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Testing the Twin Deficit Hypothesis: Evidence from the Republic of North Macedonia

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Abstract

Background: An econometric analysis of the twin deficit hypothesis is of special importance for the Republic of North Macedonia in view of its perspective membership in the European Union and from the point of view of its macroeconomic stability in the long run. **Objectives:** The objective of this paper is to test empirically the validity of the twin deficit hypothesis in the Republic of North Macedonia. **Methods/Approach:** To achieve this objective, we used actual quarterly data on Macedonia's budget and the current account deficit in the period from the first quarter of 2005 until the fourth quarter of 2017 and applied several econometrics methods: the Granger causality, a vector autoregressive (VAR) and a vector error correction model (VECM). **Results:** These findings point to the conclusion that efforts focused on improving the current account imbalances through fiscal policy will be inefficient in the short run. **Conclusions:** However, the existence of a long run relationship between the budget deficit and the current account deficit indicates the necessity of policy initiatives focused not only on reducing the budget deficit, but also on improving the external position of the country though export promotion.

Keywords: Twin deficit, Granger causality, VAR, VECM
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Introduction

The twin deficit hypothesis implies a long-term positive relationship between the budget and the current account deficit running from the budget deficit to the current account deficit. This phenomenon gained prominence in the 1980s because of the rapidly growing twin deficits in the United States and many other countries in the world. The latest global financial crisis of 2008, when many countries faced the challenge of reducing budget deficits and preventing the recurrence of high and long-term current account deficits as well as the European debt crisis of 2010 has spurred the academic interest in studying the twin deficits hypothesis.

The empirical investigation of the budget and current account deficit relationship is of special importance for the EU candidate and potential candidate countries. In the last two decades the Republic of North Macedonia, simultaneously experienced

budget and current account deficit (budget deficit averaged -2.32 percent of GDP from 1993 until 2018 and current account deficit averaged -4.07 percent from 1998 until 2018). The problem of twin deficit is not only important in view of perspective membership of the country in the European Union, but also from the point of view of its macroeconomic stability on a long run.

In this context, the purpose of this paper is to test empirically the validity of the twin deficit hypothesis in the Republic of North Macedonia using actual quarterly data on Macedonia's budget and current account deficit in the period from the first quarter of 2005 until the fourth quarter of 2017. To achieve this goal, we employed the following econometric methods: Granger causality, a vector autoregressive (VAR) model and a vector error correction model (VECM).

The paper is organized as follows. After the introduction, we explore the theoretical background and review the empirical literature on the twin deficit hypothesis. In the methodology section, we describe our research methodology and data. In the third section, we perform econometric testing of the validity of twin deficit hypothesis. We estimate the VAR model, carry out Granger causality testing, impulse response function testing as well as variance decomposition, stationary testing and finally we perform a VECM analysis. In the last section, we discuss the obtained empirical results and their implications for policy makers, draw conclusions, analyse the limitations of the paper and suggest directions for future research.

Theoretical framework and literature review

In economic literature, there are two major theories that explain the relationship between budget deficit and current account deficit: the conventional Keynesian theory (Keynes, 1936) based on the Mundell-Fleming framework and the Ricardian Equivalence Hypothesis. The traditional Keynesian proposition asserts that an excessive government borrowing for financing of government expenditures results in a budget deficit. A rise in budget deficit would induce an increase of domestic interest rates, causing more foreign capital inflows to the home country. The increased demand for financial assets in the country would lead to an appreciation of the home currency. The appreciated exchange rate would make exports relatively more expensive and imports cheaper and more attractive, which in turn would lead to deterioration of the current account balance into current account deficit under both fixed and flexible exchange rate regimes. How the budget deficit affects the current account deficit under a certain exchange rate system is explained in the Mundell–Fleming model (Fleming, 1962; Mundell, 1963). In other words, according to Keynesian conventional theory, there is a positive relationship between a budget and a current account deficit and that relation is a unidirectional Granger causality running from budget deficit to current account deficit.

Unlike the Keynesian proposition, the Ricardian Equivalence Hypothesis (REH), which was articulated first by the British economist David Ricardo and further developed by Robert Barro (1989), asserts that, there is no Granger causality relationship between the budget and the current account deficit and that the budget deficit would not cause a current account deficit. The perfect REH implies that taxpayers are rational forward-looking persons who will not respond to tax cuts by increasing their spending, but rather by increasing their savings in order to be prepared to pay future tax liabilities (Barro, 1989, p. 39; Hashemzadeh and Wilson, 2006). The increase of private savings would offset any change in the government budget (whether its debt financing or taxes) and would not cause a current account deficit (Khalid and Guan, 1999, p. 390). According to Baharumshah et al. (2006), the above outcomes are not the only possible outcomes of the relationships between the budget

deficit and the current account deficit. There might be a unidirectional causality running from current account to budget deficit. This is the case when worsening of the current account balance causes slower economic growth, which results with a budget deficit. This is especially true for small open developing economies that are very much dependent on foreign capital inflows. There might be also a bidirectional causality between the budget deficit and the current account deficit. Theoretically, the relationship between budget deficit and current account deficit can be represented by the national income identity (NII) for an open economy:

$$Y = C + I + GS + (EX - IM) \quad (1)$$

where Y is national income, C is private consumption, I is investment, G is government spending, EX is exports of goods and services and IM is imports of goods and services.

Current account is defined as

$$CA = EX - IM + NTP \quad (2)$$

where NTP is the net transfer payment i.e. the difference between payments from a country to abroad and payments from foreigners to the country.

By rearranging the variables, Equation (1) becomes:

$$CA = Y - (C + I + G) \quad (3)$$

where the term (C + I + G) represents the national spending.

National saving in an open economy equals to:

$$S = (Y - C - G) + CA \quad (4)$$

where, Y – C – G = I represents investment, so equation (4) can be rewritten as

$$S = I + CA \quad (5)$$

National saving consists of private savings (SP) and government savings (SG):

$$SP = Y - GR - C \quad (6)$$

and

$$SG = GR - G \quad (7)$$

where GR is the government revenue. Using equations (6) and (7) and substituting into equation (3) yield:

$$CA = SP - I - (G - GR) \quad (8)$$

It is evident from Equation (8) that if private savings equal investment than the current account and budget deficit are "twinned" i.e. an increase in the budget deficit will worsen the current account deficit. If government revenues and the saving-investment gap (SP – I) are held constant, a temporary increase of government spending will directly increase the budget deficit and will lead to worsening of the current account balance, which is the essence of twin deficit hypothesis.

Not only in the theoretical literature, but also in the empirical studies there is no consensus regarding the causal relationship between budget deficit and current account deficit. Most of the empirical literature refers to the developed economies and especially to the United States because of its simultaneous budget and current account deficit in the 1980s and 90s.

Darrat (1988), using both bivariate and multivariate models, confirmed the existence of tax-and-spend hypothesis in Turkey with a negative causal relationship running from government revenues to expenditures. Zietz and Pemberton (1990) and

Bachman (1992) found that the twin deficit hypothesis holds for the US. Kulkarni and Erickson (2001) concluded that in India and Pakistan trade deficit was driven by the budget deficit. Lau et al. (2010) confirmed the twin deficits hypothesis for Cambodia based on cointegration and Granger causality testing. Banday and Aneja (2016, 2017, 2019) confirmed the twin deficits hypothesis for India and China by applying cointegration and Granger causality testing. Using ARDL model, Bhat and Sharma (2018) examined the association between current account deficit and budget deficit for India over the period of 1970–1971 to 2015–2016 and found strong evidence in support of the Keynesian conventional theory.

On the other hand, Evans (1988), using data for the US found empirical evidence in favour of the Ricardian Equivalence Hypothesis (REH). Kaufmann et al. (2002) rejected the twin deficit hypothesis for Austria. Rafiq (2010) examined the interaction between budget deficits, current account balances and real exchange rates in the United Kingdom (UK) and US and provided empirical evidence in favor of REH. Nazier and Essam (2012) studied the Egyptian economic data from 1992 to 2010 and revealed twin divergence instead of twin deficits, thus supporting the REH. Ratha (2012) found that REH holds for India in the long run, and Algieri (2013) empirically validated the Ricardian theory for five countries (Greece, Ireland, Italy, Portugal, and Spain).

Other researchers gave support to the bidirectional causal link between the budget and the current account deficit. Bolukbas et al. (2018) found out a bidirectional causality between budget and current account deficit in sixteen of the twenty-eight countries (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Italy, Netherlands, Romania, Spain, Turkey and the UK) and a unidirectional causality from budget to current account deficit was also noticed in five EU countries (Cyprus, Latvia, Lithuania, Poland and Slovakia). Rajasekar and Deo (2016) found a long-run relationship and bidirectional causality between the two deficits in India.

Another group of economists found a reverse relationship running from the external imbalance, i.e. from the current account deficit to the internal deficit i.e. the budget deficit. The reasons for these divergent results lie in the different sample periods and different econometric methodologies. For example, Kim and Kim (2006) found a unidirectional causality running from current account deficits to fiscal deficits in Korea using data for the 1970 to 2003 period. According to Marinheiro (2008) causality runs from current account deficits to fiscal deficits only. On the other hand, Litsios and Pilbeam (2017) using the ARDL model found a negative relationship between saving and current account deficit in Greece, Portugal and Spain.

Despite the extensive literature on the twin deficit hypothesis, there is relatively little research on the twin deficit hypothesis in the Central and Eastern European (CEE) countries. Vyashnyak (2000) and Herrmann and Jochen (2005) confirmed the existence of the twin deficit hypothesis in this group of countries. Aristovnik and Zajc (2001) made unclear conclusions about the relationship between the budget and the current account deficit, and Fidrmuc (2003) confirmed the existence of twin deficits in Bulgaria and Estonia, but in reverse form running from the current account to the budget deficit.

Using various econometric methods Ganchev (2010) tested the validity of the twin deficit hypothesis in Bulgaria. The results of the Granger causality test confirmed the existence of dual causality between the budget and current account deficit. On the other hand, conclusions based on the vector autoregressive (VAR) and the vector error correction model (VECM) both rejected the twin deficit hypothesis in the short run, but the long-term results showed evidence in support of this hypothesis.

Ganchev et al. (2012) found a positive relationship between budget deficit and current account deficit in most of the CEE countries, except Bulgaria and Estonia. On the other hand, Tosun et al. (2014) explored the relationship between the budget deficit and the current account deficit on the long run in selected Central and Eastern European economies and obtained no empirical evidence in favour of twin deficit hypothesis, except for Bulgaria. Turan and Karakas (2018) investigated the relationship between budget deficit and current account deficit in seven CEE countries and found that changes in budget deficit had a significant effect on the current account deficit in Czech Republic, Hungary and Slovakia in the long run and in Czech Republic, Slovakia, Hungary and Romania in the short run. Grubisic et al. (2018) studied the impact of government balance and exchange rate on current account in 16 CEE countries in the period 1999-2012 and contrary to the twin deficit hypothesis, they found that government balance had non–significant and negative association with current account balance. Boljanovic (2012) investigated the relationship between government budget deficits and current account deficits for the Southeast European countries in the period 2005-2010 and found a negative correlation between government budget deficits and current account deficits, indicating that the twin deficit hypothesis could not explain current account deficits in these countries.

Margani and Ricciutii (2004) analyzed the existence of the twin deficit hypothesis in small open economies. Applying dynamic econometric methods, they found that public deficit had a strong and a significant effect on current or on lagged current account balances. Vedris and Rancic (2010) confirmed the existence of the twin deficit in Croatia, which according to them had expanded since 1994 – the time of foreign exchange rate and price stabilization in Croatia. Jošić and Jošić (2011) investigated the validity of the twin deficit hypothesis in a small open economy (Croatia) in the period 1995-2010 using VAR model, Johansen's test of cointegration and the Granger causality test. The results of their econometric analysis confirmed the existence of twin deficit hypothesis in Croatia, but in the inverse direction. On the other hand, the empirical findings of Krtalić and Grdović Gnip (2011) supported the validity of Ricardian equivalence hypothesis in Croatia. Their paper showed that there is no Granger causality amid the trade and budget deficit in Croatia in both directions. Using descriptive statistics, Tesic et al. (2014) confirmed the existence of twin deficit hypothesis in Serbia and found that growing budget deficit and the dominant external financing could not boost Serbia's economic growth.

Sobrino (2013) examined the existence of a causal relationship between the budget and current account deficit for the small open economy of Peru for the period 1980-2012 and found no empirical evidence in favour of the twin deficit in the short run. Šuliková et al. (2014) tested the validity of the twin deficit hypothesis in three small open Baltic countries using VECM model. The obtained results confirmed the existence of the twin deficit hypothesis in Estonia, Lithuania and Latvia. Using panel data analysis and Granger-causality test Eldemerdash et al. (2014) explored the relationship between the current account and budget deficit in a group of small open developing economies. Their results indicated the existence of the twin deficit hypothesis in oil producing countries, and the Ricardian equivalence proposition in non-oil countries. These contradictory results could be explained with the different levels of integration of the countries in the world financial markets (Köhler, 2005), level of the development of the country, its socio-economic and political environment and the employed quantitative methods (Noveski, 2018).

Using co-integration and other econometric techniques Gabrisch (2015) tested the long-term causality between the budget and current account deficits of three post-transition countries in Central and Eastern Europe. The obtained results rejected the

twin deficits hypothesis in the analyzed countries (Czech Republic, Hungary and Poland) due to the effect of specific transition factors (high import intensity and net capital inflows) in the analyzed countries.

Furceri and Zdzienicka (2018) examined the existence of the twin deficit hypothesis in developing economies and found that the magnitude of the effect of the budget deficit on the current account deficit is different across counties and over time. They provided empirical evidence that this effect is larger in economies that are more open to trade.

The empirical literature with regard to the validity of the twin deficit hypothesis in Macedonia is rather scarce. Focus is given on the Republic of North of Macedonia, because Macedonia, like other emerging countries in the process of convergence towards EU, has been forced to finance its investments from external sources, which resulted with current account deficits. In addition to that fact, Macedonia is a small and a highly opened economy with a fixed exchange rate and as such more vulnerable to external shocks. Therefore maintaining an external sustainability is of utmost importance for the country's overall macroeconomic stability. The obtained results for Macedonia can be used as a basis for future research of the existence of the twin deficit hypothesis in small and open emerging countries. Sadiku et al. (2018) applied a VAR model and a Granger causality test on quarterly data to investigate the validity of twin deficit hypothesis in Macedonia. Based on the VAR results they found out a short-term relationship between trade and budget deficit, and the results of the Granger causality test revealed a unidirectional relationship in direction from trade to budget deficit. Stojcevska and Miteski (2016) also employed a VAR model on quarterly data to examine the effect of fiscal policy on the Macedonian current account deficit and found a positive, but contemporaneous relationship between the budget and current account balance. The next section describes the research methodology used in this paper.

Methodology

In order to enrich the existing empirical literature, we analysed the causal link between the budget and current account deficit and tested the validity of the twin deficit hypothesis in the Republic of North Macedonia, using two series, budget deficit to GDP and current account deficit to GDP and employing the following model:

$$CA_t = f(BD_t) \tag{9}$$

where CA_t is a current account deficit at time *t*, and BD_t is a budget deficit at time *t*. Following Fidrmuc (2003) the econometric model can be written in the following form:

$$CA_t = \alpha_0 + \alpha_1 BD_t + u_t \tag{10}$$

re α_0 is a constant, α_1 is a model coefficient of the budget deficit and u_t is the random error term. We expect a positive sign for the coefficient of the budget deficit indicating that a higher budget deficit worsens the current account balance.

We empirically investigated the long-run relationship and causality between budget and current account deficit in the Republic of North Macedonia using actual quarterly data of budget deficit to GDP and current account deficit to GDP in the period spanning from the first quarter of 2005 to the last quarter of 2017. The quarterly data series for budget deficit to GDP ratio and for current account deficit to GDP ratio were taken from the Eurostat database (2020). Econometric analysis of the relationship between the budget and the current account deficit is usually performed by applying Granger causality techniques and vector autoregression (VAR) models. Unlike Granger causality, the VAR model allows the so-called impulse responses to be

calculated i.e. to determine the dynamic impact of certain variables, including their logarithmic values, on a variable, and allow for variance decomposition, which provides information on the percentage of variation of a particular variable that can be explained by its lagged values or others variables.

Since we used quarterly data for the period from the first quarter of 2005 to the last quarter of 2017, we had to solve the problem of seasonal adjustment of data. By applying a seasonal adjustment technique, we removed the cyclical seasonal components from the budget and current account deficit time series data and extracted their underlying trend components.

Based on Equation (10) we applied time series econometric methods of both the vector autoregression (VAR) and vector error correction (VEC), as well as Granger causality tests to determine the causal relationship between current account deficit and budget deficit.

The VAR model developed by Sims (1980) is one of the most popular econometric methods for investigating the twin deficits hypothesis. Sims (1980) argued that VARs provide a more systematic approach to imposing restrictions and could lead a researcher to draw conclusions, which could not be drawn using standard procedures. The VAR models have a number of advantages: they can be easily estimated, have good forecasting capabilities, they accommodate well for the endogeneity problem among the variables (all variables in the VAR model are endogenous), the results can be easily interpreted and Granger noncausality can be easily tested

The standard or reduced form of the VAR model is as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_k y_{t-k} + \alpha x_t + u_t \quad (11)$$

where y_t is a vector of endogenous variables, x_t is a vector of exogenous variables, α and β are matrices of coefficients, and u_t is a vector of innovations (white noise).

If the budget and current account deficit time series data are cointegrated, then the VAR model is not the most appropriate presentation and it is necessary to add long-run components to the VAR model. The model transformed in that way is called the vector error correction model (VECM). The application of VECM assumes that variables in the system are cointegrated and that the considered time series are integrated of order 1.

The system of the VECM equations has the following form

$$\Delta CA_t = \alpha_1 + \sum_{i=1}^{m} \mu_{1i} \Delta CA_{t-i} + \sum_{i=1}^{n} \delta_{1i} \Delta BD_{t-i} + \beta_1 \xi_{t-1} + u_{1t} \quad (12)$$

$$\Delta BD_t = \alpha_2 + \sum_{i=1}^{m} \delta_{2i} \Delta BD_{t-i} + \sum_{i=1}^{n} \mu_{2i} \Delta CA_{t-i} + \beta_2 \xi_{t-1} + u_{2t} \quad (13)$$

where α_i is the coefficient of the error-correction term (ECT),and β_i is the coefficient of the cointegrating equation of the system. The parameters of the ECT indicate the sensitivity of each of the endogenous variables in each period of time to the deviation from the long-term equilibrium condition ξ_{t-1}. Convergence exists if α_i lies between 0 and –1. A significant coefficient on the error-correction term indicates that the dependent variable is sensitive to any deviation from the system's stationarity on the long-run, and insignificant coefficient suggests that ECT is not sensitive on any deviations on the long-run. The coefficients μ_i and δ_i indicate the Granger causality of the variables with respect to the dependent variable, u_{1t} and u_{2t} are white-noise residuals, m and n *are* the lag lengths of the variables, and Δ is the first-difference operator of the corresponding variables.

In our paper, we estimated the models using the econometric computer package EViews 9.

Results

We began our econometric analysis by testing whether the obtained seasonally adjusted time series data are stationary. In order to accomplish this, we employed the augmented Dickey-Fuller (ADF) test on the null hypothesis of nonstationarity.

The results reported in Table 1 clearly show that the seasonally adjusted budget deficit time series data is stationary at level, while the seasonally adjusted current account deficit time series data is not stationary, but is stationary at the first difference, meaning CABSA ~ I (1). In order to determine the magnitude of a correlation between the two deficits, and the type of relationship that could be expected between the budget and the current account deficit in the long run, we will apply the Vector Autoregression Model (VAR) and the Vector Error Correction Model (VECM). The VAR model provides a measure of short-run correlation, while VECM model tests for a long-run relationship between the variables employed, reflecting the features of a long-run convergence of the system towards its equilibrium level.

Table 1

Augmented Dickey-Fuller (ADF) Test Results for Unit Roots

H_0: BUDGETSA has a Unit Root				**H_0: CABSA has a Unit Root**			
		t-Statistic	Prob.*			t-Statistic	**Prob.***
ADF Test Statistic		-7.760693	0.000	ADF Test Statistic		-3.168182	**0.1131**
Test Critical Values:	1% level	-4.148465		Test Critical Values:	1% level	-4.152511	
	5% level	-3.500495			5% level	-3.502373	
	10% level	-3.179617			10% level	-3.180699	
***MacKinnon (1996) one-sided p-values**							

Source: Author's own calculations

The results of the VAR model are displayed in Table 2.

After we have verified that we cannot reject that all variables are I(1), we proceed with the Johansen test for cointegration in order to determine whether there are stable long-run relationships between the budget deficits and the current account deficits. In order to implement the Johansen's procedure, we have to determine the optimum lag length in the VAR model. There are various approaches for selection of the VAR model order. In our case, we select the lag order by minimizing one or more information criteria evaluated over a range of model orders and employing the one of the most commonly used information criteria Schwarz-Bayes Criterion (SBC) also known as the Bayesian Information Criterion (BIC). This selection procedure has led us to choose a lag of 2. None of the variables explaining the budget deficit are statistically significant, while all variables explaining the current account deficit with a lag of one and two quarters are statistically significant. The stability of the VAR model is tested using the root of the AR characteristic polynomial and the results are shown in the Table 3.

Table 2
The VAR Model Results

	CABSA	BUDGETSA
CABSA(-1)	0.550755	0.099113
	(0.14103)	(0.10438)
	[3.90517]	[0.94956]
CABSA(-2)	0.059230	-0.084572
	(0.13845)	(0.10247)
	[0.42780]	[-0.82534]
BUDGETSA(-1)	-0.190774	0.129619
	(0.18174)	(0.13451)
	[-1.04970]	[0.96366]
BUDGETSA(-2)	-0.492272	0.447893
	(0.19099)	(0.14135)
	[-2.57745]	[3.16861]
C	-2.965291	-1.058929
	(0.86057)	(0.63691)
	[-3.44573]	[-1.66261]

Note: (standard errors in brackets); [t statistics in parentheses]
Source: Author's own calculation

Table 3
Stability Analysis of the VAR Model

Roots of the characteristic equation **Endogenous variables: CABSA, BUDGETSA** **Exogenous variables: C** **Specification of the lag: 2**	
Roots of the characteristic equation	Modules
0.771227	0.771227
-0.660622	0.660622
0.511852	0.511852
0.057917	0.057917
No root lies outside the unit circle. **The VAR model meets the stability requirement**	

Source: Author's own calculations

The results of the stability analysis depicted in Table 3 show that no root lies outside the unit circle, i.e. the VAR model meets the stability requirement. Having this in mind, we can proceed with calculation of the value of the impulse response function and with decomposition of the variance of the prediction error. But we first run the Granger causality test with seasonally adjusted quarterly time series data on Macedonia's current account deficit and budget deficit in order to detect how changes in one variable causes the other variable to change. The results of the Granger causality test of the seasonally adjusted CABSA and BUDGETSA series are reported in Table 4.

Table 4
VAR Granger Causality

Dependent variable: CABSA			
Excluded	Chi-sq	df	Prob.
BUDGETSA	9.423063	2	0.0090
All	9.423063	2	0.0090
Dependent variable: BUDGETSA			
Excluded	Chi-sq	df	Prob.
CABSA	0.974107	2	0.6144
All	0.974107	2	0.6144

Source: Author's own calculations

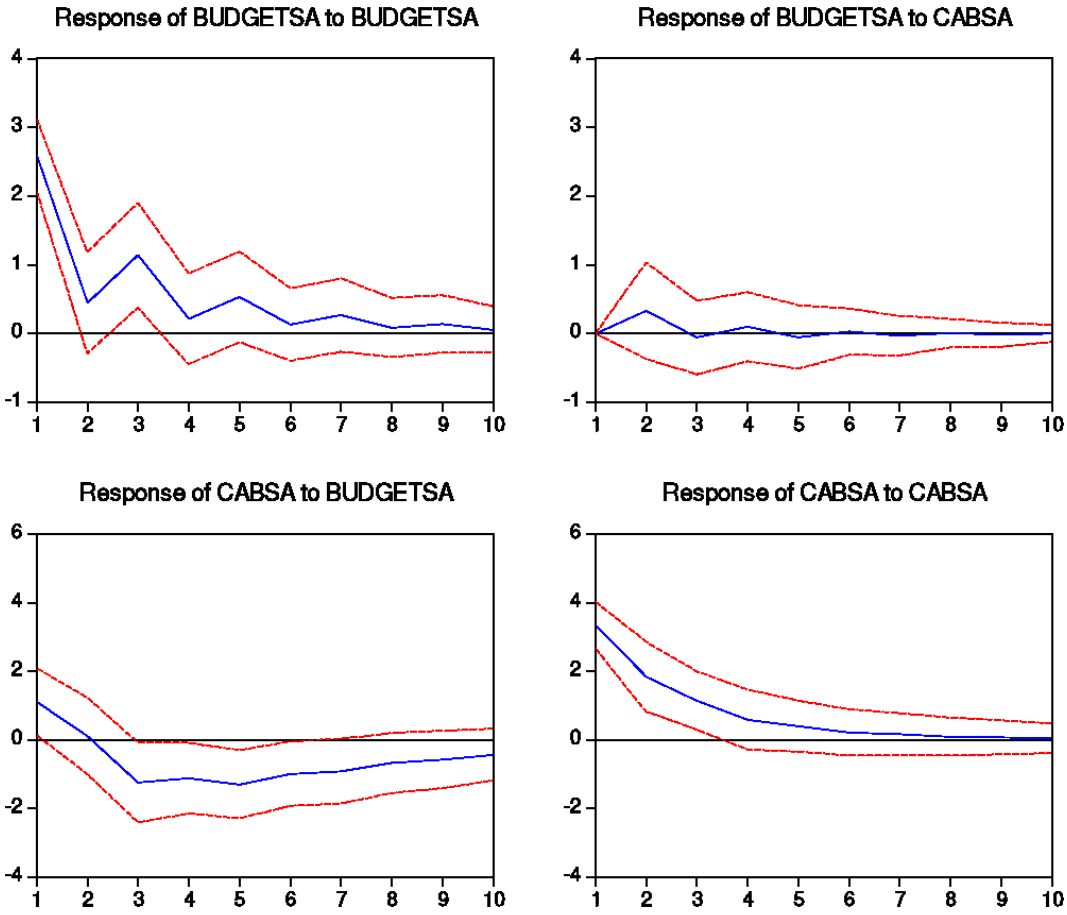
The results in Table 4 show that there is a strong Granger causality running from the budget deficit to the current account deficit. Namely, the probability that the budget deficit does not cause the Granger current account deficit is less than 1%. Contrary to that, the high probability of 61.44% indicates that the current account deficit is not caused by the Granger budget deficit. The same conclusions can be reached if lags of 3 and 4 quarters are applied in testing. These results suggest that the authorities of the Republic of North Macedonia may have indeed followed the policy of short-term targeting of the current account, i.e. they tended to increase the budget surplus based on expectations of an increasing current account deficit. However, in the long run, for example, with a lag of 15 quarter or more, the current account deficit leads to a fiscal deficit. The first result confirms the validity of the twin deficit hypothesis, while the second result complies with the structural gap hypothesis.

In order to analyse the response of one variable to a random shock in another variable we employed the impulse response function (IRF). It detects the effect of a one-time shock on the current and future values of the endogenous variables in the VAR model. To compute IRF we used Cholesky decomposition of the estimated residual covariance matrix of the estimated VAR model. Figure1 shows the impulse responses of each variable (budget balance and current account balance) to shocks in the other variables included in the model.

Row 1 of Figure 1 shows the responses of budget balance to shocks to the variable itself and to shocks in current account balance, respectively. As we can see from row 1 of Figure 1 (upper left-hand panel), the lagged values of the variable BUDGETSA offset the magnitude of BUDGETSA at time *t*, but the effect declines gradually. The increase in the current account balance for one standard deviation affects the recovery of the budget balance, resulting in a budget surplus during the first two periods, followed by a decrease of the budget surplus and converting to zero (row 1 of Figure 1, upper right-hand panel).

Row 2 of Figure 1 shows the responses of the current account balance to shocks to budget balance and to shocks to the variable itself, respectively. Current account balance responds negatively to a shock in the budget balance. The increase of the budget balance for one standard deviation, would gradually, in the following two periods, lead to a current account deficit that slightly improves, but is maintained in subsequent periods. The reason for that is because an increase in the budget balance involves more spending on the foreign sectors (importing more) causing a decrease in the budget balance surplus and therefore a decrease in the current account position.

Figure 1
The Impulse Response Function Results of the variable budget deficit (BUDGETSA) and current account deficit (CABSA)



Source: Author's own calculations
Note: Response to Cholesky One S.D. Innovations ± 2 S.E.

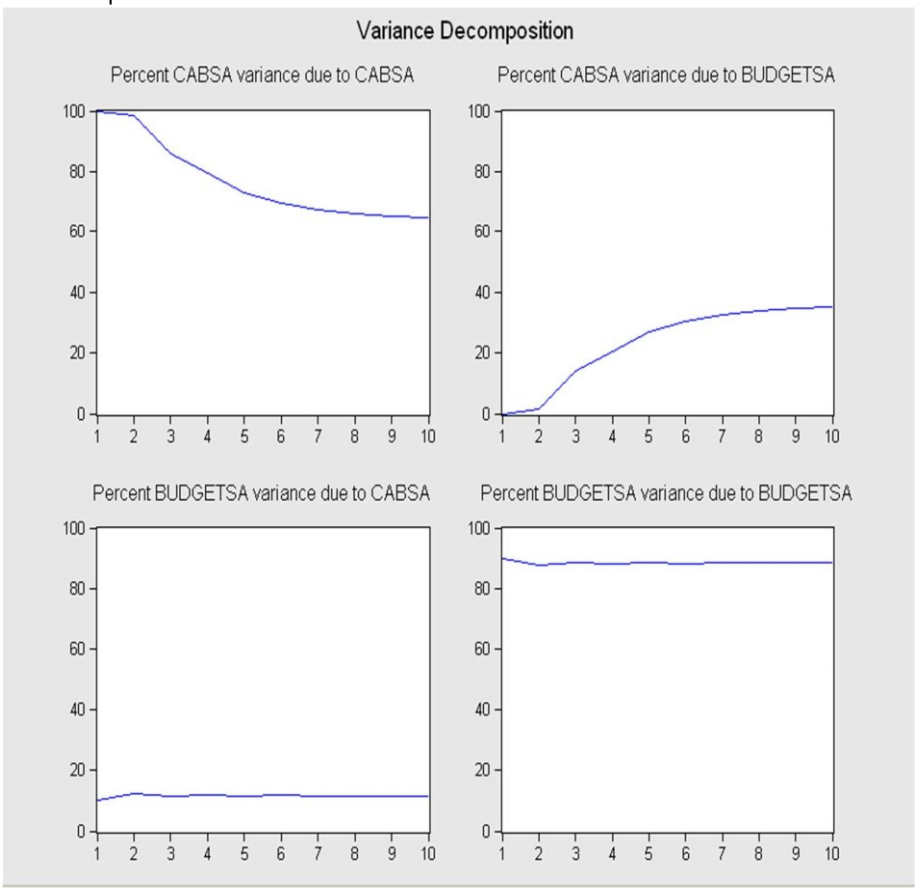
The impact of the lagged values of CABSA on itself is quite significant in the first four periods and then converges to zero (row 2 of Figure 1, lower right-hand panel).
The short-term relationship between the budget balance and the current account balance is negative, meaning that budget deficits are associated with higher rather than lower current account deficits, which is contrary to the twin deficit hypothesis. This can be explained with the fact that a budget surplus is recorded as a liability in the balance sheet of the National Bank of the Republic of North Macedonia and as such, it reduces the quantity of money in circulation. To compensate this, companies are forced to borrow money from abroad, which, in turn, worsens the trade and the current account deficit.

However, it is well established that the results of the impulse response function based on Cholesky's decomposition are generally sensitive to the ordering of the endogenous variables and the lag length. To overcome this drawback, we estimated the variance decomposition (Figure 2), taking into account both the short and long-term aspect. The variance decomposition gives information about the percentage of variation of a specific variable that can be explained by its own lagged values or other variables. We can draw interesting conclusions from the variance decomposition. The BUDGETSA variable explains 90.39% of its error in the next period

(*k* = 1), after which this percentage declines slightly, then after 5 periods it slightly increases and after 10 periods that percentage is 91.9%. CABSA therefore explains a very small portion of the variation in the prediction error of the BUDGETSA variable. On the other hand, the BUDGETSA variable in the first period does not explain the variance of the CABSA variable prediction error, but after that, that share increases significantly and at the end of the tenth period it reaches 56.61% of the variation of the CABSA variable forecast error. These results comply with the results of the Granger causality test for the causal link between the budget and the current account deficit.

Figure 2

Decomposition of the variance of BUDGETSA and CABSA variables



Source: Author's own calculations

The fact that at least one of the time series data was not stationary allowed us to proceed with the analysis of the vector error correction model (VECM). The results of the VECM analysis are presented in Table 5.

Table 5
Vector Error Correction Model (VECM)

Cointegrating Eq:	CointEq1	
CABSA(-1)	1.000000	
BUDGETSA(-1)	1.855149	
	(0.58293)	
	[3.18246]	
C	8.026611	
Error Correction:	D(CABSA)	D(BUDGETSA)
CointEq1	-0.440552	-0.073692
	(0.10452)	(0.07988)
	[-4.21510]	[-0.92251]

Note: (standard errors in brackets); [t statistics in parentheses]
Source: Author's own calculations

The basic cointegration equation has the following form:

$$CAB = \beta BUDGETB \tag{14}$$

where CAB is the current account balance, $BUDGETB$ is the budget balance, and β is the regression coefficient. The magnitude of the β coefficient estimate in the cointegration equation can be considered as a test of the validity of the different theoretical interpretations of the relationship between the budget deficit and the current account deficit. In our case, the estimated value of the β coefficient is greater than one:

$$CAB=1.855149BUDGETB \tag{15}$$

In addition, based on the *t* statistics, it can be concluded that this coefficient is statistically significant at the level of significance of 1%. The magnitude of the β coefficient does not refer to the conclusions based on the New Cambridge School hypothesis that if $\beta > 1$ the current account deficit in the long run moves in the same direction as the budget deficit. However, the current account deficit is "overreacting" as the private sector contributes to both the budget and the current account deficit. This is possible if capital inflows, i.e. current account deficits can simultaneously finance private and public sector deficits. The higher the coefficient, the stronger the effect of the budgetary position of the surplus savings relative to private sector investments. This kind of dependence implies a strong influence of the world economy on the domestic economy. However, twin deficits exist in the long run, as it is necessary to observe simultaneously the increase or decrease of both deficits (budget and current account deficit) depending on the direction of capital flows.

In order to draw precise conclusions, we have to interpret the other coefficients in the cointegration equation, i.e. α_1 and α_2 that indicate the rate of adjustment to the long-run equilibrium. The equations taking into account only error correction terms can be displayed as follows:

$$\Delta CAB_t = -0.440552(CAB_t - 1.855149\,BUDGET_t) + \ldots + u_{1t} \tag{16}$$

$$\Delta BUDGET_t = -0.073690(CAB_t - 1.855149\,BUDGET_t) + \ldots + u_{2t} \tag{17}$$

Deviations from the equilibrium equation (15) are negatively correlated with changes in the budget deficit and the current account deficit. These results point to the conclusion that the twin deficit hypothesis in Macedonia is rejected in the short run, and in the long run we can expect a positive correlation between the budget

deficit and the current account deficit in direction from budget deficit to current account deficit. These results support the hypothesis of the impact of the global economy on current account and budget deficit in the long run.

Discussion, implication and conclusion

The purpose of this paper was to explore empirically the validity of the twin deficit hypothesis in the Republic of North Macedonia for the period 2005-2017. To achieve this objective, we used actual quarterly data on Macedonia's budget and current account deficit in the period 2005Q1-2017Q4. We tested the validity of the twin deficit hypothesis by estimating a VAR model. We also performed the Granger causality test, carried out impulse response testing and variance decomposition. We also investigated the stationarity of the time series data and since one of them was not stationary, we performed a VECM analysis. Based on the Granger causality test, we found that there is a causal link between the budget deficit and the current account deficit-an increase in the budget deficit would lead to an increase in the current account deficit. The VAR model did not provide evidence in support of twin deficit hypothesis in the short run. However, based on the results of the vector error correction model (VECM) this hypothesis holds in the long run.

The obtained findings are in line with the results of previous empirical studies on the existence of twin deficit hypothesis in Macedonia (Sadiku et al., 2018 and Stojcevska and Miteski, 2016). They are also in conformity with the results of previous research of small opened economies that are highly exposed and sensitive to external price shocks (Margani and Ricciuti, 2004; Sobrino, 2013; Šuliková et al., 2014).

The results of our paper will be helpful for formulating future fiscal policy of the Republic of North Macedonia. Our finding that the twin deficit hypothesis does not hold on a short-term, indicates that in the short run the fiscal policy of the government of the Republic of North Macedonia could not affect the current account balance. On the other hand, the empirically confirmed long run link between the fiscal deficit and the current account deficit implies that the Macedonian government should focus on cutting down the non-development consumption expenditures and implementing a fiscal consolidation in the next years. This would contribute to addressing elevated government debt levels, reducing future growing external vulnerabilities and creating adequate policy space to counter future shocks, which is in line with what the International Monetary Fund has recommended to the Macedonian government. Policy initiatives should be directed not only to reducing the budget deficit, but also to improving the current account position though export promotion (supporting of export-oriented companies in order to increase their real export competitiveness) and import substitution, especially by minimizing the spending on imports of consumer goods that can be produced locally. Additionally, serious attention should also be given to encouraging domestic industry to increase production and employment. If these policies are effectively implemented, the current account balance will improve, and the budget deficit will be reduced.

In spite of the fact that our estimated model can be considered as statistically significant, the obtained results should be taken with caution, due to the relatively short time series and structural breaks in the analysed period. The latter are a result of external shocks, such as the global financial crisis of 2008 and the multiyear European sovereign debt crisis. Although the model is estimated based on reliable data sources, we should take into consideration the methodological differences in calculation of fiscal data between Macedonia and the EU member countries. The Macedonian government finance statistics is still not aligned with the EU statistics, which affects the quality of fiscal data and its comparability to EU member countries. The expansion of

the model with inclusion of other exogenous and endogenous variables could lead to other results. In this paper, we could not include other variables due to the short time series data. That is why in our future research we will expand the estimated model with other variables, such as real interest rate, exchange rate regime, and level of indebtedness (both public and external debt), economic cycle, etc. and by applying a more advanced dynamic VAR technique, such as the structural vector autoregression (SVAR) approach.

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