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FOREIGN DIRECT INVESTMENT AND ECONOMIC GROWTH RELATIONSHIP IN CROATIA

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Abstract
It is often stated that foreign direct investment (FDI) influence positively economic growth of the host country, but empirical evidences are still heterogenous. The paper examines the relationship between the FDI and economic growth (real GDP) in Croatia for the period 1995–2018. The research data were retrieved from the World Bank database. Two options of time series were considered: (1) real GDP growth rate and logarithm of FDI and (2) real GDP growth rate and logarithm of FDI/GDP. In order to examine the relationship between FDI and real GDP different cointegration tests were employed, as well as Granger causality analysis for both options. Based on the conducted analysis following conclusions can be made: (1) results of the cointegration tests indicated that there is no long-run equilibrium relationship between real GDP growth rate and any of the foreign direct investment series; (2) results of Granger causality tests indicated that there is no causal relationship between real GDP growth rate and any of the foreign direct investment series. In other words, foreign direct investments have no statistically significant impact on the growth rate of the real GDP in Croatia for the period being investigated.

Keywords: cointegration, Granger causality.

Jel Classification: F21; F43

INTRODUCTION

It is important to know if FDI inflows really generate economic growth and if a country with higher GDP rate attracts more FDI inflows (Simionescu 2016). Jovancevic (2007) stated that regardless of the volume of FDI inflows, the national investment policy might have considerable impact on the real growth of the economy. There have always been opinions that FDI has positive impact on FDI, but also the opposite ones (te Velde 2006).

The main goal of the paper is to examine the relationship between FDI and economic growth in Croatia. Besides this introductory section, the rest of this paper is organized as follows: Section 2 summarizes existing literature related to the topic considered in this

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research. Section 3 introduces research data and methodology, while Section 4 illustrates empirical analysis. The final section summarizes the main findings of the research.

1. LITERATURE OVERVIEW

Afsar (2008) explored the causality relationship between FDI and economic growth on the sample of quarterly data for the period 1992–2006 in Turkey. Results showed that there is a one-way relationship between FDI and economic growth and the direction of this relationship is from FDI to economic growth.

Alkhasawneh (2013) examined the causality relationship between the inflows of FDI and GDP per capita in the State of Qatar for the period 1970–2010 on the sample of annual data. The findings indicated that FDI Granger-causes economic growth in Qatar. Fadhil, Yao, and Ismeal (2012) examined causal relationships between inward FDI and economic growth also in Qatar on the sample of annual data for the period 1990–2010. They found bi-directional causality and long-run relationships between FDI inflows and economic growth. Mawugnon and Qiang (2011) explored the causality relationship between FDI and economic growth on the sample of annual data for the period 1991–2009 in Togo. They found that there was a unidirectional relationship from FDI to GDP. Rahaman and Chakraborty (2015) analysed the causality relationship between FDI and economic growth on the sample of annual data for the period 1987–2011 in Bangladesh. They found uni-directional causality which runs from FDI to GDP. Reza et al. (2018) examined also the causality relationship between FDI inflows and GDP on the sample of annual data in Bangladesh, but for the period 1990–2015. They found positive relationship running from FDI inflows to GDP in the long-run and short-run.

Thilakaweera (2012) studied the long-run relationship and causality between real GDP per capita, FDI and the level of the infrastructure in Sri Lanka on the sample of annual data for the period 1980 to 2011. The long-run relationship between these three variables was confirmed, as well as unidirectional causality from level of the infrastructure to FDI.

Kurecic, Luburic, and Simovic (2015) found relation between FDI and GDP per capita in transitional economies of Central and Eastern European states for the period 1994–2013, but also claim that it would be difficult to prove that it is a causal relation.

Hansen and Rand (2005) examined Granger causal relationships FDI and GDP in a sample of 31 developing countries and annual data for the period 1970–2000 and concluded FDI causes growth.

Feridun and Sissoko (2011) examined the relationship between GDP per capita and FDI on the sample of annual data for the period 1976–2002 in Singapore. They used VAR and Granger causality methodologies and found unidirectional Granger causation from foreign direct investment to economic growth (GDP per capita).

Kosztowniak (2016) examined causality relationship occurred between GDP and FDI on the sample of annual data for the period 1992–2012 in Poland. She confirmed the bi-directional relationships between FDI and GDP, using VAR. Har, Teo, and Yee (2008) studied relationship between FDI and economic growth in Malaysia on the sample of annual data for the period 1970–2005. According to their results, FDI has direct positive impact on GDP. Owolabi-Merus (2015) examined the impact of FDI on economic growth on the sample of annual data for the period 1981–2013 in Nigeria. The Granger causality test showed unidirectionary causation from FDI to GDP but not vice-versa.

Shabbir and Naveed (2010) examined the cointegrating relationship among FDI, exports and GDP on the sample of annual data for the period 1960–2010 in Pakistan. The result shows that long run relationship exists between growth and exports but not with FDI. Ogbokor (2016) examined the impact of FDI on economic growth on the sample of annual data for the period 1990–2014 in Namibia. The results showed unidirectional relationship running from real exchange rate to net FDI. Baig, Kiran, and Bilal (2016) examined the long run relationship between FDI and GDP for five south Asian countries for the period 1991–2012 on the sample of annual data. Employing the Granger test they found that FDI and GDP in case of Nepal cause a unidirectional causality. Georgantopoulos and Tsamis (2011) examined the causal relationship between GDP per capita and FDI on the sample of annual data for the period 1970–2009 in Greece. They found long-run equilibrium relationship, no bi-directional causal links, but one-way causality running from GDP to FDI.

Finally, Dritsaki and Stiakakis (2014) studied the relationship between foreign direct investments, exports, and economic growth on the sample of annual data for the period 1994–2012 in Croatia. They applied ARDL and ECM-ARDL model and confirmed bidirectional long run and short run causal relationship between exports and growth. No evidence was found that FDI lead to growth in Croatia. Ivanovic (2015) found that FDI have negative influence on domestic investment in Croatia with time lag.

2. RESEARCH DATA AND METHODOLOGY

The research data are available since 1995 until 2018 on the annual level and were retrieved from the World Bank database. Two options were considered within the research:

Option 1: Real GDP PPP (in constant USD from 2011) and foreign direct investment (FDI), net inflows (BoP, current USD) time series were used. After transformation, the following two series were used: real GDP growth rate (rGDP) and logarithm of FDI (LogFDI).

Option 2: Real GDP PPP (in constant USD from 2011) and foreign direct investment, net inflows (percentage of GDP – FDI/GDP) time series were used. After transformation, the following two series were used: real GDP growth rate (rGDP) and logarithm of FDI/GDP (Log(FDI/GDP)).

Line graphs suggest that there might be a structural break in both series, in rGDP series in 2009 and in LogFDI series in 2015, as well as in Log(FDI/GDP) series in 2015.

In order to examine the relationship between FDI and GDP cointegration tests (Johansen cointegration test, ARDL model and Bayer-Hanck meta cointegration tests) were employed, as well as Granger causality analysis.

3. EMPIRICAL ANALYSIS

3.1. Unit root tests

Since standard unit root tests are well known for its low power, in order to improve the validity of the results paper employed several different unit root tests.

3.1.1. Traditional unit root tests

Numerous unit root tests have been proposed in the literature. We can classify them in two groups. In the first group are so-called traditional unit root tests: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Elliot, Rothenberg and Stock Point Optimal (ERS), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. For the first three tests the null hypothesis is that the series contains unit root. The KPSS test differs from the other unit root tests described here in that the series is assumed to be trend-stationary under the null. The standard recommendation is to choose a specification that is a plausible description of the data under both the null and alternative hypotheses. Therefore, the ADF and PP tests have been applied with an allowance for a drift and no drift in the data. For the KPSS and ERS tests only the test equation with drift was estimated. Results of these tests are presented in Table 1.

3.1.2. Unit root tests with structural break

The second group of unit root tests take into account possible structural break(s) in time series. A well-known weakness of the ADF and PP unit root tests is their potential confusion of structural breaks in the series as evidence of non-stationarity. As Perron (1989) points out, structural change and unit roots are closely related, and researchers should bear in mind that traditional unit root tests are biased toward a false unit root null when the data are trend stationary with a structural break. To overcome this weakness, unit root tests have been developed that allow for some kind of structural instability in an otherwise deterministic model.

The first test we have used was developed by Perron and Vogelsang (1992a, 1992b). There are two forms in this unit root test, which are the additive outlier (AO) model and the innovative outlier (IO) model, which capture the immediate and gradual shocks, respectively. The graphs of time series (real GDP growth rate in particular) suggest considering model with possible additive outlier because of a sudden change in the mean of a series.

The second test we have used was developed by Zivot and Andrews (1992). This test allows one structural break in the level and trend of the series. For the purpose of testing the hypothesis of the existence of a unit root in a series in which there is one structural fracture, we estimated the following three models:

Model A:

$$\Delta y=\mu+\beta t+\alpha y_{t-1}+\theta DU_t+\sum_{i=1}^{k} c_i\,\Delta y_{t-i}+\varepsilon_t \tag{1}$$

Model B:

$$\Delta y=\mu+\beta t+\alpha y_{t-1}+\gamma DT_t+\sum_{i=1}^{k} c_i\,\Delta y_{t-i}+\varepsilon_t \tag{2}$$

Model C:

$$\Delta y=\mu+\beta t+\alpha y_{t-1}+\theta DU_t+\gamma DT_t+\sum_{i=1}^{k} c_i\,\Delta y_{t-i}+\varepsilon_t \tag{3}$$

where DU_t and DT_t are dummy variables for changes in level and trend of series respectively.

Change could happen in each break date T_B $(1 < T_B < T)$. These dummy variables are defined as follows:

$$DU_t=\begin{cases}1, \text{ if, } t>T_B\\ 0, \text{ otherwise}\end{cases} \tag{4}$$

$$DT_t=\begin{cases}t-T_B, \text{ if, } t>T_B\\ 0, \text{ otherwise}\end{cases} \tag{5}$$

where k is the number of lags used for each break date using one of information criteria (e.g. AIC or Schwarz SIC criterion).

The null hypothesis is $\alpha = 0$, i.e. the series is with a unit root and a constant increment that excludes any point of structural break. The alternative hypothesis is $\alpha < 0$, i.e. the series is trend-stationary with one unknown point of structural break. Therefore, models A, B, and C are sequentially evaluated and the breaking point T_B is chosen to minimize the one-sided t-statistic used to test hypothesis.

Clemente, Montanes, and Reyes (1998) defined the test which could be used if the series has one or two breaks. Null hypothesis is

$$H_0\colon y_t=y_{t-1}+\delta_1 DTB_{1t}+\delta_2 DTB_{2t}+u_t \tag{6}$$

while alternative hypothesis is:

$$H_1\colon y_t=u+d_1 DU_{1t}+d_2 DTB_{2t}+e_t \tag{7}$$

where $DU_{it} = 1$, when $t > TB_i$ $(i = 1,2)$, DTB_{it} is an impulse variable taking value 1 when $t = TB_1 + 1$ $(i = 1,2)$ and 0 otherwise. TB_1 and TB_2 are break dates when changes in the series mean occur.

Table 1. Traditional unit root tests

	ADF				PP				KPSS		ERS	
Series	none	D	drift	D	none	D	drift	D	drift	D	drift	D
					Level							
rGDP	-2.29 (.02)	I(0)	-2.61 (.11)	I(1)	-2.24 (.03)	I(0)	-2.57 (.11)	I(1)	0.28 (>.10)	I(0)	3.95 (>.10)	I(1)
LogFDI	0.54 (.82)	I(1)	-4.42 (.00)	I(0)	0.67 (.85)	I(1)	-4.51 (.00)	I(0)	0.33 (>.05)	I(0)	9.34 (>.10)	I(1)
Log(FDI/GDP)	-0.73 (.39)	I(1)	-4.95 (.00)	I(0)	-1.58 (.11)	I(1)	-4.94 (.00)	I(0)	0.17 (>.10)	I(0)	6.79 (>.10)	I(1)
					First difference							
rGDP	-5.16 (.00)	I(0)	-8.70 (.00)	I(0)	-5.84 (.00)	I(0)	-5.71 (.00)	I(0)	0.38 (>.05)	I(0)	2.22 (<.05)	I(1)
LogFDI	-5.31 (.00)	I(0)	-5.04 (.00)	I(0)	-9.67 (.00)	I(0)	-9.89 (.00)	I(0)	0.27 (>.10)	I(0)	5.02 (>.10)	I(0)
Log(FDI/GDP)	-8.58 (.00)	I(0)	-5.16 (.00)	I(0)	-11.0 (.00)	I(0)	-10.7 (.00)	I(0)	0.26 (>.10)	I(0)	3.40 (>.05)	I(0)

Note: D stands for Decision made based on the 5% significance level. *P*-value is given in brackets below the test statistic. The Schwarz information criterion was used to select degree of augmentation for ADF, PP and ERS tests. For the KPSS tests the bandwidth was selected using the Newey-West method, with the Bartlett kernel. For the ERS tests spectral OLS AR estimation method was used. Null hypothesis for ADF, PP and ERS tests is that the series has unit root. Null hypothesis for KPSS test is that the series is trend stationary. Asymptotic critical values for KPSS test for model with the drift: 1%: 0.739, 5%: 0.463, 10%: 0.347. Critical values for ERS test for model with the drift (calculated for 50 observations): 1%: 1.87, 5%: 2.97, 10%: 3.91.

If two structural breaks were caused by an innovative outlier, then the unit root hypothesis can be tested by first evaluating the following model:

$$y_t=\mu+\rho y_{t-1}+\delta_1 DTB_{1t}+\delta_2 DTB_{2t}+d_1 DU_{1t}+d_2 DU_{2t}+\sum_{i=1}^{N} c_i \Delta y_{t-i}+e_t \tag{8}$$

If the change in the mean of the series occurred because of an additive outlier, then the null hypothesis of a unit root can be tested using the following two-step procedure. In the first step, the deterministic part of the series is removed by evaluating the following model:

$$y_t=\mu+d_1 DU_{1t}+d_2 DU_{2t}+\tilde{y}_t \tag{9}$$

and the unit root test is applied by searching the minimal value of *t*-statistic when $\rho = 1$ in the model:

$$\tilde{y}_t=\sum_{i=1}^{N} \omega_{1i} DTB_{1t-1}+\sum_{i=1}^{N} \omega_{2i} DTB_{2t-1}+\rho \tilde{y}_{t-1}+\sum_{i=1}^{N} c_i \Delta \tilde{y}_{t-i}+e_t \tag{10}$$

To tests the hypothesis of unit root with one structural break PV, ZA and CMR tests were used. In case of CMR test models with additive outlier (AO) and innovative outlier (IO) were used. Results are presented in Table 2.

To tests the hypothesis of unit root with two structural breaks CMR tests with additive outlier (AO) and innovative outlier (IO) were used. Results are presented in Table 3.

3.1.3. Unit root tests results discussion

If the estimates of the PV, ZA and CMR unit root tests provide evidence of significant additive or innovation outliers in the time series, the results derived from ADF, PP, KPSS and ERS tests are doubtful, as this is evidence that the model excluding structural breaks is misspecified. Therefore, in applying unit root tests in time series that exhibit structural breaks, only the results from the CMR unit root tests should be considered if the two structural breaks indicated by the respective tests are statistically significant.

On the other hand, if the results of the CMR unit root tests show no evidence of two significant breaks in the series, the results from the PV and CMR unit root tests with one structural break are considered. If these tests show no evidence of a structural break, the ADF and PP tests can be considered.

By following this procedure we first examine the results of CMR tests presented in Table 3. Only in case of real GDP growth rate CMR test with additive outlier, which consider sudden change, indicated non-stationarity at level with two breaks (2006 and 2014), but stationary by taking the first difference. All the other time series according to CMR tests are stationary at level and the first difference. Now we check the unit root tests results with one structural break presented in Table 2 for remaining two time series. Only in case of Log(FDI/GDP) series CMR test with additive outlier indicated non-stationarity at level with one structural break, but stationary by taking the first difference.

Finally, for LogFDI series we check the unit root results in Table 1. In the models with intercept all tests with one exception (ERS test) indicate that the series is stationary.

In summary, we may say that the real GDP growth rate and Log(FDI/GDP) series are I(1) with two and one structural breaks respectively, while LogFDI series is I(0).

However, in case of three Croatian annual time series the results of all unit root tests, either traditional or those which take into account possible structural break(s) should be taken cautiously.

Table 2. Unit root tests with one endogenous break

	PV (AO)			ZA (AO)			CMR (AO)			CMR(IO)		
Series	stat	TB	D	stat	TB	D	stat	TB	D	stat	TB	D
						Level						
rGDP	-3.87 (.21)	2009	I(1)	-4.23 (>.10)	2008	I(1)	-2.19	2005	I(1)	-3.43	2006	I(1)
LogFDI	-4.72 (.02)	2015	I(0)	-5.56 (.03)	2010	I(0)	-4.88	2000	I(0)	-5.40	2013	I(0)
Log(FDI/GDP)	-5.81 (<.01)	2009	I(0)	-6.47 (.02)	2010	I(0)	-1.95	2010	I(1)	-5.81	2008	I(0)
						First difference						
rGDP	-5.66 (<.01)	1999	I(0)	-	-	-	-0.86	2007	I(1)	-8.38	2008	I(0)
LogFDI	-9.21 (<.01)	2008	I(0)	-5.64 (<.05)	2009	I(0)	-5.73	2013	I(0)	-8.78	2007	I(0)
Log(FDI/GDP)	-9.64 (<.01)	1999	I(0)	-5.60 (<.05)	2000	I(0)	-9.55	1998	I(0)	-9.18	1999	I(0)

Note: TB is the break point. D stands for Decision made based on the 5% significance level. *P*-value is given in bracket below the test statistic. Null hypothesis for these tests is that the series has unit root with a single break. The Schwarz information criterion was used to select degree of augmentation for PV and ZA tests. Minimize Dickey-Fuller *t*-statistic was used for break selection in PV tests.

Table 3. Clemente-Montanes-Reyes unit root tests with two endogenous breaks

	IO				AO			
Series	*t*-stat	TB_1	TB_2	Decision	*t*-stat	TB_1	TB_2	Decision
				Level				
rGDP	-6.59	2007	2013	I(0)	-3.83	2006	2014	I(1)
LogFDI	-5.73	2004	2008	I(0)	-6.05	2004	2009	I(0)
Log(FDI/GDP)	-6.22	2005	2008	I(0)	-6.53	2005	2009	I(0)
				First difference				
rGDP	-10.8	1998	2008	I(0)	-7.71	2007	2011	I(0)
LogFDI	-8.90	2008	2013	I(0)	-12.1	2008	2013	I(0)
Log(FDI/GDP)	-8.82	1999	2006	I(0)	-6.71	2005	2013	I(0)

Note: TB_1 and TB_2 are the break points. Decision was made based on the 5% significance level. Null hypothesis for these tests is that the series has unit root with two breaks. Critical value for Clemente-Montanes-Reyes unit root test with two structural breaks for IO and AO is -5.49 at the 5% significance level.

Neither of the tests exhibits good size and power properties for the smallest sample size where T=50. Since we have used even less observations (24 observations) this should be kept in mind when deciding on the integration order for three series analysed here.

3.2. Cointegration tests

Several procedures have been defined in the literature to test the existence of cointegration between series. These procedures can be divided into two groups. The first group is based on a single equation model. One of the first tests in this group is the Engle and Granger test (1987), while the most recently used procedure is based on the ARDL model (*AutoRegressive Distributed Lags* model).

The second group uses a system of equations in the form of VAR / VECM models (*Vector AutoRegressive* model and *Vector Error Correction Model*). The most well-known test in this second group is based on the use of Johansen's (1988) maximum likelihood procedure. According to this procedure, the first stage tests whether there is a long-term cointegration between the real GDP growth rate and LogFDI (or Log(FDI/GDP)) series.

The equilibrium levels of the series are then calculated by separating the permanent component of those series. Finally, the long-term coefficient vector and the separated permanent component of the series are combined to estimate the real GDP growth rate. In addition to the Johansen test in this group are the *F*-test Boswijk (1994), the Banerjee, Dolado, and Mestre (1998) *t*-test.

In the following analysis, three methodological approaches were used to assess the long-term relationship between time series of real GDP growth rates and FDI: Johansen cointegration test, Bayer-Hanck meta conitegration test and cointegration test based on ARDL model.

3.2.1. Johansen cointegration test

Since unit root tests suggested that real GDP growth rate and LogFDI series are of different order of integration (I(1) and I(0) respectively) it is not recommended to apply the Johansen procedure to test cointegration, since the assumption of this approach is that all series are of the same order of integration. For these two series cointegration tests based on ARDL model will be used.

However, there is some evidence that series real GDP growth rate and Log(FDI/GDP) series might be of the same order of integration, i.e. I(1). So, the Johansen cointegration test could be used for these two series.

Before applying Johansen test the lag order of the VAR model containing two series, rGDP and Log(FDI/GDP), should be selected.

Most of the criteria suggest lag order of 1, i.e. VAR(1) model. When applying Johansen test we need to make an assumption about the deterministic component. Based on the results of the unit root tests we assume that there is no deterministic trend in data with intercept in cointegrating equation and not intercept in VAR model. Results of the Johansen test, i.e. trace and maximum eigenvalues test statistics are presented in Table 4.

Both tests suggest that we can’t reject the null hypothesis of no cointegration relationship between two series, i.e. real GDP growth rate and the foreign direct investment to GDP. In other words, this indicates lack of the existence of a long-run equilibrium relationship between real GDP growth rate and the foreign direct investment to GDP in Croatia for the period being investigated.

Although there is no cointegration relationship between two series it is possible to examine the existence of a causal relationship between them. Before testing for Granger causality we’ll check the robustness of the results obtained using Johansen test.

3.2.2. Cointegration tests (ARDL model)

This approach is based on the use of the ARDL model proposed by Pesaran and Shin (1999) and Pesaran, Shin, and Smith (2001). The advantage of this approach over the Johansen maximum likelihood approach is reflected in the following:

1. It is simpler to use because after testing the existence of long-term cointegration and determining the number of lags to be used in the model, the same can be estimated using ordinary least squares methods.
2. While the Johansen approach largely depends on whether we correctly determine the order of integration, i.e. the existence of a unit root, the approach using the ARDL model does not require prior determination of the order of integration. Moreover, this approach allows the inclusion of series of different order of integration, i.e. series I (0) and I (1), even when the included series are not cointegrated. This feature of test based on ARDL model is particularly useful in case of testing cointegration between real GDP growth rate and LogFDI, because the first series is I(1) and the second series is I(0).
3. Johansen's approach is based on the use of a VAR model with at least two equations and a number of coefficients to be estimated. The ARDL approach is a

one-equation model with a much smaller number of coefficients to be estimated. This property of the ARDL approach is particularly important when we have relatively short time series, as is the case in this analysis when using Croatian annual time series.

Before estimating the ARDL model for real GDP growth rate, an *F*-bounds test was used to test the existence of long-term relationship between two series. The results of the *F*-bounds test are given in Table 5.

The *F*-statistic values in the *F*-bounds test are 2.27 and 2.93 for the first and second models, respectively, and are well below lower limit (3.30 and 4.29 respectively) at the 10% significance level. Therefore, we have more than enough evidence not to reject the null hypothesis that there is no long-term relationship between series in these ARDL models. In other words, this test confirmed that there are no long-term relationship between real GDP growth rate and both FDI series.

Because there is no cointegration between these series there is no reason to further estimate and analyse ARDL model.

3.2.3. Bayer-Hanck meta conitegration test

The results of cointegration tests are very sensitive to the choice of test procedure, which is due, among other things, to the length of the series, the possible structural breaks and the decision made when applying the tests (e.g. the choice of the lag length in ARDL and VAR models). In order to improve the statistical strength of cointegration tests, Bayer and Hanck (2013) have created a meta-test, i.e. analysis that combines the results of multiple cointegration tests in order to obtain a more reliable conclusion about the existence of a cointegration link between series. Bayer and Hanck (2013) use the following Fisher formula by combining the *p*-values of different cointegration tests:

$$EG - JOH = -2\left[ln(p_{EG}) + ln(p_{JOH})\right] \tag{11}$$

$$EG - JOH - BO - BDM = -2\left[ln(p_{EG}) + ln(p_{JOH}) + ln(p_{BO}) + ln(p_{BDM})\right] \tag{12}$$

Table 4. Johansen tests of cointegration

Null hypothesis	Alternative hypothesis	Test statistic	5% critical value	*P*-value
		Trace statistic		
$r = 0$	$r \geq 1$	17.20	20.26	.125
$r \leq 1$	$r \geq 2$	5.19	9.16	.263
		Maximum eigenvalue statistic		
$r = 0$	$r \geq 1$	12.01	15.89	.186
$r \leq 1$	$r \geq 2$	5.19	9.16	.263

Note: *P*-value: MacKinnon, Haug, and Michelis (1999).

Table 5. F-bounds tests

Estimated model: rGDP = f(LogFDI) Optimal lag length (SIC): ARDL(3, 1)				Estimated model: rGDP = f(Log(FDI/GDP)) Optimal lag length (SIC): ARDL(3, 0)			
F-bounds test				*F*-bounds test			
Value	Significance	I(0)	I(1)	Value	Significance	I(0)	I(1)
2.27	10%	3.30	3.80	2.93	10%	4.29	5.08
	5%	4.09	4.66		5%	5.40	6.35
	1%	6.03	6.76		1%	8.17	9.29

Note: Null hypothesis: no level relationship. Schwarz (SIC) criterion was used as a model selection method to determine the optimal lag length, i.e. order of ARDL model. Critical values are for finite sample *n*=30.

Where p_{EG}, p_{JOH}, p_{BO} and p_{BDM} are p-values of Engle-Granger (EG), Johansen (JOH), Boswijk (BO) and Banerjee-Dolado-Mestre (BDM) cointegration tests respectively. If the calculated value of Fisher's statistics is greater than the critical value then the null hypothesis of the absence of cointegration is rejected. However, in the presence of structural break, the Bayer-Hanck test will not produce efficient and consistent results. That is why, among other things, we have used in addition to this Bayer-Hanck test an ARDL based approach to cointegration.

To test the robustness of the cointegration testing results based on the Johansen and ARDL model, Bayer-Hanck meta-test of cointegration was used. The test results of Bayer-Hanck test are presented in Table 6.

Table 6. Bayer-Hanck test for cointegration

	Test		
Model	EG-JOH	EG-JOH-BO-BDM	Cointegration
rGDP = f(Log(FDI/GDP))	7.31	11.50	No
Log(FDI/GDP) = f(rGDP)	6.61	17.51	No

Note: Critical values for the 5% significance level EG-JOH: 11.229 i EG-JOH-BO-BDM: 21.931.

In both models the hypothesis of absence of cointegration was not rejected. Therefore, it can be argued that no long-term relationship has been established among these two series. However, as noticed before, it should be emphasised that the Bayer-Hanck meta-test does not account for structural breaks that are evident in two series.

Summarising results of all three cointegration tests applied we can conclude with high degree of certainty that there is no existence of a long-run equilibrium relationship between real GDP growth rate and the foreign direct investment in Croatia for the period being investigated.

3.3. Granger causality analysis

There are several forms of causality tests. One of them is based on cointegration when the vector error correction model (VECM) can be used. The existence of cointegration indicates only the presence or absence of causation, but not the direction of causation. Once the existence of cointegration is established, then the long-term and short-term causality in the Granger sense can be tested within the VECM model. However, as the results indicated, there is no cointegration relationship between the series.

Therefore, we are unable to use the VECM form of the Granger causality test. In addition to this procedure, we can use Toda and Yamamoto (1995) Granger causality test procedure. This procedure, unlike the test based on the VECM approach, does not require series to be cointegrated. The results of the Toda-Yamamoto procedure are given in Tables 7 and 8.

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