PAPER

Threshold Effects of Inflation on Growth in the Western Balkans

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Abstract The research study examines the relationship between inflation and economic growth in the Western Balkans from 2000 to 2020. This study seeks to find and determine the inflation threshold levels, where the inflation level has a positive or insignificant impact on economic growth below a specific stage or point but hinders the economic growth of Western Balkan countries above this level or point. As a result, we employ a variety of econometric models and approaches for this goal, including OLS, fixed, random effects, and Hausman Taylor IV. The study's findings revealed a statistically significant negative and non-linear relationship between inflation and economic growth, indicating that the inflation threshold is 3.90 percent, with any level above 3.90 percent impeding or negatively affecting economic growth in the Western Balkans and vice versa.

The study provides reliable and consistent findings regarding the influence of the inflation threshold level on the economic growth of Western Balkan countries over the studied period. It presents vital and valuable information to the governments of these countries about inflation levels, where a specific rise in inflation affects these countries' economic progress.

Keywords: inflation, threshold, growth, Hausman Taylor.

Jel Classification: P24, C24, H47, O4.

1. Introduction

The impact of inflation on economic growth has been a fascinating issue explored by economists and governments worldwide as essential macroeconomic determinant in a country's monetary and economic policy.

Many researchers and economists in this area believe that the ability to control inflation above a particular level has a significant impact on the country's economic growth, claiming that such effects may be seen in both short- and long-term periods

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(Kremer, Bick, & Nautz, 2013; Risso & Carrera, 2009; Vaona & Schiavo, 2007).

Many economic studies have attempted to explain the relationship between inflation and economic growth; a number of these studies have presented arguments and results that highlight the existence of particular inflation control thresholds or optimal levels (Ahmed & Mortaza, 2005; Bick, 2010; Hasanov, 2011; Kheir El-Din & Abou-Ali, 2008; Kremer, Bick, & Nautz, 2013; Risso & Carrera, 2009; Seleteng, 2005; Singh, 2010). However, no research specifically looked into the issue of establishing an inflation threshold to examine the influence of inflation on the Western Balkan countries' economic growth.

The economies of the Western Balkan countries have an unstable economic structure that faces numerous challenges and a slew of common issues, including insufficient and stable monetary policy to keep core inflation within defined limits, monetary control via money supply and demand, high-interest rate differentials on loans and deposits, banking system reserves, and volatile exchange rates. As a result, the purpose/importance of this scientific research is to investigate the level of the inflation threshold and its impact on Western Balkan countries' economic growth.
We suggest the following study hypothesis to investigate the relationship between inflation and economic growth:

H1: Inflation rates below a specific level or point of the threshold value for the Western Balkan countries have a favourable or insignificant impact on economic growth.

H2: Inflation rates beyond a specific level or point of the threshold value for the Western Balkan countries negatively impact economic growth.

We employ various econometric models and methodologies, such as ordinary least squares, fixed effect, random effect, Hausman Taylor IV, and the Bootstrap method, to evaluate the study's hypotheses and identify the inflation threshold level as an impact on the Western Balkan countries' economic growth. Quantitative data have been collected by the World Bank, International Monetary Fund, and Central Banks of these countries.

The primary motivation of this paper is that no previous study has investigated the level of inflation threshold as a factor in the Western Balkan countries' economic growth. As a result, we can highlight a deficit in the literature that this research is intended to fulfil.

This study is subdivided into numerous sections. The first section of the study contains a review of the literature on the effects of inflation thresholds on economic growth; the second section contains the data methodology; the third section covers the data analysis and study findings, and the fourth section contains the conclusions and literature.

2. Literature review

Several studies have been conducted in recent decades by various authors who have

analysed and identified the effects of the inflation threshold on the economic growth of a country or several countries that have set inflation threshold levels above which inflation would cause negative effects on economic growth. Below the inflation threshold, the empirical literature has found favorable correlations between inflation and economic growth (Ahmed & Mortaza, 2005; Akgül & Özdemir, 2012; Berentsen, Guido, & Wright, 2011; Hasanov, 2011; Khan & Senhdji, 2001; Kremer, Bick, & Nautz, 2013; Ndoricimpa, 2017).

The study by Khan and Senhdji (2001) used Hansen's (1999) threshold estimation technique to understand the existence of an inflation threshold effect that reflected the relationship between inflation and economic growth in developed and developing countries using unbalanced panel data from 140 countries from 1960 to 1998. The study proposed an inflation threshold of 1-3 percent for developed countries and 7-11 percent for underdeveloped countries, indicating that inflation rates below these levels do not influence economic growth; however, the effect is negative on the indicated levels. Similarly, Bick (2010) examines the relationship between inflation and economic growth for 40 nations from 1960 to 2004, based on Hansen's (1999) extension of the threshold model using panel data. According to the study findings, the inflation threshold is 19%, while the inclusion of another regime reduces the barrier from 19-12%.

According to Fischer (1993), the link between inflation and economic growth is non-linear, implying that it is positive when the rate of inflation is below a specific level but negative when it exceeds that level. Sarel (1996) examined the existence of a threshold effect between inflation and economic progress using panel data for 87 countries from 1970 to 1990. The study presents evidence that there is a threshold with an annual inflation rate of 8% and contends that inflation below this rate has no significant influence on economic growth; however inflation above this level has a negative and statistically significant effect.

On the other hand, Christoffersen and Doyle (1998) examined the non-linear relationship between inflation and economic growth in 22 transition countries in Central and Eastern Europe and Post-Soviet Union countries, including Azerbaijan, from 1990 to 1997. According to the study, the authors argued and discovered that the inflation threshold level for these countries was 13%. Pypko (2009) examined the relationship between CIS economic growth and inflation from 2001 to 2008. According to the author, the inflation threshold level was examined using a non-linear approach of tiny squares, and it was discovered that when the inflation rate exceeds 8%, economic growth slows, and vice versa.

Mubarik (2005) conducted a study to determine the level of inflation in Pakistan. Mubarik (2005) found that the inflation threshold level was 9% and emphasized that inflation rates beyond this level have an adverse impact on economic growth. Other studies for specific countries and selected developing countries present a range of

inflation threshold levels, including 10% for Lesotho (Seleteng, 2005), 6% for India (Singh, 2010), 6% for Bangladesh (Ahmed & Mortaza, 2005), 22.2 % for Ghana (Quartey, 2010), 9% for Mexico (Risso & Carrera, 2009), and 15% respectively for Egypt (Kheir El-Din & Abou-Ali, 2008).

Munir, Mansur, and Furuoka (2009) conducted a study on the Malaysian economy from 1970 to 2005 to examine the relationship between inflation and economic growth using Hansen's autoregressive endogenous threshold model. According to the study's estimated results, the inflation impact threshold on economic growth was 3.89 percent. An inflation rate above this threshold harmed economic growth, and an inflation rate below this threshold had a significant positive impact on economic growth, implying a non-linear relationship between inflation and economic growth. Akgül & Özdemir (2012) used the two-regime TAR model to examine the non-linear connection between inflation and economic performance in Turkey from 2003 to 2009. The study's authors discovered that the inflation threshold for the interval under investigation was 1.26 % and that inflation rates over this threshold damaged economic growth and vice versa.

Ghosh and Phillips (1998) discovered that when the inflation rate is low, inflation and economic growth are positively connected (less than 2 or 3 percent). Using data from 1970 to 2003, Fabayo and Ajilore (2006) investigated the threshold effect on the inflation-growth connection in Nigeria. According to the study, the inflation barrier is 6% because inflation has a beneficial impact on economic growth below the inflation threshold. Similarly, Hasanov (2011) conducted a study to determine an inflation threshold level for Azerbaijan as a country in transition from 2000 to 2009; they emphasized that the inflation threshold was 13 % and that annual inflation below this level had a positive effect on growth and vice versa. In addition, Sargsyan (2005) examined the level of inflation threshold for Armenia from 2000 to 2008 and determined that an inflation rate higher than 3 percent but not exceeding the 4.5 percent threshold had a favourable influence on Armenia's economic growth.

Vaona and Schiavo (2007) examine the long-term link between inflation and economic progress for 167 industrialized and developing nations from 1960 to 1999. The study examined the effect of many instrumental variables on economic growth, including inflation, gross fixed capital formation, population growth rate, education, and government spending. According to the authors, the inflation threshold is 12 percent, and any inflation rate less than that does not jeopardize economic growth. In comparison, an inflation rate of more than 12% would have a negative impact on economic growth. Another similar study, undertaken by Gylfason and Herbertsson (2001), studied 170 nations from 1960 to 1992 and discovered that annual inflation rates exceeding 10-20 percent hinder economic growth.

Another study by Kremer, Bick, and Nautz (2013), examined the impact of the inflation threshold on long-term economic growth for 124 industrialised and non-industrialised countries from 1950 to 2004, predicting that the inflation threshold was

2% for industrialised countries and 17% for non-industrialised countries. The study's findings and results support the economic theory that inflation impacts economic growth, stating that annual inflation above this level has a negative impact on economic growth. In contrast, below this level, the influence was negligible. Similarly, Vinayagathasan (2013) used the dynamic panel threshold model, which allows for fixed effects and endogeneity, to examine the relationship between inflation and economic output in 32 Asian nations between 1980 and 2009. According to the study, the threshold value for the impact of inflation on economic growth is 5.43 percent, which means that high inflation over this threshold negatively influences economic growth, while inflation rates below this threshold have no impact.

Various global research studies have provided various inflation threshold levels. Rao and Abate (2015) discovered a non-linear link between inflation growth and economic growth, but Ashagrie (2015) suggested that empirical evidence does not support an inflation threshold's current effects. Ndoricimpa (2017) examined the effects of inflation on economic growth in 47 African nations between 1970 and 2013. The analysis discovered an inflation threshold of 9% for lower-income categories and 6.5 percent for middle-income categories.

Only a few research studies on the nature of the influence of inflation on economic growth in the Western Balkans have been done. However, we emphasize that no study analyses or specifies inflation levels and their effects on the growth of Western Balkan countries.

3. Research methodology and data

3.1 Research Methodology

We employ panel data models and methodologies such as OLS, fixed effect, random effect, the Hausman test, and the Hausman Taylor IV test to analyse and reflect the impacts of inflation on economic growth and the optimal inflation threshold level values in economic growth. Furthermore, we employ Hansen's (1999) threshold model to identify the threshold values of the inflation rate to GDP using the Bootstrap approach.

As a result, this study aims to investigate the impact of the inflation threshold level on the economic growth of Western Balkan countries. This paper's empirical analysis incorporates panel data acquired from secondary sources for six Western Balkan countries from 2000 to 2020. Data sources are secondary data that have been collected by WB, IMF, and the Central Banks of these countries.

The dynamic panel data model (Hausman Taylor IV) specification for testing the influence of inflation on Western Balkan countries' economic growth (GDP) is as follows:

$$LnGPD\_per\_Capita_{it} =$$
$$c + LnGPD\_per\_Capita_{(it-1)} + \beta_1 LnG\_TermsofTrade_{it}$$
$$+ \beta_2 Inv\_Growthrate_{it} + \beta_3 Empl\_growthrate_{it}$$
$$+ \beta_4 G\_Spending_{it} + \beta_5 Inflation_{it} + u_{it}$$

The dependent variable is the GDP growth rate per capita for each country i and t represents the years, **c** is the constant term; Explanatory variables include GDP_{it-1}, which is the first-lag of the dependent variable. The independent variables are $G\_TermsOfTrade_{it}$ which reflects the growth rate of international trade by dividing the value of exports by imports; $Inv\_GrowthRate_{it}$ is the growth rate of investments as % of GDP; $Inv\_GrowthRate_{it}$ is the employment rate as a ratio of the population; $G\_Spending_{it}$ represents the final consumption expenditure of the general government as % of GDP; inflation represents inflation taking into account consumer prices on an annual basis assuming that there is a non-linear relationship between inflation and economic growth; while u_{it} represents exogenous disturbances.

Based on this non-linear relationship, according to the theoretical assumption, there is a negative relationship between inflation; therefore, from the results of this research, we expect that low inflation will positively affect economic growth and vice versa.

Their approach proposes an option that incorporates the advantageous characteristics of the two previous effects models, random and fixed effects (Hausman & Taylor, 1981). The mismatch between the explanatory variable and the error term is a fundamental disadvantage in the random-effects model. The Hausman-Taylor method is a variable instrumental technique that uses the information in the model to eliminate reciprocal links between site-specific effects and the error term. This approach differs from the fixed effects model because it does not require the elimination of time-immutable in the explanatory variable.

The panel data threshold model created by Hansen (1999) is used to examine the non-linear relationship between economic growth (GDP) and inflation. We can use this statistical technique to determine the threshold level. The author's proposed threshold level specification (Hansen, 1999) is as follows:

$$Y_{it} = \alpha_i + \beta'_1 x_{it} I_{(q_{it} \leq c)} + \beta'_2 x_{it} I_{(q_{it} > c)} + \varepsilon_{it}$$

Where the dependent variable Y_{it} is scalable, α_i is a fixed effect, the threshold variable q_{it} is scalar, the regressor x_{it} is a vector k, and $_{(.)}$ is the pointer function, and c is a threshold parameter.

The panel threshold regression model can also be specified as follows:

$$Y_{it} = \alpha_i + \beta'_0 x_{it} + \beta'_3 x_{it} I_{(q_{it} < c)} + \varepsilon_{it}$$

For any given threshold c, we can estimate the slope of coefficient β with the ordinary least squares (OLS), determining the following:

$$\beta(c) = (X^*(c)' X^*(c))^{-1} X^*(c)' Y$$

The vector or residue can be given as follows:

$$\varepsilon^*(c) = Y^* - X^*(c) \beta(c)$$

Whereas the sum of squares errors is:

$$SSR(c) = \varepsilon^*(c)' \, \varepsilon^*(c)$$

Hansen (1999) states that the threshold parameter **c** is estimated by minimizing the concentrated sum of the squares:

$$\hat{c} = arg \, min \, SSR(c)'$$

Therefore, if the threshold effect is static and significant in the two-mode model, the null hypothesis is:

$$H_0 : \beta_1 = \beta_2$$

As a result, the null hypothesis corresponds to the no-threshold effect hypothesis. Under H_0, the model is equivalent to a linear model with $\beta = \beta_1 = \beta_2$:

$$Y_{it} = \alpha_i + \beta' x_{it} + \varepsilon_{it}$$

The null hypothesis, $H_0 : \beta_1 = \beta_2$, can be tested with a standard test. If we observe that S_0 is the square sum of the linear model, the approximate probability ratio test of H_0 is based on:

$$F_1 = \frac{SSR_0 - SRR_1(\hat{c})}{'\sigma^2}$$

Where $'\sigma^2$ indicates a convergent estimate of σ^2.

3.2 Research Methodology

In this section of the study, we provided the definitions and descriptive statistics of the variables used to measure the effects of the inflation threshold level on the economic growth of the Western Balkan countries.

Table 1. Variable definitions and descriptive statistics

Variables	Definition, description and source	Obs.	Mean	Std. Dev.	Min	Max
Growth rate of GDP per capita	Log of GDP per capita (constant 2010 US$) from World Bank Data, the IMF and Central Banks	126	8.415006	0.3148241	7.523519	9.058518

Variables	Definition, description and source	Obs.	Mean	Std. Dev.	Min	Max
Level of output	Log of GDP, PPP (current international $) from World Bank Data, the IMF and Central Banks of these countries	126	23.86389	0.8377239	22.0131	25.61248
Employment growth rate	Employment to population ratio, 15+, total (%) (modelled ILO estimate) from World Bank Data, the IMF and Central Banks of these countries	126	38.59675	8.167557	22.49	53.41
Investment growth rate	Gross capital formation (% of GDP) from World Bank Data, the IMF and Central Banks of these countries	124	60.67728	17.77398	11.36	100
Growth rate of terms of trade	Export value divided by import value (2000 = 100) from World Bank Data, IMF and Central Banks of these countries	125	13.785	3.146876	9.61	18.56
Standard deviation of terms of trade	Standard deviation of export value divided by import value (2000 = 100)	6	18.67937	5.246111	9.69	39.28

Variables	Definition, description and source	Obs.	Mean	Std. Dev.	Min	Max
Government spending growth rate	General government final consumption expenditure (% of GDP) from World Bank Data, the IMF and Central Banks of these countries	126	4.352857	10.77671	-4.3	95.01
Inflation rate	Inflation, consumer prices (annual %) from World Bank Data, the IMF and Central Banks of these countries	126	8.415006	0.3148241	7.523519	9.058518

Source: Authors' calculations

Secondary data sources mostly come from the World Bank, the International Monetary Fund (IMF), and the Central Banks of the economies included in the study. The GDP growth rate per capita is the dependent variable, whereas the independent variables are the output level, employment growth rate, investment growth rate, terms of trade growth rate, terms of trade standard deviation, government spending growth rate, and inflation rate. The model's controllable variables for understanding the non-linear relationship between economic growth and inflation are output level, employment growth rate, investment growth rate, terms of trade growth rate, terms of trade standard deviation, and government spending growth rate.

4. Empirical Results

The table below (Table 2) shows the regression analysis results using panel data and the assessment of the inflation threshold value in Western Balkan countries (Albania, Montenegro, Bosnia and Herzegovina, Northern Macedonia, Serbia, and Kosovo). The table of results below employs a variety of econometric approaches or measurements, with the study findings reflecting the same results from nearly all panel data models evaluating the effect of inflation on GDP per capita growth rate. In addition, an important element of this research was determining the optimal level of inflation threshold to the GDP growth rate using Hansen's bootstrap method (1999). This approach assesses the threshold and identifies the anticipated values of the inflation threshold to the GDP growth rate per capita in Western Balkan countries.

Table 2. The results of the regression analysis

Variables	OLS Reg.	Fixed Effects Reg.	Random Effects Reg.	Hausman-Taylor Reg.
Lag LnGdp_per_Capita	-	-	-	0.77016***
				0.000
Lnl_Output	0.05936*	0.58131***	0.05936*	-
	0.074	0.000	0.071	
LnG_TermsOfTrade	0.37910***	0.02128	0.37910***	-0.38547***
	0.000	0.188	0.000	0.000
Inv_GrowthRate	-0.00074	-0.00111	-0.00074	-0.00594**
	0.897	0.238	0.897	0.024
Empl_Growthrate	0.00903**	-0.00759***	0.00903**	0.00291
	0.023	0.000	0.021	0.426
G_Spending	0.01748***	-0.00071	0.01748***	-0.02920***
	0.007	0.597	0.006	0.000
Inflation	-0.00641***	-0.00017	-0.00641***	-0.00447***
	0.007	0.664	0.006	0.000
Constant	4.83877***	-5.2062***	4.83877***	4.04010***
	0.000	0.000	0.000	0.000
Observation	123	123	123	122
Code	-	-	-	0.01616
				0.719
Sigma_u	-	0.52561	0	0.17556
Sigma_e	-	0.03708	0.03708	0.10146
Rho	-	099504	0	0.74963
Turning Point 95% Confidence Intervals bootstrap – normal-based Confidence Intervals	-	-	-	3.90 (1.52; 5.83)

*Note that the symbols *, **, and *** signify significance at 10%, 5%, and 1%, respectively. Bootstrapping with a normal distribution is used to establish the confidence intervals (CI) for the inflation turning point.*
Source: Authors' calculations

Therefore, using the Hausman Taylor IV method, variables such as G_TermsOfTrade, Inv_GrowthRate, Empl_Growthrate and G_Spending, which vary over time, are considered to be exogenous. Therefore, we can use them as separate instruments while

variables such as GDP_per_Capita and Inflation vary over time, but we defined them as endogenous. We can explain the significance of each variable in the model and the constant according to the Hausman Taylor IV method results.

From the equation specified above at the beginning of this study, we can say that in this model, we have used GDP with a delay of one year as a variable to check the 'steady-state' convergence predicted by other models, and through the results, we see that the estimated coefficient (GDP_{it-1}) is 0.77016; as a result, we can emphasise that there is a positive and at the same time significant link between the initial level of GDP and economic growth. As a result of this coefficient, we can conclude that a 1% increase in GDP_{it-1} has a 0.77016% positive impact on economic growth. Taking the 2008-2009 financial crisis into account, we can also conclude that the degree of economic growth in the Western Balkans has shifted from one period to the next for a variety of reasons.

To test and understand their impact on economic growth, we have considered other factors like G_TermsOfTrade, Inv_GrowthRate, Empl_Growthrate, G_Spending and Inflation. As a result of the regression analysis results shown in the table above, we emphasize that the circumstances of international trade (exports and imports) negatively affect economic growth by -0.3854 percent and the growth rate of investments negatively affects economic growth by -0.00594 percent. While employment growth positively influences economic growth by 0.00291 percent, government expenditure negatively affects economic growth by -0.0292 percent, and inflation negatively affects Western Balkan countries' economic growth by -0.00447 percent.

This model also includes the state code to balance the data in the model and share the effects between the six countries of the Western Balkans.

Furthermore, the study's findings on the inflation rate threshold represent the critical point of the consequences of the inflation rate, with GDP per capita ranging from 1.52 percent to 5.83 percent. More specifically, the turning point is 3.90 percent, which means that any inflation rate below this level will have a positive or insignificant impact on the GDP growth rate per capita; these findings provide sufficient support for accepting the first hypothesis of this study, which contends that any inflation rate below 3.90 percent has a positive or insignificant impact on the economic growth of Western Balkan countries. The Hausman Taylor IV regression analysis, on the other hand, provides a significant level of 0.01 (1 percent), indicating that inflation has a negative influence on GDP per capita in the Western Balkan countries. Furthermore, we emphasize that when the inflation rate surpasses the 3.90 percent limit, it may have a negative influence on the GDP growth rate per capita. We can claim that accepting the second hypothesis of this study is justified since inflation growth rates above a specific level or point of the threshold value for Western Balkan countries damage economic growth.

5. Conclusions

Many studies have been conducted to examine the impact of the inflation threshold on economic growth in various nations, but no study of Western Balkan countries has been conducted. As a result, this study examined the threshold effects of inflation on economic growth, as well as the relationship between inflation and economic growth for Western Balkans countries using techniques or various econometric measurements such as OLS, Fixed Effects, Random Effects, Hausman Taylor IV, and inflation threshold estimation using the Bootstrap method.

The study's findings show that there is a negative influence and an inverse association between inflation and economic growth rate in Western Balkan countries. In addition to the Empl_Growthrate variable, we should also note that other variables with a significance threshold of 5%, such as _TermsOfTrade, Inv_GrowthRate, and G_Spending, have had a negative impact on these countries' economic growth. Furthermore, the study findings emphasize that the turning point for the effects of inflation on GDP ranges from 1.52 percent to 5.83 percent, with a specific threshold level of 3.90 percent. As a result of this study, we may conclude that a higher inflation rate is related with a poorer economic growth rate when it exceeds the 3.90 percent barrier, but a lower inflation rate is connected with a greater economic growth rate when it falls below 3.90 percent threshold. More specifically, any movement in the inflation rate below this level will have a positive or negligible influence on economic growth, while any movement over this level will have a negative impact on economic growth.

In conclusion, based on the findings of this study, the countries of the Western Balkans must employ monetary policy instruments effectively and manage monetary mass by economic realities in order to maintain a stable economic structure and controlled inflation in the country. Except for Kosovo and Montenegro, which have the Euro as their official currency, local governments cannot manage such a thing since European Central Bank decisions regulate monetary policy instruments and monetary measures. Despite significant limitations in the data acquired for Western Balkan countries, the study produced consistent and valuable results in accordance with economic theory. As a result, such a study might be expanded further by considering other variables that would indirectly affect economic growth or decisions made through these countries' key monetary and economic policy instruments.

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