INFLATION DIFFERENTIAL BEETWEN EURO AREA AND NORTH MACEDONIA

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Abstract: The main purpose of this study is to make a comparative analysis of the inflation differences between euro area and North Macedonia and to propose a simple model for inflation calculation for the North Macedonian economy by using an OLS regression of several explanatory variable to estimate the inflation level. Since the common currency was establish by the European countries the monetary policy is conducted by the European Central Bank (ECB) with the primarily goal of price stability i.e. low inflation, by considering the interest of all members of the European Monetary Union (EMU). The focus of the ECB on low inflation pressured the governments of various euro zone countries to develop the appropriate models to measures inflation and respond in time to shocks that may affect them. Historically, since its creation, the ECB has made a good effort in containing the inflation within the boundaries of 2% annually. On the other note it cannot be stated that this is the case for the North Macedonian National Bank, where inflation is subject to considerable variations. First a comparative method is used to show the evolution of inflation differentials between euro area and North Macedonia for the period 2000-2024. Inflation, is calculated as annual percentage of consumers price. From 2000 inflation differentials where increasing until 2009, reaching a minimum in 2004 and a peak in the year 2008. Afterwards the inflation dispersion decreased until 2021, before the COVID pandemic, there was a temporary upsurge to reach its peak in 2022, passing the 2008 level, before decreasing again in 2024. The other approach taken in this paper is to present a model for inflation calculation based on the formulation by Honohan et al. (2003) and Angeloni and Ehrmann (2004). The economy of North Macedonia is modeled only as an aggregate supply where inflation is depended on past and expected inflation, domestic output gap, and the real effective exchange rate weighted by the appropriate trade share of the North Macedonian economy. From all the explanatory variables of the model only the effective exchange rate is statistically significant at the 5% level, meaning that the association between *Inflation* and *Reer* is significant. Apart from the explanatory variables, the constant -97.36 is statistically significant at 10% level and represents the expected average level of inflation in the case where each independent variable is null. The study, culminated by creating a least square model to detect the relationships between various explanatory variables and inflation. The same model identifies that only the effective exchange rate is significant at 5% level and all the other variables although they are important in explaining inflation they are not statistically significant. From this study, it can be also concluded that it does not include all the macroeconomic factors that influence inflation. The determinants used in the model have an R squared of only 0.386 which means that they explain only 38.6% of Inflation.
Keywords: Money, Inflation, Central Bank, Macroeconomics

1. INTRODUCTION

The main purpose of this study is to make a comparative analysis of the inflation differences between euro area and North Macedonia. Since the common currency was establish by the European countries the monetary policy is conducted by the European Central Bank (ECB) with the primarily goal of price stability i.e. low inflation, by considering the interest of all members of the European Monetary Union (EMU). The ECB has quantified the inflation target not to exceed the 2% annual mark. Even though the inflation differences have diminished, they are still present among EMU countries. The focus of the ECB on low inflation pressured the governments of various euro zone countries to develop the appropriate models to measures inflation and respond in time to shocs that may affect them. Historically, since its creation, the ECB has made a good effort in containing the inflation within the boundaries of 2% annually. On the other note it cannot be stated that this is the case for the North Macedonian National Bank, where inflation is subject to considerable variations. Identifying the drivers of inflation has always been problematic for both academics and policy makers, Bernanke and Mishkin (1997) advocated for a monetary policy known as inflation targeting, in which the central bank officials announce the target ranges for the inflation rate over a particular time horizon and by confirming that a low and stable inflation is the primary goal of the monetary policy.

Apart from targeting inflation other dimensions of monetary policy have also their importance as variations of supply of bank reserves, the changes in assets acquired by central banks and interest paid on reserves. By adopting a canonical New Keynesian model these dimensions are explained, dimensions that are important especially in times of financial crises Curdia and Woodford (2010). Studying the asymmetric shock on the supply chain, particularly in period of crises, Tillmann (2024), developed an empirical model based on panel local projections (Jordà, 2005), and showed that supply chain disruptions have significant effect on three types of inflations, headline inflation, core

inflation and producer price inflation. According to him positives shocks have stronger and more persistent effects that the negative ones.

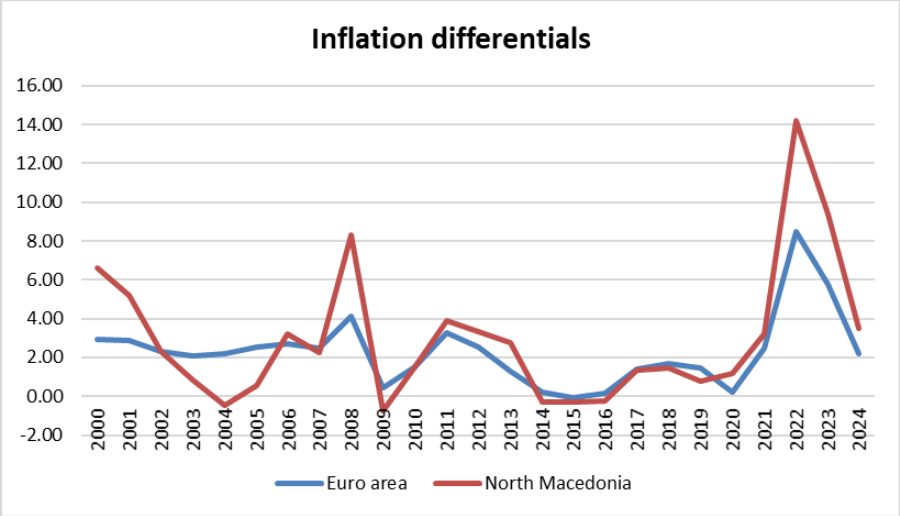
Motivated by artificial intelligence, Almosova and Andresen (2023), applied a recurrent neural network to efficiently predict inflation and found that long short-term memory recurrent neural network (LSTM) is highly efficient in predicting univariate forecasts of monthly US CPI inflation. Simionescu (2022), used sentiment analysis to accurately predict inflation on quarterly data for the Romanian economy. According to the author the sentiment forecasts performed better than the numerical ones for the period 2008-2021.Bańbura et al. (2023), used a medium-sized structural Bayesian VAR to construct a framework for analyzing how global supply chain shocks and gas prices shocks affect inflation. They concluded that these shocks have greater impact than they did in the past. Also, they found that core inflation in the post COVID recovery was guided by supply side shocks. Clements and Galvão (2013) use a statistical VAR model to forecast macroeconomic variable of output and inflation for the Us economy based on past observations and post revision data and found that these types of models are useful in predicting US inflation, but far less useful in predicting its output. McKnight et al. (2020), by analyzing data from the Euro Area and US developed an advancing method based on new Keynesian Phillips curve to forecast inflation and found that their approach is more robust than various methods used to predict inflation. Relating inflation to climate change, Boneva and Ferrucci, (2022), have shown that traditional macroeconomic models should include climate variables as they can improve inflation forecasts significantly.

Apart from presenting a comparative analysis for inflation differentials, the aim of this paper is to propose a simple model for inflation calculation for the North Macedonian economy by using an OLS regression of several explanatory variable to estimate the inflation level. In addition to this introduction section, this article incorporates several sections, as materials and methods, results and discussions.

2. MATERIALS AND METHODS

In this section are presented the materials and methods used in this study. First a comparative method is used to show the evolution of inflation differentials between euro area and North Macedonia for the period 2000-2024. Inflation as presented in figure 1, is calculated as annual percentage of consumers price. From 2000 inflation differentials where increasing until 2009, reaching a minimum in 2004 and a peak in the year 2008. Afterwards the inflation dispersion decreased until 2021, before the COVID pandemic, there was a temporary upsurge to reach its peak in 2022, passing the 2008 level, before decreasing again in 2024.

Figure 1



Source: Author's research

The other approach taken in this paper is to present a model for inflation calculation based on the formulation by Honohan et al. (2003) and Angeloni and Ehrmann (2004). The economy of North Macedonia is modeled only as an aggregate supply where inflation is depended on past and expected inflation, domestic output gap, and the real effective exchange rate weighted by the appropriate trade share of the North Macedonian economy. Mathematically, the model can be written as follows:

$$\pi_{t,j} = c_1 + \alpha\pi_{t-1,j} + (1-\alpha)E_t\pi_{t+1,j} + \beta gap_{t,j} + \gamma reer_{t,j} + \varepsilon_{1t,j}$$

The modeled regression is developed by using all the available yearly observations data for the period 2005-2024. The inflation data was gathered from the World Development Indicators database (World Bank) and the Central Bank of North Macedonia. α and 1-α coefficients represents the weights of past and expected inflation given by the model. Considering that the model gives more weight to the expected inflation than the inflation for the previous year, these coefficients are split as 40 and 60 percent appropriately. The inflation evolution is directed by a combination of factors that are not presented in this model. The expected inflation, $E_t\pi_{t+1,j}$, is calculated by subtracting the real interest rate for the time *t* from the interest rate of a 2 years North Macedonian T-bills (according to the data provided by the National Bank of North Macedonia, there where no t bills for 1-year maturity).

For the calculation of the output gap, the potential output was calculated using Okun's Law:

$$\%GDP_{gap} = -c\ x\ (U - U^*)$$

Where -c is the Okun coefficient, typically between 2 and 3 percent, with a negative sign, meaning that for every 1 percent increase in unemployment there will between 2% or 3% decrease in economic output. U and U* represents the unemployment and natural unemployment rate respectively, which based on the literature is considered to be 5%. $reer_{t,j}$, is the nominal effective exchange rate index adjusted for relative movements in national price or cost indicators of North Macedonia and the euro zone countries. $\varepsilon_{1t,j}$ represents the error term at time t.

Table.1 Linear regression

VARIABLES	(1) Inflation
Inflation (t-1)	-0.957
	(0.993)
Inflation (t+1)	-0.304
	(0.490)
Output_gap	0.0483
	(0.0980)
Reer	1.012**
	(0.472)
Constant	-97.36*
	(48.01)
Observations	20
R-squared	0.386

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Author's research

3. RESULTS

In table 1, are presented the results of the significance of the regression model. The linear regression investigates the relationship between the independent variables and dependent variable, inflation. The regression equation presented in the section above with the estimated coefficients can be rewritten as follows:

Inflation = -97.36 - 0.957(Inflation_t-1) - 0.304(Inflation_t+1) + 0.04(Output_gap) + 1.012(Reer)

Each coefficient in the regression represents an average increase in the dependent variable for one unit increase in the given independent variable. According to the independent variables, for every increase of one percent of backward inflation *Inflation_(t-1)* the average expected decrease in inflation is -0.957 percent. For one unit of increase of expected *Inflation_(t+1)* the average expected decrease in inflation is -0.304 units. For one percent increase in the *Output_gap* there is an estimated increase of inflation of 0.048 percent and for a one percent increase

of the effective exchange rate *Reer* there is a 1.012 percent increase of inflation. From all the explanatory variables of the model only the effective exchange rate is statistically significant at the 5% level, meaning that the association between *Inflation* and *Reer* is significant. Apart from the explanatory variables, the constant -97.36 is statistically significant at 10% level and represents the expected average level of inflation in the case where each independent variable is null. The uncertainty coefficients measured by the standard error are as follows: 0.993 for *Inflation_(t-1),* 0.490 for *Inflation_(t+1),* 0.098 for *Output_gap* and 0.472 for *Reer.*

4. DISCUSSIONS

This study showed the relationship between stated above macroeconomic variables and inflation in the specific case of the North Macedonian economy. It worth pointing out that from all the explanatory variables used in the model only the effective exchange rate is statistically significant at the 5% level, meaning that exchange rate and the share of trade is an important factor to consider for predicting inflation. Considering the *Reer* variable in the model, in term of significance, it fits with the results shown in Angeloni and Ehrmann (2004). The result presented in this paper should be considered with restraints because it does not include all the factors that can impact inflation. The choice of the variables to be included in the model where based on the literature but non the less selected by the author. The other limit is that the model presented has an R-squared of 0.386 which means it explains only 38.6 % of inflation. Furthermore, the period of analyses considered for the collected data is relatively short.

5. CONCLUSIONS

The research in this paper was focused on identifying the variables that can have an impact in estimating inflation in North Macedonia for the 20-year period. The study, culminated by creating a least square model to detect the relationships between various explanatory variables and inflation. The same model identifies that only the effective exchange rate is significant at 5% level and all the other variables although they are important in explaining inflation they are not statistically significant. For this study, it can be also concluded that it does not include all the macroeconomic factors that influence inflation. The determinants used in the model have an R squared of only 0.386 which means that they explain only 38.6% of Inflation.

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