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Macroeconomic determinants of FDI inflows in Macedonia: A breakpoint analysis

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Abstract

This article investigates the impact of macroeconomic variables on FDI inflow in Macedonia using quarterly data for 2000-2016. The structural breakpoint method is used to disclose the non-linear effects in a context of structural shocks. The results indicate a significant impact of our macroeconomic variables on FDI inflows and reveal temporal heterogeneity of the slopes reflecting a non-linear impact of real GDP, interest rate, real effective exchange rate and trade openness on FDI inflows.

Keywords: FDI, Structural Breaks, Breakpoint analysis, Macedonia.

JEL codes: C20, F43, O11

INTRODUCTION

Literature on the impact of macroeconomic variables on foreign direct investment (FDI) widely uses standard linear regression models. In that sense, analyses implicitly assume that the coefficients of the slopes do not vary across observations (Muaremi, Konomi and Salihi, 2015; Shehaj and Haderi, 2015; Dunning, 2009; Chidlow *et al.*, 2009; Caves, 2007; Harford, 2005; Agenor, 2000 among others). However, recent evidence shows that time series are often characterized by structural breaks that affect cross-relationships among different variables. Assuming homogeneity of the slope could therefore lead to biased results.

In this paper, we identify and underline the role of structural change, defined as the changing of parameters at dates in the sample period, to accurately estimate the impact on FDI inflows of different macroeconomic variables.

We apply the currently famous break point regression method to Macedonia – a small Balkan country that faces economic instability since its inception. These episodes of instability lower the explanatory power of traditional –linear– methods.

The rest of the paper is organized as follows. Section II describes the data; section III presents the methodology, while section IV analyzes the main results. We conclude in the last section.

DATA

The data used in this study consist of quarterly time series of FDI inflows (FDI), real GDP (GDP), unemployment rate (UN), reel effective exchange rate ($REER$), interest rate (INT) and trade openness (TO) for Macedonia from 2000Q4 to 2016Q2. The variables FDI and real GDP are expressed in million US dollars. Data on unemployment rate come from the State Statistical Office of Macedonia.Data on exchange rate and interest rate come from the International Monetary Fund. Trade openness is obtained as the sum of import and export values divided by real GDP. Denton method[1] was used to obtain quarterly series where required.

METHODOLOGY AND PRE-TESTS

To avoid biased results emerging from the use of a simple ordinary least squares (OLS) regression, we use in this study the breakpoint regression analysis. We adopt the methodology defined by Bai and Perron (1998, 2003) and applied in Syed and Syed Zwick (2016). The baseline model with m breaks ($m+1$ subperiods) is as follows:

$$y_t = x_t'\beta + z_t'\delta_j + u_t \qquad (t = T_{j-1}+1, \dots, T_j), \quad (1)$$

for $j = 1, \dots, m+1$ and where we use the convention that $T_0 = 0$ and $T_{m+1} = T$. $y_t$is the observed independent variable at time t,$x_t(p \times 1)$and $z_t(q \times 1)$are vectors of covariates andβ andδ_j $(j = 1, \dots, m+1)$ are the corresponding vectors of coefficients, u_t is the disturbance. The indices $(T_1, \dots, T_m)$ or the break points, are explicitly treated as unknown. The purpose is to estimate the unknown regression coefficients together with the break points when T observations on (y_t, x_t, z_t) are available. Following the main stream of the literature regarding the impact of macroeconomic variables on FDI inflows, we present two models to avoid endogeneity. Model 1 includes lag of FDI inflows($FDI(-1)$), GDP, $REER$ and INT as independent variables, while model 2 includes$FDI(-1)$, UN, $REER$ and TO.

[1]This method relates a higher frequency series h to a lower frequency series x, to obtain an interpolated series y. We minimize the proportional first difference function proposed by Denton (1971):$F = \sum_{t=1}^{T}(\frac{y_t}{h_t} - \frac{y_{t-1}}{h_{t-1}})^2$.

Before running the regression, we study the time series properties of our data and we conduct a break point unit root test (URT). We adopt here the approach of Glynn *et al.* (2007) based on Perron (1989). Three kinds of structural breaks are considered: one that allows for a break in the intercept of series another that allows break in slope and the third one that allows both effects to occur simultaneously. According to the results displayed in table 2, we find that all our series contain structural breaks which could be the main reason behind the unit-roots in our data at level[2]. These results allow for a breakpoint regression analysis.

Table 2: Breakpoint unit root test at first difference

Variables	Breakpoint statistics	Dates of the breaks	Lag length
FDI	-4.534	2006Q2	0
GDP	-3.066	2007Q2	2
TO	-4.622	2008Q3	9
UN	-9.365	2005Q1	0
REER	-5.533	2007Q3	0
INT	-6.064	2009Q3	1

Notes: Critical values equal -3.96, -3.41, and -3.13 for the significant levels of 1%, 5% and 10%, respectively. Break selection: minimize DF t-statistic. Lag length: based on Schwarz information criterion.

Source: Authors' calculations

EMPIRICAL RESULTS

Once unveiled the presence of structural breaks in our series, we use Bai-Perron (2003) method of sequentially determined breaks. The breakpoint specification re-computes and displays the test statistics used to obtain the optimal break dates. Results indicate that in our two models, there are five optimal breaks that appear to be at the same frequency with a slight difference of one quarter for two of them (table 3).Based on these results, we apply the breakpoint least square method where the changing coefficients for each of the six sub-periods due to the five breaks may lead the debate to an interesting conclusion.

[2] We also ran the first generation ADF (1979, 1981) panel unit root test. Results, available upon request, indicate stationarity at first difference for all our series.

Table 3: Breakpoint specification

	Model 1			Model 2		
	F. Stat.	Scaled F. Stat.	Critical Value**	F. Stat.	Scaled F. Stat.	Critical Value**
0 vs 1*	1615.6	6462.38	16.19	213.70	1068.52	18.23
1 vs 2*	42.14	168.59	18.11	35.23	176.15	19.91
2 vs 3*	6.29	25.17	18.93	8.58	42.92	20.99
3 vs 4*	6.99	27.99	19.64	7.01	35.06	21.71
4 vs 5*	8.75	35.01	20.19	12.39	61.97	22.37
Break dates* **	**2006Q1, 2003Q3, 2008Q3**		**2010Q4, 2013Q2,**	**2006Q2, 2013Q3, 2003Q3**		**2011Q1, 2008Q3,**

*Notes: *Significant at the 0.05 level. **Bai and Perron (2003) critical values. ***Based on the sequential process.*
Source: Authors' calculations

The results from the breakpoint regression are displayed in table 4. Model 1 reveals that GDP, $REER$ and INT have a non-linear impact on FDI inflows characterized by a heterogeneous slope. While some studies find a positive and others a negative impact of GDP on FDI, our results justify the accuracy of both strands of literature. Regarding the impact of $REER$ on FDI inflows, it is negative for all the sub-periods except for the first and the last ones. Again, our study is able to expose the disagreement about the nature of this relationship both in the theoretical and empirical works. The opposite is found regarding the impact of interest rate on FDI inflows: it is mostly positive except for the first and the last periods. Our results reflect the ambiguous conclusions mostly found in the literature. While a positive impact is obtain in the empirical studies (Grosse and Trevino, 1996 for example), the direction of the impact could be reverse if the foreign investors depend on host countries capital market for raising FDI funds.

Results for model 2 also confirm the significant non-linear relationship between FDI inflows and other macroeconomic variables. In this regard, UN has a persistent negative impact on FDI inflows (confirming Cleeve (2008)), however, the size of coefficient slightly changes over time depending on the breaks. Finally, we find that TO has a time-barred changing impact on FDI inflows. Negative for the three first sub-periods, the coefficient becomes positive afterwards. Our results confirm the complexity of this relationship that recent literature discusses (Liargovas and Skandalis, 2012). While there are studies which find a positive impact (Biglaiser and deRouen, 2006; Chakrabarti, 2001 for example), others obtain a negative one (Seim, 2009). Theoretically, the effect of trade openness on FDI inflows varies according to the motivations for engaging in FDI activities (Dunning, 1993).

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Table 4: Least squares regression with structural breaks

	Model 1			Model 2		
	Variables	Coef.	S.E.	Variables	Coef.	S.E.
Subperiod 1	*2001Q1 - 2003Q2 - 10 obs.*			*2001Q1 - 2003Q2 - 10 obs.*		
	FDI(-1)	1.006***	0.007	FDI(-1)	-0.14	0.161
	GDP	-0.003***	0.000	UN	-0.003***	0.000
	REER	2.99***	0.315	REER	16.14***	2.181
	INT	-10.08***	0.802	INT	-18.9***	1.390
				TO	-2.49***	0.296
Subperiod 2	*2003Q3 - 2005Q4 - 10 obs.*			*2003Q3 - 2006Q1 - 11 obs.*		
	FDI(-1)	0.12	0.227	FDI(-1)	0.86***	0.193
	GDP	0.004***	0.001	UN	-0.0006***	0.001
	REER	-3.94***	1.254	REER	4.27***	0.394
	INT	15.31***	5.100	INT	-10.55**	3.978
				TO	-0.76***	0.151
Subperiod 3	*2006Q1 - 2008Q2 - 10 obs.*			*2006Q2 - 2008Q2 - 9 obs.*		
	FDI(-1)	0.60***	0.141	FDI(-1)	-0.19	0.494
	GDP	0.0006***	0.000	UN	-0.007**	0.000
	REER	-0.47***	0.120	REER	3.27**	1.437
	INT	1.66***	0.344	INT	0.367	0.648
				TO	-0.21*	0.111
Subperiod 4	*2008Q3 - 2010Q3 - 9 obs.*			*2008Q3 - 2010Q4 - 10 obs.*		
	FDI(-1)	1.24***	0.275	FDI(-1)	1.48***	0.062
	GDP	-7.45E-05	0.000	UN	-0.0005***	0.000
	REER	-0.17***	0.046	REER	-3.13***	0.593
	INT	1.84	1.399	INT	4.87***	0.495
				TO	0.48***	0.119
Subperiod 5	*2010Q4 - 2013Q1 - 10 obs.*			*2011Q1 - 2013Q2 - 10 obs.*		
	FDI(-1)	0.93***	0.031	FDI(-1)	-0.15	0.22
	GDP	0.0007***	0.000	UN	-0.008***	0.00
	REER	-0.79***	0.205	REER	-2.75***	0.67
	INT	2.85***	0.552	INT	23.99***	5.24
				TO	2.17***	0.50
Subperiod 6	*2013Q2 - 2016Q2 - 13 obs.*			*2013Q3 - 2016Q2 - 12 obs.*		
	FDI(-1)	-0.38	0.528	FDI(-1)	1.00	0.38
	GDP	-0.001**	0.001	UN	-0.003	0.34
	REER	2.75**	1.119	REER	-0.79	0.29
	INT	-6.65*	3.253	INT	9.90	1.88
				TO	0.55	0.24
R-squared		0.90			0.84	
D.W. stat.		2.62			2.06	
AIC		-4.37			-5.69	
SIC		-3.55			-4.66	

*Notes: ***, ** and * indicate 1%, 5% and 10% of significance, respectively.*

Source: Authors' calculations

CONCLUSION

This study brings new evidence on the impact of different macroeconomic variables on FDI inflows in Macedonia for the quarterly period 2000-2016. We attempted to explore the gaps in most of the studies that ignore the importance of slope analyses while investigating these relationships. Our findings reveal that though there are significant impacts of macroeconomic variables on FDI inflows, the nature of these impacts can change depending on the overall macroeconomic environment.

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