K stands for industry-specific capital stock, and L stands for labor in a specific industry. The value of the factors marginal (social) products (where $\alpha+\beta=1$) is very often set at α=0.33, and β=0.66 (Hall & Jones, 1999; McQuinn & Whelan, 2007; Burda & Severgnini, 2009). α is calculated as a ratio between the industry-specific gross wages and the industry specific-GVA.

Capital stock is calculated based on the perpetual inventory method (PIM), which represents the solution of the Goldsmith difference equation:

$$K_t = I_{t-1} + (1-\delta)K_{(t-1)} \quad (2)$$

where I stands for investments and δ stands for the depreciation rate. Following K. McQuinn and K. Whelan (2007a), M. Burda and B. Severgnini (2009), the depreciation rate is set at 0.06. To estimate the initial capital, the US Bureau of Economic Activity's (BEA) procedure is applied, as is done in M. Burda and B. Severgnini (2009):

$$K_0 = I_0 \frac{1+\delta}{g+\delta} \quad (3)$$

where K_0 stands for the initial capital, I_0 stands for investment in the initial year. Following B. S. Bernanke and R. S. Gurkaynak (2002), g represents a ten-year annual average output growth rate. Because of a lack of data, full capital utilization is assumed. The assumption of full capital utilization could lead to an over/under-estimated TFP measure, which implies the failure of the exogeneity condition of the Solow residual. In order to obtain the current capital stock, the linear depreciation method is applied, which enables the full depreciation of the initial capital in 1/δ years:

$$K_t = (1-t\delta)K_0 + \sum_{i=0}^{t-1}(1-t\delta)I_{t-i} \quad (4)$$

In this way, the current capital stock is the weighted sum of the initial capital value K_0, and intervening investment expenditures, with the weights corresponding to their undepreciated components (Burda & Severgnini, 2008).

Econometric specification

Following A. B. Bernard and C. I. Jones (1996), the empirical convergence equation for the RSRP is the equilibrium correction model (ECM) derived from the first-order autoregressive distributed-lag specification (ADL (1,1)) in which the TFP level in each industry is co-integrated with the leader's:

$$logTFP_y = \alpha + \beta logTFP_{y,t-1} + \gamma logTFP_x + \theta logTFP_{x,t-1} + \mu_{y,t} \quad (5)$$

where μ stands for all the observed and unobserved effects that may have an impact on the TFP growth of the RSRP, and it is further decomposed as follows:

$$\mu_{y,t} = \Sigma_n \gamma_n Z_{y,t-1} + \rho + d_t + \varepsilon_{y,t} \quad (6)$$

The right-hand side of the equation (6) includes all the observed factors that have an impact on TFP, namely the country-level variables (R&D and FDI) and the sector-level variables (trade and human capital), while *ρ* and *d* control for the industry- and year-specific effects, respectively. Under the assumption of the long-term homogeneity condition (i.e., $1\text{-}\beta = \gamma+\theta$) after the transformation, the equation (6) can be written as follows:

$$\Delta logTFP_y = \alpha + \gamma\Delta logTFP_x + (1-\beta)log\left(\frac{TFP_x}{TFP_y}\right) + \mu_{y,t} \quad (7)$$

where $log\left(\frac{TFP_x}{TFP_y}\right)$ represents the TFP gap defined as the logarithmic difference between the TFP level in the frontier country (RSRB) and the following country (RSRP). TFP_x represents the TFP level of the RSRB, and TFP_y, represents the TFP of the RSRP.

The following expression can be obtained by substituting the equation (6) for the equation (7) as follows:

$$\Delta logTFP_y = \rho + \vartheta\Delta logTFP_x + \gamma Z_{y,t-1} + \lambda TFP_{gap} + \mu Z_{y,t-1}TFP_{gap} + \varepsilon_{y,t} \quad (8)$$

The dependent variable is TFP growth for the RSRB, the ρ_y controls for industry-specific heterogeneity, ϑ captures the impact of TFP growth at the frontier, the speed of technological transfer is captured by λ, Z captures the impact of R&D, FDI, trade, and human capital. The impact of the absorptive capacity on TFP growth is captured by μ, and $\varepsilon_{y,t}$ is the time-varying error term.

Data

This study is primarily aimed at investigating whether trade can facilitate technology transfer or not. The analysis covers the RSRB as the technological leader, and the RSRP as the country falling behind the frontier. The analysis is based on the following industries for the period from 2005 to 2019:

- mining and quarrying (B)
- manufacturing (C)
- electricity, gas, steam and air-conditioning supply (D)
- construction (F).

The variables, their definitions and the sources are presented in Table 1.

Table 1 The description of the variables

Variable	Description	Source
Y	GVA - the previous year's prices, thousands of euros	RSIS (2023); SORS (2023)
I	Gross fixed capital formation, the current prices, thousands of euros	RSIS (2023); SORS (2023)
K	Capital stock	Authors
L	The employment type: the harmonized ILO definition (in thousands)	RSIS (2023); SORS (2023)
α	Capital marginal (social) product	The authors' calculation
β	Labor marginal (social) product	Authors
TFPy	Total factor productivity	Authors
gap	The total factor productivity gap	Authors
TFPx	Total factor productivity, the leader's growth rate	Authors
R&D	Gross domestic expenditure on R&D as % of the GDP	RSIS (2023)
IMP	Import from the RSRB at the industry level as % of the total GVA	RSIS (2023)
EXP	Export to RSRB at industry level as % of the total GVA	RSIS (2023)
h	Human capital as % of the gross wage of the highly educated employees in the total sum of the gross wages	RSIS (2023)
INTIMP	The interaction variable calculated as the gap*IMP	Authors
INTEXP	The interaction variable calculated as the gap*EXP	Authors
INTR&D	The interaction variable calculated as the gap*R&D	Authors
INTh	The interaction variable calculated as the gap*h	Authors

Source: Authors

Table 2 accounts for the descriptive statistics for the main variables.

Table 2 The descriptive statistics (in logs)

Variable	Obs	Mean	Std. Dev.	Min	Max
ΔTFPx	56.00	0.04	0.12	-0.16	0.51
ΔTFPy	56.00	0.05	0.13	-0.23	0.39
gap	60.00	1.99	0.47	1.24	2.99
h	28.00	-1.69	0.29	-2.11	-1.16
R&D	44.00	-6.03	0.39	-6.46	-5.19
imp	45.00	-5.70	2.41	-9.50	-2.04
exp	45.00	-5.69	2.21	-12.65	-3.07

Source: Authors

The data on R&D are available for the period 2009-2019, whereas the data on imports and exports are not available for the construction. The data on human capital are available only for the period from 2013 to 2019, and the data on R&D are available for the period from 2009 to 2019. The RSRP's industries demonstrate higher productivity growth rates on average than the RSRB's industries, which is in line with convergence theory. The descriptive statistics by industries are presented in Table 3.

The biggest gap is in construction. On the other hand, the highest productivity growth rate for the RSRP is in the construction industry. The highest productivity growth rate for the RSRB is also in the construction industry. In the Appendix, Tables A1, A2, A3, and A4 show the descriptive statistics for the five-year subperiods. The time scope of the analysis covers the period characterized by an economic boom and deep recession. In order to gain an insight into the dynamics of the variables, the statistics for subperiods are provided.

RESULTS AND DISCUSSION

In this study, the data are organized as an unbalanced panel covering a period of 14 years and including four industries. According to R. A. Judson and A. L. Owen (1999), if T>N, where T is the number of the years and N is the number of the cross-sections, the fixed effect (FE) panel estimator performs more efficiently than the instrumental variable (IV)-GMM estimator. To estimate the equation (8), the FE panel estimator is applied. In this study, the number of years ranges between 10 and 20, and according to R. A. Judson and A. L. Owen (1999), the T. W. Anderson and C. Hsiao (1982), AH estimator should be chosen because it produces the smallest root mean square error (RMSE). As an additional test of robustness, the dynamic AH estimator is applied. The results are presented in the Tables 4 and 5.

Table 3 The descriptive statistics by industries (in logs)

	gap			*ΔTFPy*			*ΔTFPx*		
Industry	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.	Mean	Std. Dev.	Freq.
B	1.52	0.23	15.00	0.05	0.17	14.00	0.03	0.18	14.00
C	1.88	0.17	15.00	0.03	0.10	14.00	0.05	0.07	14.00
D	1.88	0.12	15.00	0.05	0.09	14.00	0.03	0.12	14.00
F	2.69	0.16	15.00	0.07	0.14	14.00	0.05	0.10	14.00
Total	1.99	0.47	60.00	0.05	0.13	56.00	0.04	0.12	56.00

Source: Authors

Table 4 The results of the fixed effect estimator

	Model (1) (2005-2019)	Model (2) (2009-2019)	Model (3) (2013-2019)	Model (4) (2005-2019)	Model (5) (2009-2019)	Model (6) (2013-2019)
Dependent variable: *ΔlogTFPy*						
ΔlogTFPx	0.144 (0.095)	0.4351 (0.189)	0.4 (0.148)	1.091*** (0.079)	0.998*** (0.012)	0.996*** (0.01)
gap	0.443* (0.111)	0.42** (0.068)	0.595 (0.326)	0.98*** (0.04)	0.997*** (0.016)	0.987*** (0.006)
IMP	0.083 (0.05)	0.022 (0.018)	-0.093 (0.039)	0.065 (0.245)	0.009 (0.013)	0.024** (0.003)
EXP	0.027* (0.007)	-0.003 (0.023)	0.072 (0.034)	0.372 (0.314)	0.043* (0.012)	0.005 (0.011)
R&D		-0.1 (0.046)	-0.215* (0.038)		-0.211* (0.04)	-0.242* (0.011)
h			0.6 (0.428)			0.009 (0.051)
INTIMP				0.212 (0.182)	0.011 (0.008)	-0.017** (0.005)
INTEXP				-0.035 (0.144)	-0.027* (0.007)	-0.005 (0.008)
INTR&D					-0.131 (0.011)	-0.145 (0.008)
INTh						0.005 (0.028)
cons	-0.425 (0.315)	0.009 (0.3)	1.162 (0.159)	-1.734*** (0.024)	-1.554** (0.189)	-1.611** (0.167)
Cross-sectoral dependence	2.064 (0.039)	2.741 (0.0061)	-1.181 (0.2374)	1.887 (0.04)	3.981 (0.0006)	5.595 (0.000)
Wooldridge test F (1,2)	1.371 (0.369)	5.328 (0.1473)	21.241 (0.04)	15.529 (0.05)	25.725 (0.03)	26.959 (0.003)
Modified Wald test Chi²(3)	2.2 (0.5319)	14.12 (0.0027)	2.96 (0.398)	5.47 (0.14)	0.65 (0.8848)	13.08 (0.0034)

Notes: Standard errors are given in the brackets. For the fixed effects (FE) estimator, robust standard errors are presented. All the variables are expressed in logs. The null hypothesis of the Modified Wald test reads H_0: $\sigma i^2=\sigma^2$. The cross-sectoral dependence test relies on the Pesaran test under the null hypothesis Ho: $E(e_{i,t}e_{k,t})=\sigma_{i,k}$, where $i \neq k$ denotes the countries. The Wooldridge test takes the null hypothesis of no serial correlation after allowing for an AR (1) process of the residuals.

*Significance at 10%; **significance at 5%; ***significance at 1%.

Source: Authors

Table 5 The results of the feasible generalized least squares and dynamic panel estimators

	Model (1) (2005-2019)	Model (2) (2009-2019)	Model (3) (2013-2019)	Model (4) (2005-2019)	Model (5) (2009-2019)	Model (6) (2013-2019)
Dependent variable: *ΔlogTFPy*						
ΔlogTFPy	0.384** (0.155)	0.273** (0.241)		0.316** (0.119)	0.137** (0.056)	
ΔlogTFPx	0.3* (0.172)	0.47** (0.155)	0.437** (0.131)	0.852*** (0.149)	1.054*** (0.062)	0.956*** (0.026)
gap	0.244** (0.105)	0.372** (0.162)	0.372*** (0.111)	0.786*** (0.123)	1.039*** (0.054)	0.985*** (0.016)
IMP	0.06** (0.036)	0.049** (0.018)	0.113** (0.037)	0.251* (0.081)	0.039** (0.027)	0.127** (0.039)
EXP	-0.01* (0.012)	-0.0044* (0.021)	-0.09* (0.037)	-0.017* (0.1)	-0.01** (0.057)	-0.011** (0.004)
R&D		-0.084** (0.055)	-0.214*** (0.036)		-0.211*** (0.033)	-0.025* (0.143)
h			0.654 (0.189)			0.37 (0.325)
INTIMP				-0.153* (0.159)	-0.026* (0.028)	-0.11* (0.016)
INTEXP				0.003 (0.044)	0.008 (0.0013)	0.079 (0.023)
INTR&D					-0.134 (0.017)	-0.274 (0.067)
INTh						0.025 (0.017)
cons			0.855 (0.528)			1.478* (0.142)

Notes: The Dynamic Panel (DP) estimators in the columns (1), (2), (4), and (5) initialized by the T. W. Anderson and C. Hsiao (1982) estimator correcting for the bias of the order (1/*T*). The industry and years dummy variables are included. All the estimates reported from the FGLS regression in the columns (3) and (6) refer to the second-stage results. The standard error is normalized by *N-k* instead of *N*. *Significance at 10%; ** significance at 5%; ***significance at 1%.

Source: Authors

When analyzing the results given in Table 4, the strong evidence of productivity convergence at the industry level is found. The positive gap term coefficient indicates that the farther an industry lies behind the frontier, the faster the TFP growth rate. The results obtained in this study are in line with those of R. Inklaar, M. P. Timmer and B. van Ark (2008) and K. Mc Morrow *et al* (2010) for the EU and the USA, G. Nicoletti and S. Scarpetta (2003) for the OECD countries, and I. Bournakis (2011) for Greece and Germany, K. Männasoo *et al* (2018) for the overall sample of the European NUTS-1 regions, and D. Radicic *et al* (2023) for the "new" and the "old" EU countries. The same conclusion applies to the leader's productivity growth. The RSRP's TFP growth at the industry level is highly driven by the leader's productivity growth, which is in line with K. Havik *et al* (2008), R. Inklaar *et al* (2008) and K. Mc Morrow *et al* (2010). Since the obtained results given in Table 4 are affected by the problems of autocorrelation, heteroscedasticity, and cross-sectoral dependance, on the results given in Table 5 are focused on.

When analyzing the impact of trade on TFP growth, it can be seen that imports have a positive impact ($p < 0.05$) on productivity growth, whereas exports have a negative impact on productivity growth ($0.1 < p < 0.05$) for all the specifications accounted for in Table 5. The imports interaction term is negative ($p < 0.1$), which means that more imports from the RSRB lead to convergence, which narrows the productivity gap, which also means that the farther an industry behind the frontier, the more fading the impact of the imports. The impact of the R&D is negative ($0.1 < p < 0.01$) in all the specifications of Table 5. The positive impact of the R&D on productivity growth is characteristic of highly-developed countries (Grifith *et al*, 2004; Mc Morrow *et al*, 2010). The results obtained in this research are in line with K. Männasoo *et al* (2018). According to K. Männasoo *et al* (2018), only the most productive regions can benefit from R&D investments.

CONCLUSION

This research study investigated productivity convergence between the RSRP and the RSRB at the industry level. The importance of trade and R&D as the source of productivity growth within the convergence frame is emphasized.

There is strong evidence of productivity convergence at the industry level between the RSRB and the RSRP. The farther a country is behind the frontier, the higher the TFP growth rate. The results of the study have proven to be in line with previous research studies, which only partially confirms the second hypothesis of this study. The stationarity of the gap is the formal evidence of convergence. Due to insufficiently long time series, it was impossible to test the stationarity of the gap term. The productivity growth of the RSRP is found to be strongly driven by the leader's productivity growth. Relative TFP is approximately 50% on average, which means the higher the potential gains from adopting more efficient, internationally available technologies, consequently the faster the TFP growth rate. The high impact of the leader's productivity growth implies that productivity growth in the country falling behind the technological frontier can be explained by innovation and knowledge spillovers taking place in the technologically most advanced country. The obtained results of this study are in line with K. Havik *et al* (2008), R. Inklaar *et al* (2008) and K. Mc Morrow *et al* (2010). When trade is concerned, imports are found to have a positive impact on TFP growth, which is in line with the previous findings that the RSRP imports technology more superior to ours, the technology developed in the RSRB, which reflects the impact of innovation and technology spillovers, and convergence via the adoption of the existing superior technologies. In our case, the impact of the exports on TFP growth is negative. One possible reason for that is the fact that the RSRP exports mainly intermediate products, which leaves small room for the implementation of product or process innovations through competition. The other reason implies the absence of competition itself. The RSRB is an EU candidate. Compared to the rest of the former SFRY countries which are full EU members, it is considered to be less developed. These results partially confirm the first hypothesis of this research study.

According to the obtained results of this study, more imports create convergence, which decreases the productivity gap, but the farther away the country is behind the technological leader, the more fading is the impact of imports. This is because the ability to adopt the technology developed elsewhere depends on our own development. If the RSRP is far behind the RSRB, its ability to adopt new technology is diminished. The same conclusion is applicable to R&D. Because of its very low level of productivity and overall development, the RSRP cannot fully benefit from R&D investments. Also, R&D investments are very low, accounting for only 0.24% of the GDP on average. This research study provides sufficient results to answer the main research question. The main sources of productivity growth for the RSRP at the industry level within the frame of convergence are highlighted.

This study offers some policy implications. First, the RSRP has to create a growth supporting environment, i.e. a high-quality institutional framework, which will accelerate domestic development through increased investing in R&D and human capital in order to be able to benefit from innovation and knowledge spillovers. Second, policymakers should focus their attention on imports supporting policies. Speaking of imports, not any and all imports are implied, but rather those pertaining to advanced technologies. Third, policymakers should also focus on exports. Speaking of exports, not any and all exports are implied - the RSRP should focus on the exports of final goods and products potentially competitive on international markets. In this way, the RSRP's industry could benefit from learning-by-exporting.

The main limitation of this research study is due to a lack of data. The data about human capital and R&D are only available for a very short period. The second limitation of the study refers to data comparability. The data extracted from the RSRP's statistics are expressed in the national currency or in the euro currency. There are no data on the purchasing power parity (PPP), which makes the data less comparable. The fixed EUR exchange rate for the RSRP and the EUR exchange rate for the RSRB taken from the Eurostat database were applied so as to achieve a certain level of comparability. Moreover, further research could focus on the analysis of the TFP gap between the RSRP and the other former SFRY countries at the industry level with different specifications of control variables.

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APPENDIX

Table A1 The descriptive statistics for the subperiods in natural logarithms (B)

	Mean			St. Dev.			Min			Max		
Period	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap
2005-2010	6.13801	4.383796	1.754213	0.243166	0.330593	0.226849	5.735061	3.966132	1.589022	6.31317	4.6933	2.141295
2010-2015	6.371786	4.969837	1.401949	0.079275	0.169251	0.147262	6.271086	4.6994	1.243835	6.455305	5.16212	1.605968
2015-2019	6.150082	4.99212	1.157962	0.065847	0.122893	0.08533	6.049992	4.648734	1.26287	6.217585	4.954714	1.471044

Source: Authors

Table A2 The descriptive statistics for the sub-periods in natural logarithms (C)

	Mean			St. Dev.			Min			Max		
Period	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap
2005-2010	5.868129	3.856003	2.012127	0.136385	0.02505	0.119489	5.670106	3.820201	1.827577	6.010212	3.882286	2.135948
2010-2015	5.687151	3.814945	1.872206	0.038038	0.089237	0.122096	5.641658	3.680854	1.71964	5.741415	3.922018	2.060561
2015-2019	5.41685	3.666222	1.750627	0.12624	0.17682	0.152982	5.287322	3.425226	1.567991	5.605557	3.860679	1.921172

Source: Authors

Table A3 The descriptive statistics for the subperiods in natural logarithms (D)

	Mean			St. Dev.			Min			Max		
Period	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap
2005-2010	6.358096	4.445888	1.912208	0.051945	0.082387	0.111856	6.309852	4.318041	1.768886	6.427174	4.541565	2.076531
2010-2015	6.201791	4.315979	1.885813	0.121192	0.16252	0.155237	6.094195	4.076584	1.697327	6.399248	4.475602	2.037857
2015-2019	6.490687	4.638426	1.852261	0.13152	0.061796	0.094661	6.33551	4.565906	1.753096	6.663079	4.712063	1.97614

Source: Authors

Table A4 The descriptive statistics for the subperiods in natural logarithms (F)

	Mean			St. Dev.			Min			Max		
Period	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap	TFPx	TFPy	gap
2005-2010	6.29052	3.616842	2.673678	0.23283	0.183107	0.140383	6.049027	3.361293	2.503217	6.547366	3.791059	2.852034
2010-2015	6.464687	3.655338	2.809349	0.079732	0.097121	0.15291	6.389359	3.515555	2.644365	6.585099	3.745568	2.9873
2015-2019	6.667149	4.068159	2.59899	0.079314	0.219601	0.146561	6.583669	3.848489	2.357159	6.763119	4.40596	2.73518

Source: Authors