Measuring the determinants of the Real Effective Exchange Rate (REER) fluctuations of the Denar in North Macedonia

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Abstract

This article aims to provide an empirical approach on the impact of economic and financial indicators on the calculation of the REER of the denar (MKD) and its fluctuations. The study covers the 2010m1-2024m6 period using monthly-level data.

The empirical estimation utilises the dynamic generalised method of moments whereas its results align with the economic theory, providing important insights. The obtained results confirm that GDP, trade openness, producer prices, domestic credit, and net international investment position play significant roles in the fluctuations of the REER index. On the other hand, the net national investment position, trade openness, and producer price indices show a negative impact, depreciating the denar. Moreover, the diagnostic postestimations support the validity of the instruments.

The study contributes in economic literature with a novel REER calculation method using a broader range of deflator weights of the REER, and measuring their impact on the depreciation or appreciation of the REER index. It provides valuable insights and empirical background for future policies and national strategies in NM and in emerging economies.

Keywords: REER; Emerging economy; GMM; International finance; North Macedonia.

JEL Classifications: F30, F31, F32, F37.

Introduction

The real effective exchange rate (REER) is broadly used by economists, and as a crucial economic indicator, has gained major importance in the financial literature. It reflects the relative value of a nation's currency against a weighted average of the currencies of its major trading partners, adjusted for deflator weights. Therefore, the REER index refers to a wide range of factors within the financial sector that define its major impact in the ability of an economy to compete in a wide global market. Its impact is seen in terms of the ability to attract financial inflows in a country's economy. North Macedonia (NM) is an emerging economy, and its national currency is the Denar (MKD). An emerging economy such as NM often faces major disadvantages in the process of the internationalisation of its domestically produced goods and services in a globalized market. Hence, the REER plays an essential role in shaping its international competitiveness and influencing a country's financial inflows.

For emerging countries, the need to integrate further into the global economy becomes increasingly vital. Therefore, this objective includes understanding the relationship between REER movements and key macroeconomic outcomes, such as international trade performance, balance of payments, financial fund management, investment attractiveness, etc.

The first condition that must be fulfilled in order to become competitive in international level is the stability of the REER index of the country's currency. In this case, a depreciating REER is what's required, as it implies that the currency has weakened relative to its trading partners. In this case, the depreciated exchange rate can increase the exports and the demand for the country's domestic goods in the international markets.

Following the latest research and the background literature on this topic, this paper investigates the impact of the economic indicators on the real effective exchange rate (REER) of the Denar (MKD) in North Macedonia.

Therefore, considering the theoretical background, we can build the first null hypothesis, which says that the effective exchange rate of the Denar is influenced by major macroeconomic factors of the country, which leads to its fluctuations resulting on the appreciation or depreciation of the index.

This study provides valuable insights into the indicators that affect the mechanisms of the REER, which indicate the ability of an economy to increase its international economic importance in the international market. The analysis is important in the research field of this topic in the context of an emerging economy that is undergoing core structural reforms in order to integrate into the European trade zone and in the overall global market.

Understanding the dynamics and the major importance of the exchange rate in shaping the gains of the overall national economy and the financial inflows of emerging economies, especially of North Macedonia, this research will be an added value for policy makers to build and integrate strategies to enhance economic growth and attract the needed foreign investment, capital, and innovative technologies.

Furthermore, the findings of this study will contribute to the broader literature on exchange rate behaviour and its performance in assisting the increase of economic growth and development in emerging markets. The specific contribution that this article gives to the research literature is the inclusion of several variables and weights that impact the real exchange rate and its movements. The choice of variables is based on a combination of deflators and indicators that are mentioned in the methodology section. Moreover, the contribution of this study will be major as an empirical background for the establishment of future policies and national strategies of North Macedonia. It can also be a reference for emerging economies that are in similar conditions, such as North Macedonia.

Literature review

The real effective exchange rate has a pivotal role as it is considered an incentive of the competitiveness of every country in the international market. The REER index measures the value of a currency in relation to a basket of currencies of the trading partners. The REER index value is impacted by several indicators, including inflation and price indices.

This section summarises the theoretical background by reviewing the existing literature and empirical studies that have been conducted and presented important findings on their investigation of the relationship between the aforementioned factors, with a specific focus on an emerging economy.

The fact that is mostly emphasised by researchers is the connection between REER and exports of a country, stating that it affects the trade balance and inflation dynamics as in ((Edward, 1988) (Dornbusch, 1987) (Kenen, 1994) (Edwards, 2011) (Banerjee & Goyal, 2020) (Silva, 2015) (Meshulam & Sanfey, 2019) (Rodrik, 2008)).

Furthermore, (Aye, et al., 2013) have found that exchange rate uncertainty has a negative effect on exports, underscoring the exchange rate stability for maintaining international competitiveness. The results of (Vika & Luçi., 2011) add that both government spending and interest rate differentials, which reflect the fiscal and monetary stances respectively, do affect RER. A relaxation of either of them would lead to a real depreciation of the lek that would be reflected in higher domestic prices and/or depreciation of the nominal exchange rate. Furthermore, according to (Kulkarni & Kamaiah, 2015) policymakers can use the early warning system as the core of a larger set of variables on their radar to take pre-emptive measures to avoid crises or dampen their effects.

On the other hand, the study of (Opoku-Afari, 2004) analyses the importance of the RRER index calculation, mentioning that the fundamentals determining REER in the literature are mostly trade related and thus the CPI gives a better reflection of prices of both tradables and non-tradables. This underscores the important role played by the domestic-foreign income growth differential in driving trade flows. And the REER performs better as an indicator of external competitiveness under a floating exchange rate regime than in a fixed or pegged regime (Bassey, 2021). The study

of (Badia & Segura-Ubiergo, 2014) addresses the problem of REER appreciation and concludes that one opportunity for reducing its appreciation is to increase public savings or implement a stronger fiscal position.

Moreover, the study of (Ahmetaj & Bejtja, 2019) found that there is a long-run relationship between the real exchange rate of the Albanian lek against the euro, relative productivity, and net foreign assets in the country's economy. The empirical analysis of other studies also reveals significant relationships between the trade balance and net foreign assets, as well as between real exchange rates and the trade balance (Zhang & MacDonals, 2014). Furthermore, (Jacob, et al., 2022) found that foreign portfolio investment, foreign direct investment, the index of industrial production, interest rate, and wholesale price index have a positive impact on the exchange rate (REER).

In North Macedonia there are fewer studies that this paper would rely on, or would compare to; however, the scarcity of previous relevant studies makes this study even more important. A depreciated currency helps small enterprises in their growth and their internationalisation process, as is suggested by the study of (Hasani-Limani V & Tahiri H, 2022). Credit access represents a crucial part and a major factor in the development of micro and small enterprises also (Hasani-Limani, 2022).

The study of (Stojcevska & Miteski, 2016) analysed the relationship between trade balance and the budget balance, i.e., the twin deficit hypothesis which proved a positive result using a VAR modelling setup. Furthermore, on this topic, (Bucevska, 2020) using VAR analysis suggested that it is required to focus on reducing the budget deficit while also improving competitiveness through export promotion.

Methodology

Dataset

The data for this study are secondary in nature and have been collected from several official databases. The time period of the study includes a monthly data set from January 2010 to June 2024.

The Balance of Payments data are in millions of euros and were obtained from the Central Bank of North Macedonia. The data on the Consumer Price Index and the Industrial Production Price Index were obtained from the database of the Statistical Office of North Macedonia. Data for the Real Effective Exchange Rate Index of the Denar (REER) and data for the Net International Investment Position, External Assets, and Liabilities (NIIP) are also collected from the Central Bank of North Macedonia.

Construction of the model

Models for calculating the real exchange rate (REER) index represent a narrower concept of the price competitiveness of an economy at the international level. The effective exchange rate represents a standard measure of the price competitiveness of an economy, as well as an indicator of the international competitiveness of an economy.

The models for calculating the REER are the same in essence, but there are differences in the criteria used by the largest financial institutions, such as the Central Bank of the Republic of Macedonia, the International Monetary Fund, the European Central Bank, or the Bank for International Settlements. These differences usually include the forms of price treatment, weighting criteria, time periods, and other trade-related characteristics, which are expressed in the form of variables in the models. It cannot yet be concluded that any of the models created by the aforementioned institutions represents the ideal model for calculating the REER.

A priori defining the model of this study, we need to analyse the possible models. According to the publication of (Monetary Policy and Research Department at the National Bank of the Republic of North Macedonia., 2014), the Central Bank of the Republic of North Macedonia has decided to use the new REER calculation methodology. According to this methodology, the REER index is derived from the nominal exchange rate index (NEER) and is based on the law of one price.

According to the Central Bank of North Macedonia, the methodology for calculating the REER index is in line with that of the European Central Bank and is calculated as the weighted geometric average of the nominal bilateral exchange rates, deflated by one of the relative price indices.

$$\mathrm{REER}^t = \prod_{i=1}^{N} (d_{euro}^t * e_{i,euro}^t / d_i^t)^{w_i} \quad (1)$$

$$\mathrm{NEER}^t = \prod_{i=1}^{N} (e_{i,euro}^t)^{w_i} \quad (2)$$

Where:

N represents the number of countries - trading partners, included in the calculation;

$e_{i,euro}^t$ represents the index of the average exchange rate between the currency of the partner country *i* and the euro in the period *t*;

w_i is the weight assigned to the partner country's currency *i*;

d_i^t and d_{euro}^t are the deflators of the partner country and the euro area, respectively, in the period *t*.

This REER index calculation model uses trade weights based on exports and imports. It also uses consumer price index deflators, producer price indices, and the GDP deflator.

The second model for calculating the REER index according to (Coutinho, et al., 2021) is based on the relationship between this index and the current account of the balance of payments, implying the fact that these two indicators are often used to predict each other's moving trends. Therefore, this calculation bases the REER standards on the current account standards. This current account-based approach requires that the gap or difference between the current account in relation to the country's GDP be calculated first, as well as the current account standard in relation to GDP, both of which are related to the current account elasticity coefficient in the longer term.

$$\frac{(REER_{i,t}-REER^{*}_{i,t})}{REER^{*}_{i,t}} = \frac{ca^{adj}_{i,t}-ca^{bench}_{i,t}}{\varepsilon_{i,t}} \quad (3)$$

$$\varepsilon_{i,t} = \frac{\Delta CA_{i,t}/Y_{i,t}}{\Delta REER_{i,t}/REER_{i,t-1}} \quad (4)$$

Where:

$dca^{adj}_{i,t}$ - the difference between the current account/core GDP ratio (cyclically adjusted) at the time *t*.

$dca^{bench}_{i,t}$ - benchmark (standard) for the current account/GDP ratio.

$\varepsilon_{i,t}$ – current account elasticity in the longer term.

$\Delta CA_{i,t}$ - the change in the current account balance and

$Y_{i,t}$ represents GDP.

The National Bank of North Macedonia (NBRM, 2025) in the process of REER calculation uses several price indicators as deflators: consumer price indices, producer price indices, and unit labour costs. In this study, the analysis of the effective exchange rate of the denar includes a larger number of indicators based on the method of (Coutinho, et al., 2021) published in their study at the European Commission, which includes a considerable number of deflationary variables.

Following these theoretical and empirical foundations, in this study, the following weights are used when calculating REER: price indices (CPI), producer price indices, unit labour cost indices, GDP

deflator, GDP inflation, domestic credit in the private sector, GDP growth, trade in GDP, gross national income (GNI) growth, trade openness, and net national investment position (NIIP).

Based on the economic theoretical background, with particular emphasis on the theory of international finance, we can build the basic model according to the null hypothesis, which states that the appreciation of the effective exchange rate of the denar is affected by CPI, domestic credit to the private sector, producer price indices and GDP growth.

The model uses endogenous, dependent, as well as independent or exogenous variables/instruments. The empirical model uses the dynamic GMM method to predict the impact of the major economic factors on the effective exchange rate of the denar of North Macedonia.

The following models use empirical measurements to analyse REER movements calculation in North Macedonia.

The General Method of Moments is often utilised by authors who addressed the topic of linear and non-linear growth estimation factors, which applies in both economic and finance in studies such as: Thus, the basic model is as follows:

$$REER_{t-1} = \alpha + \beta CPI_{t-1} + \gamma TradeO_{it} + \delta Do.Credit_{it} + \varepsilon PPI_{it} + \epsilon LCI_{it} + \\ + \theta NIIP_{it} + \vartheta GDPg_{it} + \mu \quad (5)$$

Table 1. Data description

Consumer Price Index by COICOP, by month CPI	the relative prices in RNM calculated as the current month/average of the year 2010.
Industrial producer price indices; *PPI*	monthly data about the price indices of the producers in RNM. Source: State statistical office.
Labour cost indices; LCI	the index of the monthly gross wage and are gathered through the database of the state statistical office.
Domestic credit to private sector by banks (% of GDP); Do.Credit	financial resources provided to the private sector by other depository corporations. Source: World Bank. The data are published annually, and we converted it to monthly data using the interpolation command in Stata.
Trade openness; TradeO	was not published as a dataset in any of the statistical databases; therefore, we calculated it through the widely known formula in economics. We divided trade by GNI in order to find the trade openness. The data were then also converted to monthly through interpolation.

GDP growth	gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.
Net International Investment Position (EUR); NIIP	represents the international investment position (NIIP) presents the stock and structure of external financial assets and liabilities vis-à-vis non-residents based on financial instruments on a specific date. The difference between the total international financial assets and liabilities presents the net-international investment position of a country. Source: National Bank of the RNM.
Instruments:	
The GDP deflator	the ratio of GDP in current local currency to GDP in constant local currency. Source: the World Bank's databank. The data are published annually, and we converted it to monthly data using the interpolation command in Stata.
Inflation; INFL	measured by the annual growth rate of the GDP implicit deflator, which shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency. Source: the World Bank's databank. The data are published annually and we converted it to monthly data using the interpolation command in Stata.
GNI growth	represents the sum of value added by all its producers. Source: the World Bank's databank. The data are published annually and we converted it to monthly data using the interpolation command in Stata.
Trade (%of GDP)	the sum of exports and imports of goods and services measured as a share of gross domestic product. The data are also published on annual basis and we converted it to monthly data through the interpolation command in Stata. Source: World Bank national accounts data.

Source: Author

Descriptive statistics and empirical analysis

In this section of the paper, the statistical and empirical analyses of the models are elaborated. Through the obtained results, we can extract the interpretations and comments in order to justify the hypotheses presented in the first section. Therefore, through a statistical analysis of the data, we can create a preliminary overview regarding the variables we have considered in this study.

Table 2. *Summary statistics*

Variable	Obs	Mean	Std. Dev.	Min	Max
reer	174	101.739	4.04	96.14	114.54

cpi	174	98.853	4.294	92.2	105.76
ppi	174	104.995	23.754	0	141.1
lci	174	104.416	8.643	10.24	117.7
gdp	174	2.031	2.28	-4.688	4.511
do.credit	174	47.747	9.468	0	53.677
tradeo	174	-3.88	140.379	-479.155	112.641
niip	174	-5762.128	1446.583	-8622.46	-3629.54

Source: Author

In the summary statistics of the variables in the model, we have 174 observations. As shown in Table 1, the REER index has a mean of 171.7, while its minimum and maximum in the period 2010-2024 were 96.1 and 114.5, respectively. The price level index mean is 98.8, while the minimum and maximum are 92.2 and 105.7, respectively.

Results and discussion

The results from a dynamic panel data regression are obtained using a one-step GMM estimation. The detailed results are presented in Table 4.

Table 4. Results from panel-data estimation, one-step system GMM

l.reer	Coef	t-value	p-value	sig.
cpi	.738	6.16	0	***
ppi	-.085	-3.92	0	***
lci	.011	.85	.399	
gdp	.125	2.81	.006	***
do.credit	.172	3.00	.003	***
tradeo	-.004	-4.05	0	***
niip	-.004	-11.55	0	***
constant	2.22	0.15	.88	
Number of groups	160	Number of instruments	10	
AR test (1) in 1st difference (z)	-0.37	Sargan test overd. Rest, (chi2)	0.73	
AR test (1) in 1st difference, (p>z)	0.714	Sargan test overd. Rest, (p>z)	0.695	
F test	190645	F statistics, p value	0.000	

Notes: *** *p<.01,* ** *p<.05,* * *p<.1*

Source: Author

These results show a statistically significant (p-value=0) impact of CPI on the REER index of the denar. This suggests that an increase in CPI or inflation is associated with an appreciation of the REER index. Therefore, a higher inflation tends to decrease the purchasing power of the denar, but the REER can adjust to it. The negative coefficient of trade openness is -0.004, which means that it is linked to a depreciation of the REER. This can increase the demand for foreign currency and the country's competitiveness, indicating a strong significance of the variable in the model.

The positive impact of the domestic credit to the private sector is 0.72 and shows that access to credit is associated with an appreciation of the denar, indicating capital inflows and economic development.

The producer price indices show a negative impact on the REER, implying that higher prices of domestic producer prices are linked to depreciation of the denar. From an economic standpoint, it indicated that increased production costs linked with a depreciated currency can impact on reduction of international competitiveness. On the other hand, unit labour cost doesn't seem to have a significant impact on the REER index as its p-value is 0.39.

The negative net national investment position (NIIP) in the model suggests that its increase can lead to a small depreciation of the REER index. This variable shows its impact in 1% significance level. Meanwhile, GDP has a significant positive impact on REER appreciation and is in line with the economic theory that says that an economic expansion increases the exchange rate.

The overall F-test indicates that this model is statistically significant; thus, the independent variables explain a significant proportion of the REER. The Arrellano-Bond Test for Autocorrelation AR(1) shows that there is no any significant first-order autocorrelation in the first difference. The Sargan test for over-identification is 0.69, showing that the instruments in the model are valid.

Conclusion

The purpose of this research study was to offer some key insights about the impact of the major economic and financial indicators in the Real Effective Exchange Rate (REER) calculation and its movements. The objective of this research was to observe the relation of the REER with the aforementioned indicators and its important implications for international finance and competitiveness of an emerging economy, such as North Macedonia. The study covers a monthly period from January 2010 to July 2024 with secondary data from various national and international databases. The first set of analysis included the descriptive statistics where some summary statistics were performed, such as mean, standard deviation, minimum, and maximum. The matrix of correlations was intended to show the correlations between the variables in order to observe the presence of the expected correlations and to evaluate the possibility for the problem of multicollinearity. After the exact and expected answers from this analysis were extracted, we conducted the Generalised Method of Moments (GMM). The model estimations showed

meaningful results that are aligned with the economic theory. As it is shown in detail in the result discussion section, inflation, represented by CPI, impacts the REER index depreciation due to rising prices. The trade openness increases competitiveness while causing a depreciation of the denar (MKD). The domestic credit to the private sector positively impacts the REER index, indicating financial expansion and capital inflows in the country due to higher interest. The cost of producing domestic products negatively affects the real exchange rate, aligning with the theory of the price competitiveness channel. And GDP growth's positive relation shows that an economic expansion leads to a strong currency.

The overall model provides important insights, and the estimated coefficients are in line with the economic theory. It confirms that GDP, trade openness, producer prices, domestic credit, and net international investment position play significant roles in the fluctuations of the REER index. Moreover, the diagnostic postestimations support the validity of the instruments.

This study serves as a good empirical base covering the topic of the REER index in emerging countries. It can serve researchers as a fruitful and significant background for future studies. It can also be used as a reference for the establishment, for increasing the awareness of the impact of the exchange rate, in the future policy and strategy of the country to improve the balance of payments of the country.

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