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THE IMPACT OF ENERGY PRICES AND THE REAL EXCHANGE RATE ON THE TRADE BALANCE: THE CASE OF SERBIA

Abstract: The Republic of Serbia consistently records a trade balance deficit (TBD), as the value of imports exceeds the value of exports, with energy import dependency being a significant contributing factor. The aim of this paper is to examine the impact of changes in energy prices, measured by the Energy Price Index (EPI), and the real effective exchange rate (REER) on the TBD in the context of the competitiveness of the national economy. Empirical findings are based on estimated Vector Autoregression (VAR) model comprising the variables of TBD, EPI and REER in order to reveal their dynamic interdependence in the period 2009M1-2023M12 when National Bank of Serbia operates under the monetary framework of inflation targeting. It is expected that REER appreciation and EPI growth will worsen the TBD, which is supported by the results of the estimated VAR model and derived impulse response functions (IRFs). Republic of Serbia, as a small and open economy in the process of real convergence with developed European economies, is highly vulnerable to external shocks and turbulences at international market. Reducing the chronic TBD and energy dependence requires strategic investments in renewable energy sources and energy efficiency on one hand, and improving export performance via structural reforms on the other.

Keywords: energy prices, real exchange rate, trade balance, Republic of Serbia, VAR model

1. INTRODUCTION

The trade balance is a crucial indicator for identifying external (im)balance, reflecting the difference between the value of exports and the value of imports of goods and services. In the case of the Republic of Serbia, the trade balance continuously records a deficit, indicating significant dependence on imports and insufficient competitiveness of the national economy in the international market. One of the key factors contributing to this deficit is energy dependence, given that Serbia imports energy sources to a significant extent. During periods of sharp increases in global energy prices, import value rises, deepening the imbalance. The appreciation of the REER also negatively affects the external trade position. In this regard, understanding the impact of energy prices and the exchange rate on the trade balance becomes essential for shaping appropriate economic policy.

REER and energy prices represent two important determinants of the competitiveness of the domestic economy and the state of the trade balance. REER appreciation, which implies the strengthening of the domestic currency relative to the currencies of trading partners, can negatively impact export competitiveness by making domestic products more expensive on the international market. At the same time, the rise in energy prices (expressed by the Energy Price Index - EPI) increases production costs and further worsens the trade balance, especially in economies highly dependent on

energy imports. Therefore, analyzing the interdependence of these variables can provide valuable insights into the mechanisms shaping economic flows within the national economy.
The paper is structured so that, following the introductory considerations, there is a literature review (Section 2) discussing EPI and REER as determinants of the trade balance. Within the descriptive statistics (Section 3), these variables are analyzed in more detail from the perspective of national economic competitiveness. This is followed by the part related to the econometric analysis (Section 4), where the research results are interpreted. Finally, the paper concludes with final considerations and recommendations for economic policymakers (Section 5).

2. LITERATURE REVIEW

The study of the relationship between energy prices, exchange rates, and the trade balance is a significant topic in international economics from both a theoretical and empirical perspective (Allegret, Mignon & Sallenave, 2014; Kurtović, 2019). Due to the increasing integration of national economies with the rest of the world, developments in the international environment, crises, and external shocks spill over from the global to the national level.
One of the most significant external shocks affecting national economies is the rise in energy prices. Many countries worldwide depend on the import of oil and other energy sources. Combined with an exceptionally high level of financial integration, oil shocks become a key exogenous variable for a large number of countries participating in the global economy (Hammoudeh & Li, 2005). Energy price fluctuations have significant macroeconomic consequences, especially for countries heavily reliant on energy imports (Stojkov, Beker Pucar, Glavaški & Beljić, 2023). Oil is an essential resource in the production process, directly influencing the real economy, inflation, and the balance of payments position of oil-importing countries (Stojkov, Beker Pucar, & Sekulić, 2023). The increase in energy prices, primarily oil prices, directly affects production and transport costs, leading to rising prices of goods and services. Due to inflationary pressures (disruption of internal balance), competitiveness worsens, leading to a trade balance deficit, (threat to external balance). (Basher et al., 2015; Wesseh & Lin, 2018). Additionally, there are negative effects in the context of financial stabilization, particularly on financial markets. Given the transmission of crises from the global to the national economy, identifying triggers or external shocks is of crucial importance for economic policymakers. Changes in energy prices complicate economic policy management (Rahman & Serletis, 2010). Coordinated and countercyclical economic policy responses can mitigate the depth of crisis consequences (Beljić & Glavaški, 2021).
An important indicator of national economic competitiveness is the Effective Exchange Rate (EER), which can be nominal (NEER) or real (REER). The effective exchange rate reflects the value of the national currency relative to a basket of the most significant trading partner currencies. When calculating NEER or REER, the first step is selecting the currency basket against which the domestic currency's value will be determined. Second, EER is calculated as the weighted average of bilateral exchange rates. Accordingly, it is necessary to determine weights based on imports and exports. Import weights are calculated as the relative significance of each partner country in total imports, while determining export weights is a more complex task. Namely, when determining export weights, there are bilateral and double-weighted export schemes. The bilateral weighting approach considers only the competitiveness between the domestic economy and direct trading partners, neglecting indirect competition in third markets. In contrast, the double-weighting approach includes competition in third markets to which domestic exporters are indirectly exposed. Besides selecting the currency basket and calculation method, it is necessary to determine the base year relative to which exchange rate changes are measured (Đorđević, 2023). The difference between REER and NEER lies in the fact that REER accounts for inflation differentials between countries, making it a more relevant indicator of foreign trade competitiveness (Dhakir, Fuadah & Haji Alias, 2014).

3. DESCRIPTIVE ANALYSIS
3.1. TRADE DEFICIT AND ENERGY PRICES

The Republic of Serbia is highly dependent on its foreign trade partners and imports, making it particularly vulnerable to external shocks, supply chain disruptions, energy price volatility, and other factors. This dependence can also be confirmed by the Index of Trade Openness (ITO) presented in Figure 1, which shows a growing share of trade (the sum of imports and exports) relative to GDP, increasing from 63% in 2009 to 114% in 2023. This trend indicates a strong integration of the national economy into global trade flows.

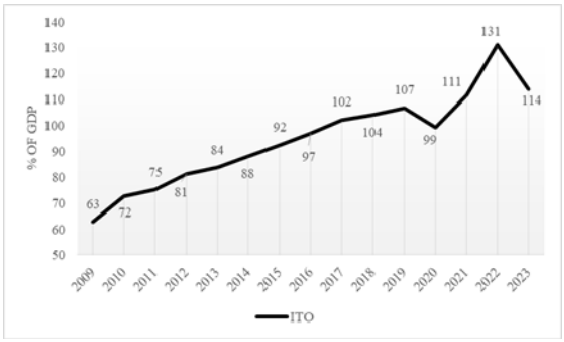

Figure 1: Index of Trade Openness
Source: Authors according to National Bank of Serbia

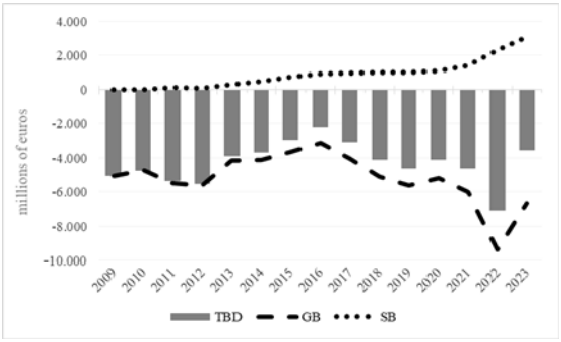

Figure 2: Trade Balance
Source: Authors according to National Bank of Serbia

The trade balance is a crucial indicator for assessing balance of payments (im)balances. The Republic of Serbia has been running a persistent trade deficit, primarily due to higher imports of goods. Figure 2 illustrates the deficit position of the trade balance (TBD) along with its components: the goods balance (GB) and the services balance (SB). During recent global crises, primarily the Pandemic and later the Geopolitical crisis, foreign trade remains unfavorable, with the negative balance deepening. The COVID-19 pandemic led to a decline in economic activity and a slowdown in global trade, yet the deficit continued to grow. A record-high deficit was recorded in 2022 with the outbreak of the Geopolitical crisis. The trend of surplus in service trade contributes to reducing the negative balance; however, it is insufficient to offset the chronic negative balance of goods trade.

To understand the trade linkages of the national economy with foreign markets and analyze the challenges related to import dependence, it is crucial to examine the structure of imports. Figure 3 presents the sectors with the highest import values, among which are: Machinery and transport equipment, Manufactured goods classified chiefly by material, Mineral fuels, lubricants and related materials, Chemicals and related products, not elsewhere specified, and Food and live animals (Statistical Office of the Republic of Serbia, 2025).

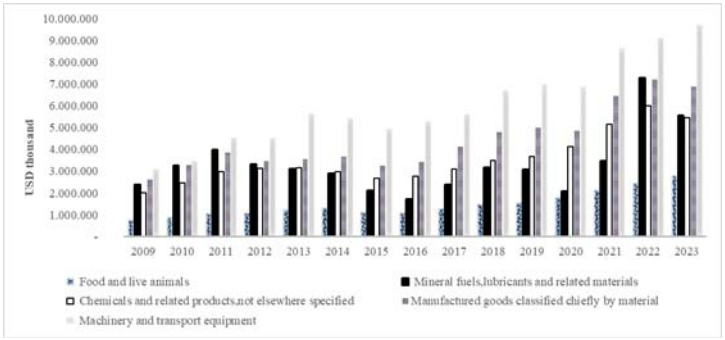

Figure 3: Value of Imports by Sector
Source: Authors according to Statistical office of the Republic of Serbia

If we direct our attention to energy sources, we can see that import value varies over the observed period depending on import volume (Figure 4) and prices (Figure 5). The energy sector holds a crucial position in Serbia's industry. Given Serbia's limited domestic reserves of oil and natural gas, the country is highly dependent on imports (Brkić, 2023). In 2020, energy imports drastically declined, which was linked to the COVID-19 pandemic and its economic consequences. Global lockdowns, border closures, and restricted international trade slowed economic activity and reduced energy consumption, especially in industry and transportation (Ćorović, Gvozdenac Urošević & Katić, 2022). The escalation of the conflict in Ukraine led to a sharp increase in energy and raw material prices, intensifying global inflationary pressures (Mathilde, Garima & Hakan, 2023). Energy prices are measured using the Energy Price Index (EPI) (Figure 5). The index rose from 67.1 in 2009 to as high as 133.8 and 299.9 in 2022 and 2023, respectively. During this period, Serbia significantly increased electricity imports, driven by internal structural issues in the power sector. It is also important to note that agricultural production requires high energy consumption. The costs of agricultural production directly or indirectly depend on energy prices: irrigation, the use of agricultural machinery, product processing, transportation, and other activities rely on oil and electricity (Kirikkaleli & Darbaz, 2021).

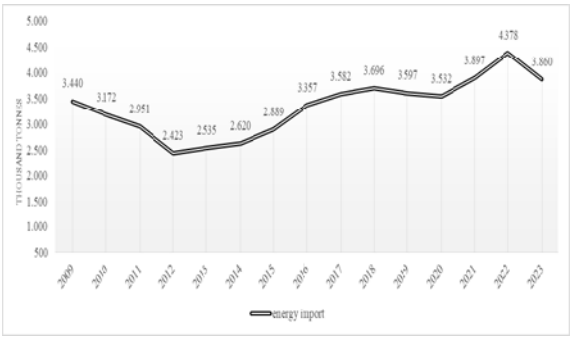

Figure 4: Import of oil
Source: Authors according to Eurostat

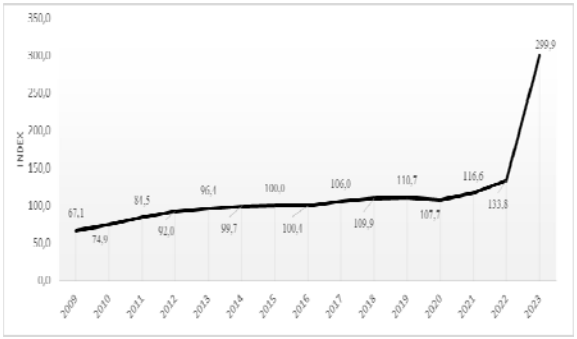

Figure 5: Energy Price Index
Source: Authors according to World Bank

The combination of rising prices, increased import volumes, and higher transportation costs has led to a record-high trade balance deficit. Countries that are more dependent on energy imports typically experience stronger inflationary pressures (Ramadani Mehmedi, 2024). A sharp increase in energy prices also triggers financial destabilization, particularly affecting financial markets (Stojkov et al., 2023).

3.2. REAL EFFECTIVE EXCHANGE RATE AS AN INDICATOR OF COMPETITIVENESS

Since the start of the transition period, the central bank of Serbia has implemented various exchange rate regimes in accordance with the challenges and objectives of the national economy. From 2000 to 2009, the exchange rate was used as a nominal anchor (fixed regime) to curb inflationary pressures (Bungin, Reljić & Ivković, 2015). Starting in 2009, the National Bank of Serbia has adopted an inflation-targeting regime and a managed floating exchange rate regime. To mitigate excessive exchange rate fluctuations of the dinar against the euro, maintain price stability, ensure financial system stability, and maintain an adequate level of foreign exchange reserves, the National Bank of Serbia conducts interventions in the foreign exchange market (National Bank of Serbia, 2008). Between 2009 and 2023, two sub-periods can be distinguished: i) *de jure* and *de facto* managed floating (2009-2017) and ii) *de jure* managed floating but *de facto* stable dinar exchange rate (2017-2023). Graph 6 presents the movement of the Nominal Exchange Rate (NER) RSD/EUR and the Real Effective Exchange Rate (REER) index (2005=100) for the period 2009M1-2023M12. An increase in NER implies a decrease in the value of the domestic currency (depreciation), while an increase in REER is interpreted conversely, as a strengthening of the national currency (appreciation). The domestic currency experienced nominal depreciation until 2017, while REER fluctuated. After that, the dinar exchange rate stabilized between 117 and 118 RSD/EUR until the end of the observed period. Notably, from 2017 onward, REER appreciated. A stronger national currency implies that domestic products become more expensive in foreign markets, making exports costlier, while foreign products become more affordable in the domestic market, thus reducing import costs. Under such conditions, exports are expected to decline, while imports rise, contributing to a trade balance deficit. It can be concluded that maintaining a stable (*de facto* fixed) exchange rate leads to an overvaluation of the national currency, REER appreciation, and a deterioration in the competitiveness of the domestic economy.

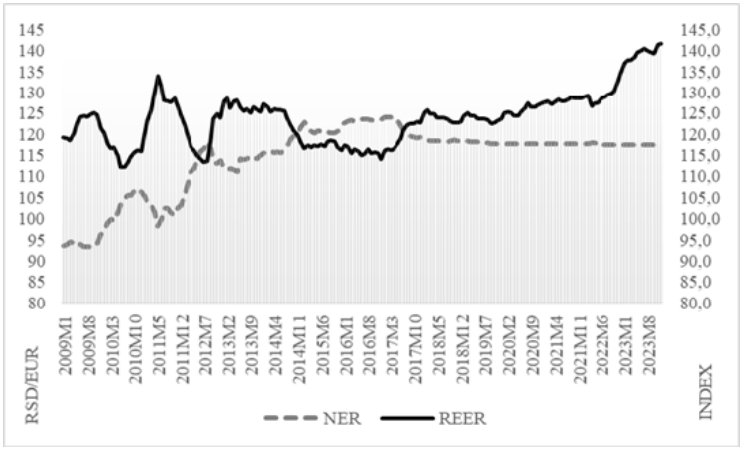

Figure 6: Nominal Exchange Rate (NER) & Real Effective Exchange Rate (REER)
Source: Authors according to National bank of Serbia

A de facto stable exchange rate does not function as a shock absorber or as a stimulus for export competitiveness. Nevertheless, it serves as a nominal anchor due to the "fear of floating" and "fear of inflation," which is characteristic of more vulnerable economies. Under such circumstances, monetary authorities prevent the depreciation of the domestic currency (Beker Pucar, 2020). The escalation of the Pandemic and Geopolitical crises has brought strong inflationary pressures as a result of rising food and energy prices on a global scale. Given the nature of these inflationary pressures, a significant number of countries are also experiencing stagflationary pressures, characterized by a combination of inflation and recession (Pejčić, Sekulić & Glavaški, 2024).The vulnerability of the domestic economy to external shocks and the spillover of global crises into the national economy are key reasons for using the exchange rate as a nominal anchor. This is based on the fact that further depreciation of the dinar would exacerbate inflationary pressures (Bungin, Reljić & Ivković, 2015).

4. ECONOMETRIC ANALYSIS

This study applies Time Series Analysis (TSA) to examine the interdependence between the Energy Price Index (EPI) and the trade balance (TBD), as well as between the Real Effective Exchange Rate (REER) and TBD. TSA analyzes a set of random variables under the assumption that they exhibit dependency or correlation. The goal is to assess the dynamic correlation between these variables over time using an appropriate mathematical model, based on pre- and post-estimation results. The econometric analysis examines EPI, REER, and TBD from January 2009 to December 2023. The analysis relies on monthly data from the World Bank (WB) and the National Bank of Serbia (NBS), as shown in Figure 7.

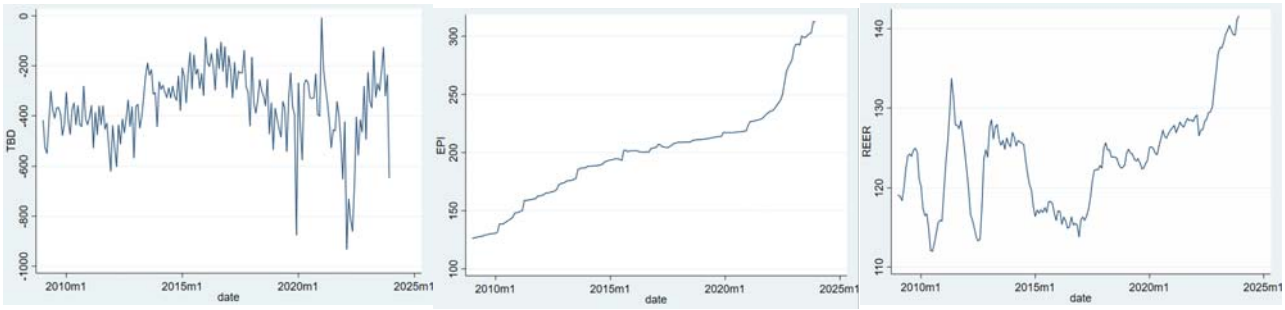

Figure 7: TBD, EPI & REER
Source: Author's research using Stata 15

The research on the interdependence of these variables is based on two hypotheses. The first hypothesis is that rising energy prices worsen the TBD (a negative relationship). Serbia is a country dependent on energy imports, and an increase in their prices raises the value of imports, leading to a higher TBD. The second hypothesis assumes that the appreciation of the REER also increases the deficit TBD (a negative relationship). In the case of an appreciation (strengthening) of the national currency, exports become more expensive, while imports become cheaper. When an economy imports more than it exports, deficit TBD is generated. Therefore, a negative relationship is expected between the increase in the EPI and TBD, as well as between the appreciation of the REER and TBD.
Informal (graphical representation, correlogram at lag 1) and formal stationarity tests (Dickey-Fuller and Phillips-Perron) reveal different levels of integration among the time series. TBD is stationary at I(0), implying a predictable movement, whereas EPI and REER are non-stationary with a single unit root I(1), indicating an unpredictable pattern over the analyzed period. However, the first differences of EPI and REER are stationary at I(0). The results of the stationarity tests are summarized in Table 1 and Table 2. When the values of the AC and PAC coefficients in the correlogram are close to 1, this indicates non-stationarity, confirming that the EPI and REER time series are non-stationary I(1), while TBD is a stationary time series I(0) (Table 1).
Since the test statistics of Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for TBD are lower than the critical values (in absolute terms), the null hypothesis (H_0) is rejected, confirming that this time series is stationary. For EPI and REER, the ADF and PP test statistics are greater than the critical values in absolute terms, meaning the null hypothesis (H_0) is accepted, indicating that these two series are non-stationary at their levels. The results of the ADF and PP tests for the first differences of EPI and REER confirm their stationarity (Table 2).

Table 1: Correlogram

CORRELOGRAM						
TBD	In the Level		p-value	At the First Differences		p-value
	AC	PAC		AC	PAC	
	0,5253	0,5372	0,0000	-	-	-
	In the Level		p-value	At the First Differences		p-value

EPI	AC	PAC		AC	PAC	
	0,9703	1,0109	0,0000	0,2552	0,2554	0,0006
REER	In the Level		p-value	At the First Differences		p-value
	AC	PAC		AC	PAC	
	0,9521	0,9963	0,0000	0,4003	0,4004	0,0000

Source: Authors based on Stata 15.

Table 2: Results of Formal Stationarity Tests

Variable / Test	ADF in the Level	ADF in the First Differences	PP in the Level	PP in the First Differences
TBD	p-value			
	0,0218	-	0,0000	-
	Test Statistic			
	-	-	-82,874	-
	-3,170	-	-7,192	-
	Critical Value (5%)			
	-	-	-13,858	-
	-2,575	-	-2,885	-
EPI	p-value			
	1,0000	0,0000	1,0000	0,0000
	Test Statistic			
	-	-	3,010	-131,002
	0,786	-7,330	1,293	-10,188
	Critical Value (5%)			
	-	-	-21,016	-13,856
	-3,440	-2,885	-3,439	-2,575
REER	p-value			
	0,3723	0,0000	0,6648	0,0000
	Test Statistic			
	-	-	-5,206	-106,530
	-1,816	-5,278	-1,220	-8,677
	Critical Value (5%)			
	-	-	-13,860	-13,860
	-2,885	-2,885	-2,885	-2,885

Source: Authors based on Stata 15.

The continuation of the empirical research involves applying the VAR model with a prior transformation of first differences to achieve stationarity. The pre-estimation procedure for selecting the lag order in the VAR model suggests that the dynamic relationship between the time series should include three lags. The post-estimation steps indicate that the estimated VAR model is stable and that there is no serial correlation. The derived impulse response functions enable an analysis of the impact of EPI and REER shocks on TBD over a six-month period in this specific case.

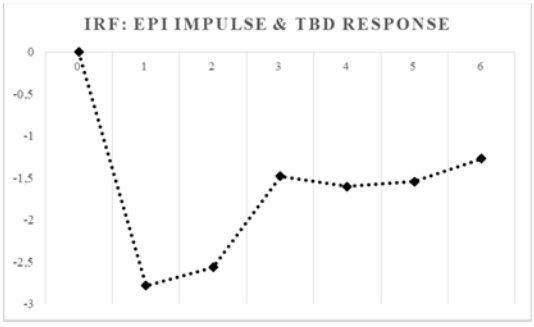

Figure 8: IRF: EPI & TBD
Source: Authors' estimations

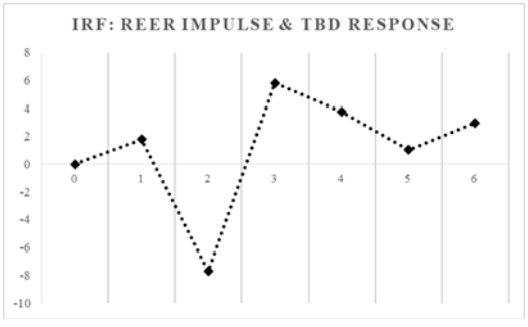

Figure 9: IRF: REER & TBD
Source: Author's estimations

Graph 8 illustrates the impact of an EPI shock (increase in energy prices) on the TBD. The impulse response function (IRF) confirms a negative relationship between these two variables over a six-month period. A shock on the EPI side (increase) leads to a sharp TBD deficit in the first and second months. The effect gradually weakens by the end of the observed period. Graph 9 presents empirical findings regarding the impact of REER appreciation on trade balance

growth. After an initial decline (deterioration) in the trade balance position, a gradual adjustment occurs over a six-month period.

5. CONCLUDING REMARKS

The fundamental trade balance deficit is a problem characteristic of developing countries, including the Republic of Serbia, on its path to real convergence with the developed economies of Europe. An analysis of trade openness confirms Serbia's increasing integration into global economic flows but also highlights its vulnerability to external shocks. During the observed period from 2009 to 2023, the trade deficit remained persistent, with a record-high deficit in 2022, which can be linked to rising energy prices in the global market and an increase in import value. These factors underscore the importance of energy policy and the need for a strategic reduction in energy import dependency.

The exchange rate policy has significant implications for the trade balance. With the shift in monetary strategy, the National Bank of Serbia has applied a managed floating exchange rate regime and inflation targeting since 2009. There is a noticeable period of *de jure* and *de facto* managed floating between 2009 and 2017, followed by a period of *de jure* managed floating and *de facto* stable exchange rate from 2017 until the end of the observation period. The appreciation of the real effective exchange rate, resulting from nominal stability, combined with higher inflation in Serbia compared to its main trading partners, reduces the price competitiveness of domestic products in foreign markets, further deepening the trade deficit.

The empirical research results confirm a negative relationship between rising energy prices and the trade balance, as well as a negative relationship between real exchange rate appreciation and the trade balance in terms of increasing the deficit. These findings emphasize the importance of adjusting exchange rate and trade policies to mitigate negative effects. Given the identified challenges, Serbia's economic policy should focus on reducing structural imbalances in trade. Diversifying the export structure and increasing the share of products with higher added value are key factors for the long-term sustainability of the trade balance. At the same time, the energy strategy should prioritize expanding renewable energy capacities and improving energy efficiency to reduce import dependency.

Furthermore, the results indicate the need for greater exchange rate flexibility to enhance the competitiveness of the domestic economy. In this context, the coordination of monetary and trade policies plays a crucial role in achieving macroeconomic stability and increasing the economy's resilience to global shocks.

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