National Bank of the Republic of Macedonia

MONETARY POLICY AND RESEARCH DEPARTMENT

Information on the changes to the methodology for calculating the real effective exchange rate of the Denar (REER)

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1. Introduction

The indicators of international competitiveness of the economy are such measures that attract numerous discussions. This stems from the fact that competition can be viewed from many aspects, such as product quality, innovation ability, the capacity to quickly adapt to the needs and demands of the market or the absence of restrictions on the labor market. Typically, different competitiveness of the economies is seen through the prism of price competitiveness and in terms of the structural competitiveness (differences in technology and production capacity). This analysis focuses on the **price competitiveness** as a narrower concept, i.e. the **real effective exchange rate (REER)**, as a standard measure of change in the price competitiveness of an economy and a commonly used indicator of international competitiveness.

Despite the same essence of the calculations of the REER used worldwide, there are numerous differences arising from the treatment of relative prices, selection of the weighting criterion and its time variation, the inclusion of third market competition etc. In other words, although the REER is a relatively narrow concept of competitiveness, it can be given a wide range of statistical forms. None of them has been treated as being the ideal solution so far, and different approaches to measurement may show a different picture about the competitiveness of the economy.

Given the significance of the REER statistics as a starting point in determining whether a country's currency is overestimated or underestimated, a constantly hot topic in the field of statistics is how to measure properly the movement of one currency against other currencies. Given that the exchange rate is of high importance to the economy, its measurement is subject to continuous improvement. In this context, the NBRM made certain changes in the calculation of this important indicator for the Macedonian economy, aimed at its modernization and opening up a possibility to observe the price competitiveness from various points of view. Emphasis is placed on the choice of currencies and weights for calculation of the index, as key aspects in the construction of the REER indices. Consequently, several measures of the REER index of the Denar for the Macedonian economy have been calculated.

2. Brief review of the more important methodological aspects of the calculation of NEER and REER

The index of the nominal effective exchange rate is a statistical measure that compares the exchange rate of an economy with the exchange rates of its trading partners, i.e. economies with which it has trade relations. It is calculated on the basis of a weighted basket of currencies, where the weights are determined according to the purpose for which the index is used.

The construction of the NEER is associated with several important aspects:
- The choice of countries and currencies,
- The choice of the base period,
- Determination of the weights.

In theory, all convertible currencies and all currencies of countries with which trade is conducted should be included in the calculation of the index. Of course, this is not always feasible in practice, and therefore it is usually insisted that the currencies (countries) included in the calculation represent a larger share of total trade. It is also recommended the currencies of countries with very high inflation not to be included in the calculation of NEER, because they can dominate the movement of NEER, even in circumstances when their participation is very low, and thus create an unrealistic picture about the movement of the domestic currency and competitiveness. Also, the choice of countries depends not only on their importance in the total trade of an economy, but also on the availability of data, and primarily on whether there are high quality data on the price indicators for a particular country, that would later be used in the calculation of REER.

When selecting the base period for determining the weights, several important arguments need to be considered. The base period should adequately reflect (cover) the latest developments, which means it should be of relatively recent period. In this context, it is necessary to have it periodically updated, every 4-5 years at the most, in order to maintain "realistic" weights. If the structure of the foreign trade of a country is subject to frequent changes, updating should be made in a shorter time interval. Also, the base period may include several years (as the average of the period).

The most problematic part of the NEER calculation is the determination of weights. Many central banks use *bilateral trade weights* for calculation of the indices, derived from the bilateral trade relations with the countries that are trading partners. Deriving of the shares depends on the purpose of the index and on what it should show and measure. Thus, the shares can be derived from the total foreign trade or just the trade in industrial goods; the shares can be derived from the total exports or, if we want to perceive the competitive position of the domestic market, then the shares can be derived from the total imports. However, the index calculated on the basis of bilaterally derived weights is considered an incomplete measure of competitiveness of export markets, as it presumes that on each export market the domestic manufacturer is the only competitor, whereby it does not take into account (ignores) the competition from other exporters at the same market (so-called third market competition). Therefore, two alternative calculations for determining the weights have been developed: global weights and multilateral weights. *Global weights* are derived according to the share of each

country in the total world trade, which completely covers the effect of third markets. But on the other hand, this calculation underestimates the impact of traditional trade relations and the impact of changes in exchange rates in the neighboring countries, as it neglects the individual allocation of exports and imports common for each country. Recently, *multilateral weights* are being more frequently applied. They are designed to eliminate the disadvantages of bilateral and global weighting calculations and are based on the so-called double weighting. Namely, according to this approach, the share of the currency of country B in the NEER index of country A depends on two components:

- The share of country B in the total imports of the other countries involved in the NEER index of country A;
- The share of the exports of country A relative to the same countries.

However, a potential problem with this approach is the availability of data and the possibility of linking international with national trade statistics.

The real effective exchange rate (REER) index is calculated on the basis of an index of a nominal effective exchange rate corrected for the relative movements of the national price or cost indicators of the domestic economy and foreign economies - trading partners. The concept of measuring price competitiveness is primarily associated with the exchange of so-called differentiated goods, and does not have great relevance in the exchange of so-called homogenous goods, as on the world markets the prices of these goods from different suppliers should not deviate significantly (due to the "law of one price").

In practice, there are different *deflators* for calculating the REER: consumer price index, producer price index, the index of wholesale prices, the export price index, GDP deflator or the index of unit labor costs. The application of each of these deflators has its advantages and disadvantages. Overall, mostly used deflators are consumer prices or producer prices. The main advantage of consumer prices is the high degree of international comparability, accuracy, they are available in a short time span and on a monthly basis. However, they are not the most appropriate approximation when it comes to tradable goods (they cover goods and services that are non-tradable) and are influenced by changes in indirect taxes, subsidies, and even price controls. Producer prices and wholesale prices more closely reflect the changes in the tradable goods, they are available on monthly basis, but they largely contain prices of raw materials, semi-commodities and other imported goods, and their structure varies considerably from country to country because of differences in coverage or different data quality. Export prices have significant shortcomings and are rarely used, primarily because they are unit values and as such are not real price indices, and because of the different structure of exports they vary considerably from country to country. Similar is the criticism about the use of the GDP deflator, and additionally, it is available with a greater time lag because it is derived from the national accounts statistics. A growing number of countries use the unit labor costs as deflators to calculate the REER, because of the relative simplicity in statistical terms and their availability, with mostly comparable data by countries. They cover much of the non-tradable costs, which may significantly vary from country to country, reflecting changes in productivity. But on the other hand, the insufficient precision of the labor productivity statistics is a major drawback. .

Given the different approaches that can be applied in the calculation of the REER, in terms of determining the weights and deflators, their choice should reflect the economic purpose of the

calculation, but also the availability of data. It is important to keep in mind that the common practice and the often applied calculations may be inappropriate for a given economy and for a specific purpose, so that in the preparation of the REER indices, the specifics of the particular country and/or the specific purpose should always be taken into consideration.

3. Approaches in the calculation of the REER of individual international institutions

This part of the analysis is devoted to the most commonly used reference methodologies for compiling the statistics on the real effective exchange rate of an economy. The three basic methodologies are those used by the ECB, IMF and BIS, which have a common theoretical basis, but also some differences in the way of weighting, the choice of trading partners, the choice of trade flows as a basis for the weighting process, and the choice of deflators used when calculating the price competitiveness. The spotlight is on the ECB methodology, with an additional emphasis on the more significant differences between individual methodologies.

According to the methodology of the European Central Bank for calculation of the real effective exchange rate of the euro, as an indicator of price competitiveness of the euro-zone, the REER is calculated as a weighted geometric average of the bilateral nominal exchange rates, deflated by one of the indices of the relative prices.

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

and

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

where:

- N represents the reference number of countries - trading partners, included in the calculation;
- $e^{t}_{i,euro}$ represents an 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 that is assigned to the currency of the partner country i;
- d^{t}_{i} и d^{t}_{euro} are the deflators of the partner country and the euro zone, respectively, in the period t.

Regarding the other methodological aspects, it is important to note that the calculation of the weights uses the data on foreign trade in industrial goods (*manufactured goods*), i.e. commodities classified in sectors 5 to 8 according to the Standard International Trade Classification (SITC). The choice of trading partners involved in the calculation is based on the importance of the particular country as a trading partner of the euro zone, but additional emphasis is placed also on the availability and quality of data on individual price indices of the trading partners. In accordance with these principles, ECB prepares indices with different combination of trading partners, i.e. by using two groups of partner countries, a narrower group of countries (EEA-20), which mainly includes the industrialized economies, and a wider group of countries, which additionally includes the emerging economies with significant trade links with the euro zone.

REER of the euro is calculated by using trade weights based on data on both exports and imports, excluding the data on trade within the euro zone. The import weights represent a simple share of the imports of each trading partner in the total imports of the euro zone, while export weights are calculated on the basis of dual weighting, in order to include the effect of third markets[1]. The total weight of a particular partner country is calculated as the weighted average of export and import weights. The weights are updated on a regular three-year basis.

Regarding the deflators for calculation of the relative price competitiveness, the ECB uses the consumer price index, the producer price index and the GDP deflator. Upward changes in the REER of the euro indicate that the price competitiveness of the euro-zone is reduced in relation to the particular trading partners, and respectively, suggests a real appreciation of the euro.

The methodology of the ECB is largely compatible with the methodology for calculating the REER used by the Bank for International Settlements (BIS). Both methodologies use the foreign trade of industrial goods, rather than the overall foreign trade, and there are methodological matches also in the way of calculating the export and import weights. Similarities and differences between the methodologies of the three international institutions are illustratively shown in the following table:

[1] The *effect of third markets* includes the effect of competition the exporters from the euro zone face with on the foreign markets, and that does not come from domestic companies (direct export competitiveness of the economy), but from the exporters coming from third countries (export competitiveness of third markets).

	ECB	BIS	IMF
Main flow from foreign trade	Industrial goods	Industrial goods	Industrial goods, primary commodities, services from tourism and other services
Method of weighting	Weighted average for the imports and dual weighting for the exports (including the third markets effect)	Weighted average for the imports and dual weighting for the exports (including the third markets effect)	Aggregated weight includes the weights of: - Primary commodities; - Industrial goods (including the third markets effect); - Tourism, with the participation of the individual weights in the aggregation being calculated on the basis of the importance of these components for the total foreign trade of that particular economy. The share of services (excluding tourism) is weighted with the weight of industrial goods.
Price deflators for calculating the REER	- Consumer price index (CPI) - Producer price index (PPI) - GDP deflator	Consumer price index (CPI)	Consumer price index (CPI)
Updating of the base period for the weights	Every three years, and at the time of any enlargement of the Eurozone	Every three years	The update is not performed on a regular basis

4. Previous methodology for calculating the real effective exchange rate of the Denar

The calculation of the real effective exchange rate is a regular activity of the National Bank, as part of the statistical data set within the external statistics. The methodology for calculating the REER index corresponds with the methodologies used by the ECB, IMF and BIS, as relevant international methodologies. The index itself is a ratio between the nominal effective exchange rate index (NEER) and the index of relative prices.

$$REER_{g,t} = 100*(NEER_{g,t}/RP_{g,t})$$

where:

- *REER* is the index of the real effective exchange rate;
- *NEER* is the index of the nominal effective exchange rate;
- *RP* is the index of relative prices;
- *g* is the weighted geometric mean;
- *t* is the time period.

According to the previous methodology, NEER was calculated as a weighted geometric mean of the average monthly exchange rates of 12 countries, the most important trade partners of the Republic of Macedonia. In the selection of the countries - trading partners included in the calculation we applied the principle of the ECB for at least two-thirds coverage of the foreign trade, as well as the approaches of the IMF and the OECD, which recommend using a relatively wide range of currencies and countries - trading partners. Accordingly, the calculation included the most important trading partners from the group of developed countries, EU Member States, but also emerging economies. The share of the selected trading partners in the total foreign trade in 2006, the base year in the calculation, was 74%. The weights were fixed for the entire period, reflecting the structure of exports and imports by country in 2006, and were calculated on the basis of the bilateral trade flows between the domestic economy and the trading partner country. The bilateral weights are calculated according to the following formulas:

Normalized import weight: $w_i^m = S_i^m / \sum_{i=1}^{j} S_i^m$ where $S_i^m = m_i / \sum_{i=1}^{n} m_i$

Normalized export weight: $w_i^x = S_i^x / \sum_{i=1}^{j} S_i^x$ where $S_i^x = x_i / \sum_{i=1}^{n} x_i$

Normalized total weight:

$$w_i = w_i^m * [\sum_{i=1}^{n} m_i \ / (\sum_{i=1}^{n} m_i + \sum_{i=1}^{n} x_i)] \ + \ w_i^x \ * [\sum_{i=1}^{n} x_i \ / (\sum_{i=1}^{n} m_i + \sum_{i=1}^{n} x_i)]$$

- m_i represents imports from the trading partner *i*
- x_i represents exports to the trading partner *i*;
- S_i^m represents the share of the trading partner *i* in the total imports of RM;
- S_i^x represents the share of the trading partner *i* in the total exports of RM;
- j is the number of trading partners included in the calculation;
- n is the total number of countries trading partners of RM.

Accordingly,

$$NEER_{g,t} = \prod_{i=1}^{j} (NER_{i,t}/NER_{i,b})^{w_{i,b}}$$

where,

- $NER_{i,t}$ is the nominal exchange rate of the Denar expressed in the currency of the trading partner (country) *i* at time period *t*;
- $NER_{i,b}$ is the nominal exchange rate of the Denar expressed in the currency of the trading partner (country) *i* in the base year *b*;
- $w_{i,b}$ is the normalized weight of the currency of the trading partner *i* in the base year *b*;
- *b* represents the base period and the base year for calculating the weights;

The index of relative prices represents the ratio between the domestic price index and the weighted index of foreign prices in selected trading partners, and, respectively, indicates the ratio between the change in the domestic relative to foreign prices and the effect on the competitiveness of the domestic economy. In the previous methodology two price deflators were used: the consumer price index (CPI) and the producer price index (PPI). Mathematical formulation for the calculation of relative prices is the following:

$$RP_{g,t} = DP_t/\left[\prod (FP_{i,t})^{w_{i,b}}\right]$$

where,

- DP_t is the index of domestic prices in period *t*;
- $FP_{i,t}$ is the index of the foreign prices of the trading partner *i* in period *t*.

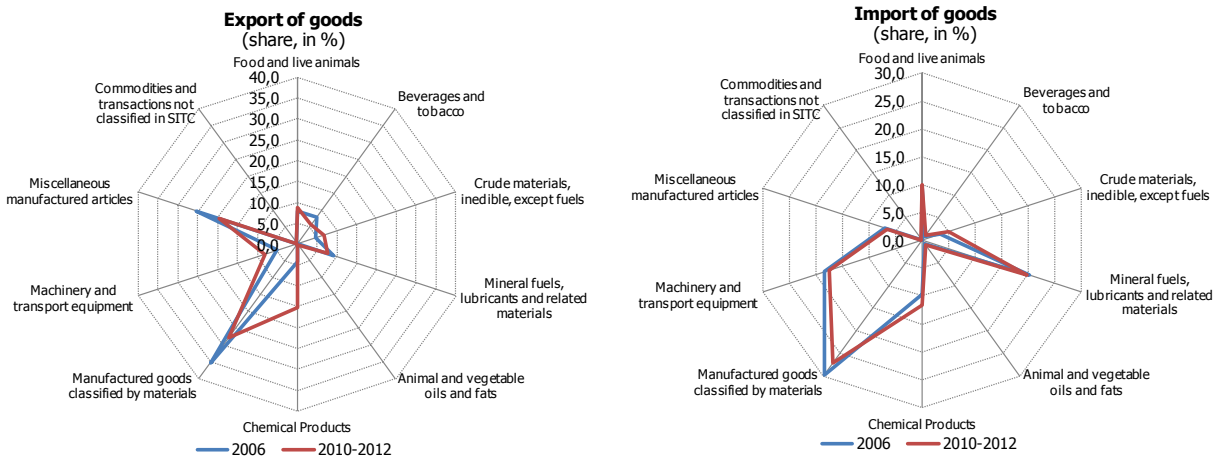
The increase in the index of the real effective exchange rate of the Denar is interpreted as appreciation of the domestic currency and reduced price competitiveness, while the downward movements of the index indicate depreciation and a corresponding increase in the competitiveness. Specifically, the level of the REER index above 100 indicates a real appreciation relative to the base period (2006), while a level lower than 100 indicates a real depreciation.

5. New calculations of the REER of the Denar

5.1. Updating the base period for the selection of currencies and weights

In recent years, significant structural changes have occurred in the foreign trade, which have an impact on the overall economic activity of the country. This process is mostly a result of the new FDI invested in existing, as well as in new activities in the economy, which contributed to a significant change in the "traditional structure" of foreign trade. Thus, **the structure of the exports of goods** includes larger share of the exports of commodities for the automotive industry (chemical commodities, machinery and equipment) and raw materials, as opposed to the lower share of the exports of "traditional" export goods, i.e. iron and steel, clothing and textiles, beverages and tobacco and oil derivatives. On the other hand, the **imports of goods** registered an increased structural share of the imports of non-ferrous metals (platinum), chemical commodities and raw materials, at the expense of the lower share of the imports of iron and steel, machinery and equipment and miscellaneous finished products. *A more significant change in the imports* is the lower share of the import component for the metal industry, with a simultaneous increase in the import of raw materials of the companies in the free economic zones.

Figure 1
Change in the structure of exports and imports of goods



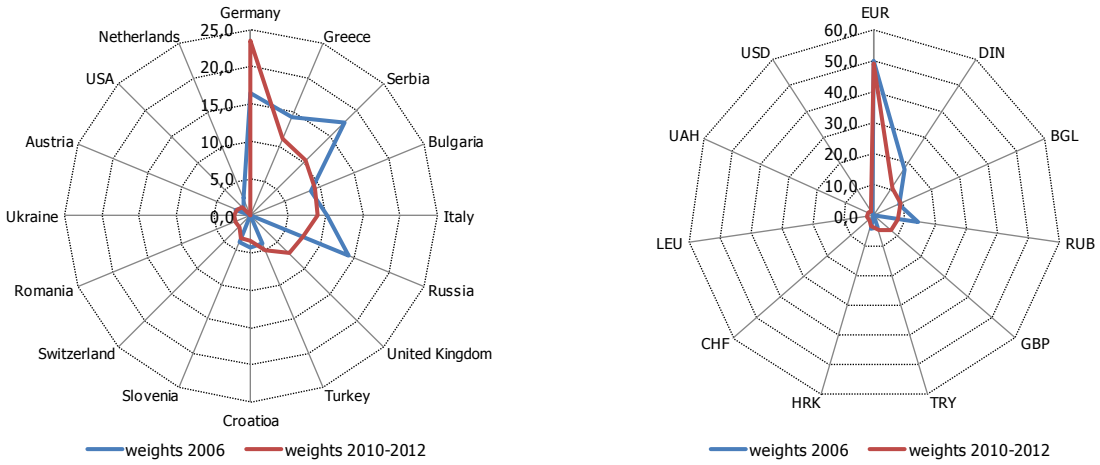
Source: NBRM.

This has imposed a need to change the ***previous methodology for calculating the REER,*** *in order to include in the calculation the latest developments and changes in the foreign trade.* The analysis showed that in the new calculations of the REER, in the selection of countries and corresponding weights it is most appropriate to use data on foreign trade in the period 2010-2012 rather than 2006, as was the case before. Analyzing the bilateral trade, 15 major trading partners were selected, representing 71.8% of the total foreign trade in the period 2010-2012. This shows a slight improvement of trade diversification, however without change in the top six most important trading partners, compared to the previous calculation.

Nevertheless, changes are noticeable in their relative shares, i.e. a significantly larger share in the trade with Germany at the expense of the reduced share of the trade in goods with Serbia, Russia and Greece. The new countries included in the new calculation of the index are: United Kingdom, Switzerland, Romania and Ukraine, while the Netherlands is excluded. Consequently, the currency basket used in calculating the NEER is also extended. Thus, beside the seven previously selected currencies, the basket is now enriched with additional four currencies (British pound sterling, Swiss franc, Romanian leu and Ukrainian hryvnia).

Previous calculation		**New calculation**	
countries	weights 2006	countries	weights 2010-2012
Serbia	17,7	Germany	23,5
Germany	16,4	Greece	11,1
Greece	14,4	Serbia	10,4
Russia	14,2	Bulgaria	9,4
Italy	10,1	Italy	8,9
Bulgaria	8,6	Russia	7,4
		United	
Croatia	4,3	Kingdom	7,2
Turkey	4	Turkey	5,0
Slovenia	3,9	Croatia	3,3
Netherlands	2,6	Slovenia	3,3
Austria	2,2	Switzerland	2,2
USA	1,4	Romania	2,2
		Ukraine	2,2
		Austria	2,1
		USA	1,7
% of total trade	*73,6*	*% of total trade*	*71,8*
Basket of currencies			
EUR	49,7	EUR	48,9
DIN	17,6	DIN	10,4
RUB	14,2	BGL	9,4
BGL	8,6	RUB	7,4
HRK	4,3	GBP	7,2
TRY	4,1	TRY	5,0
USD	1,4	HRK	3,3
		CHF	2,2
		LEU	2,2
		UAH	2,2
		USD	1,7

Figure 2
Change in the selected countries and in the currency basket

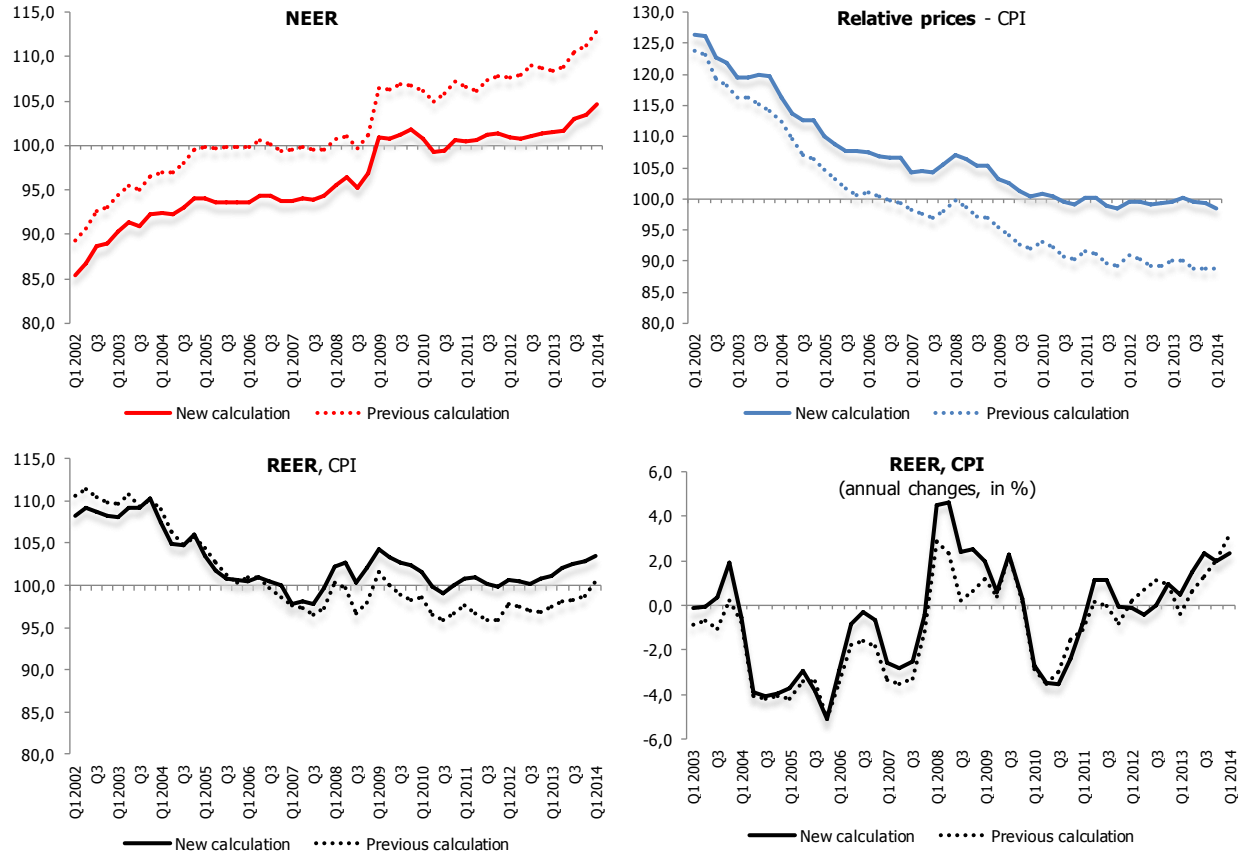


Source: NBRM.

With respect to the base year, the new methodology of REER uses year 2010 as the base period for calculating the indices, rather than year 2006, used in accordance with the previous methodology. There are several reasons for this change, the most important of which are: calculation with a period closer to the current period and compliance with international statistics, which switched to the base 2010, thus reducing the need for additional calculations for the purpose of re-basing the source data, by individual countries. In the new methodology of the REER index, as in the previous methodology, the NEER index is deflated by the consumer price index and the producer price index.

In general, the analysis of REER calculated according to the new and according to the previous methodology does not indicate major differences in the movements of the indices. The figure presenting NEER and REER based on the consumer price index calculated in this way, shows lower appreciation of the NEER, especially in the last period. On average, in the period between Q1 2002 - Q1 2014, according to the new calculation, the NEER appreciated by 1.5%, compared to the appreciation of 1.7% according to the previous methodology. On the other hand, the new relative prices show less favorable changes relative to the previous calculation. As a result of these developments, the new REER shows less improvement in the price competitiveness compared with the previous calculation. On average, during the analyzed period, REER calculated according to the new methodology depreciated by 0.5%, compared with the depreciation of the previously calculated REER of 1.1%.

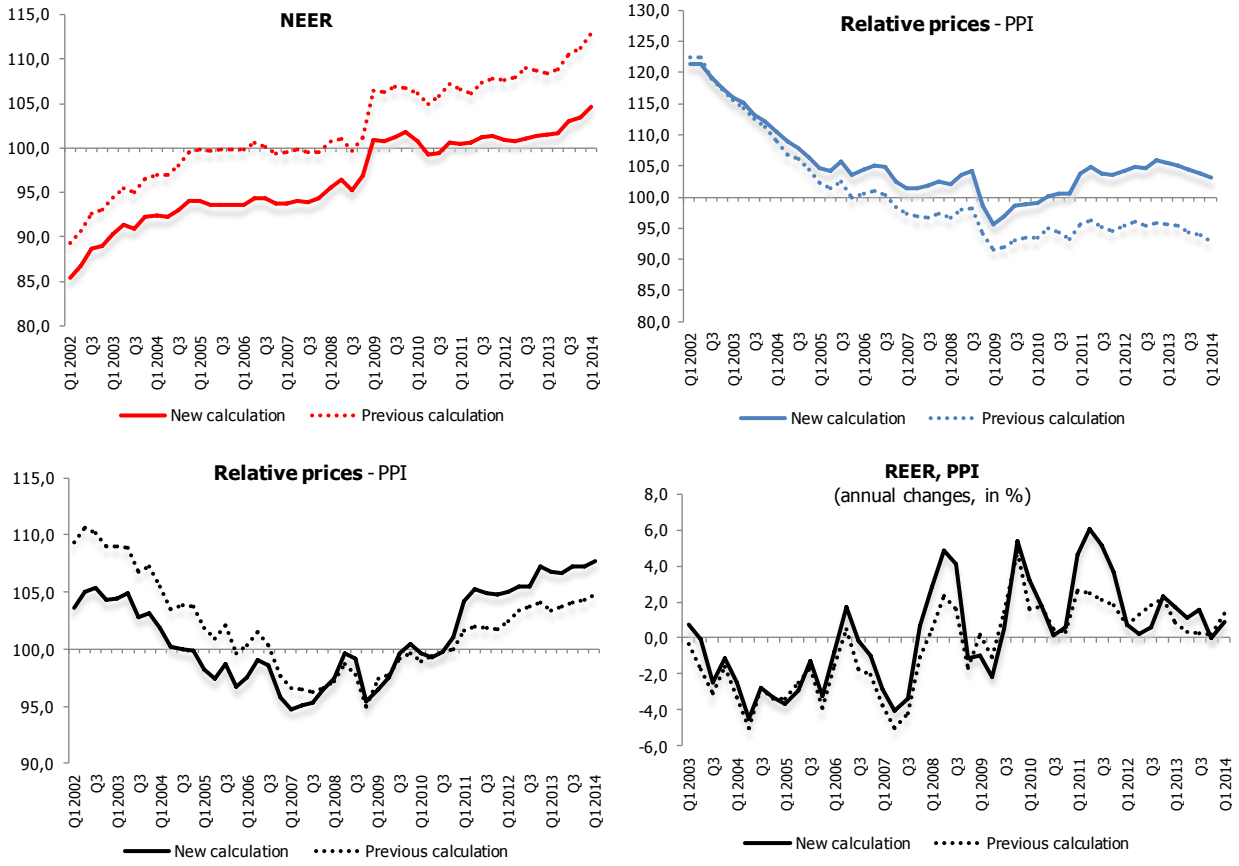
Figure 3
Comparison of REER based on the consumer prices - previous and new calculation



Source: NBRM.

The new methodology of *REER based on the producer price index* shows minimal appreciation as opposed to the slight depreciation under the previous methodology. With the new method of calculation, the slight improvement in the relative prices is not sufficient to cover the NEER appreciation entirely. On average, in the period between Q1 2002 - Q1 2014, REER calculated according to the new methodology appreciated minimally by 0.3%, contrary to the average depreciation of the previously calculated REER of 0.4%.

Figure 4
Comparison of REER based on the producer prices - previous and new calculation



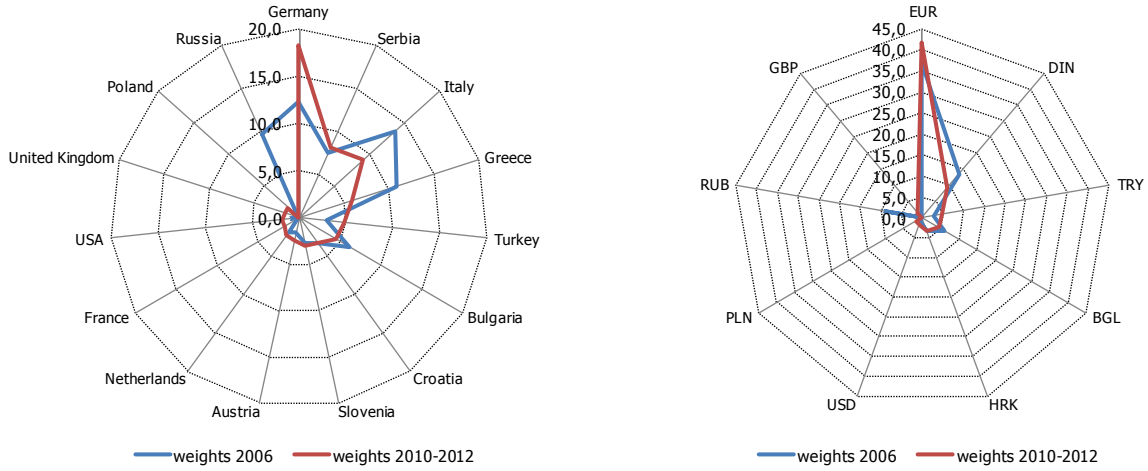
Source: NBRM.

5.2 REER index with updated base period for the selection of currencies and weights and with the primary (homogeneous) commodities excluded from the calculation

Previous calculation		New calculation, without primary commodities	
countries	weights 2006	countries	weights 2010-2012
Serbia	13,6	Germany	18,3
Germany	12,2	Serbia	9,2
Greece	10,8	Italy	8,1
Russia	9,7	Greece	5,9
Italy	7,6	Turkey	4,8
Bulgaria	6,2	Bulgaria	4,5
Croatia	3,3	Croatia	3,2
Turkey	2,9	Slovenia	3,0
Slovenia	2,8	Austria	2,5
Netherlands	1,9	Netherlands	2,2
Austria	1,6	France	1,8
USA	1,0	USA	1,8
		Poland	1,5
		United Kingdom	1,5
% of total trade	*73,6*	*% of total trade*	*68,4*
Basket of currencies			
EUR	36,9	EUR	41,8
DIN	13,6	DIN	9,2
RUB	9,7	TRY	4,8
BGL	6,2	BGL	4,5
HRK	3,3	HRK	3,2
TRY	2,9	USD	1,8
USD	1,0	GBP	1,5
		PLN	1,5

A specific feature of the structure of the Macedonian foreign trade is the large portion of exported and imported raw materials and primary commodities. The prices of these so-called "homogeneous" goods mainly result from the supply and demand on the world markets, and hence the producer prices do not differ much from those of their competitors. Therefore these goods register rapid price convergence. Consequently, changes in the exchange rates do not affect the price of these commodities (unless it is a country that is dominant in the relevant market). ***For these reasons, and primarily for analytical purposes, a new additional calculation of the REER was made that does not take into account the trade in these commodities.*** Raw materials and primary commodities that are excluded from the calculation include: crude oil and oil derivatives, iron and steel, ores and imported raw materials for the new industrial companies in the free economic zones. The weights are again derived from the period 2010-2012, with 2010 as the base year for the indices. The countries selected in this way are a little more diversified than according to the previous methodology and comprise 68.4% of the total foreign trade (versus the previous 73.6%). Added to the new calculation are France, United Kingdom and Poland, while the only country excluded is Russia. Consequently, the number of currencies in the basket used in calculating the NEER is slightly increased, and the composition of the basket is different. Thus the basket comprises eight currencies (versus the seven currencies in the previous calculation), excluding the Russian ruble, while including the British pound sterling and the Polish zloty.

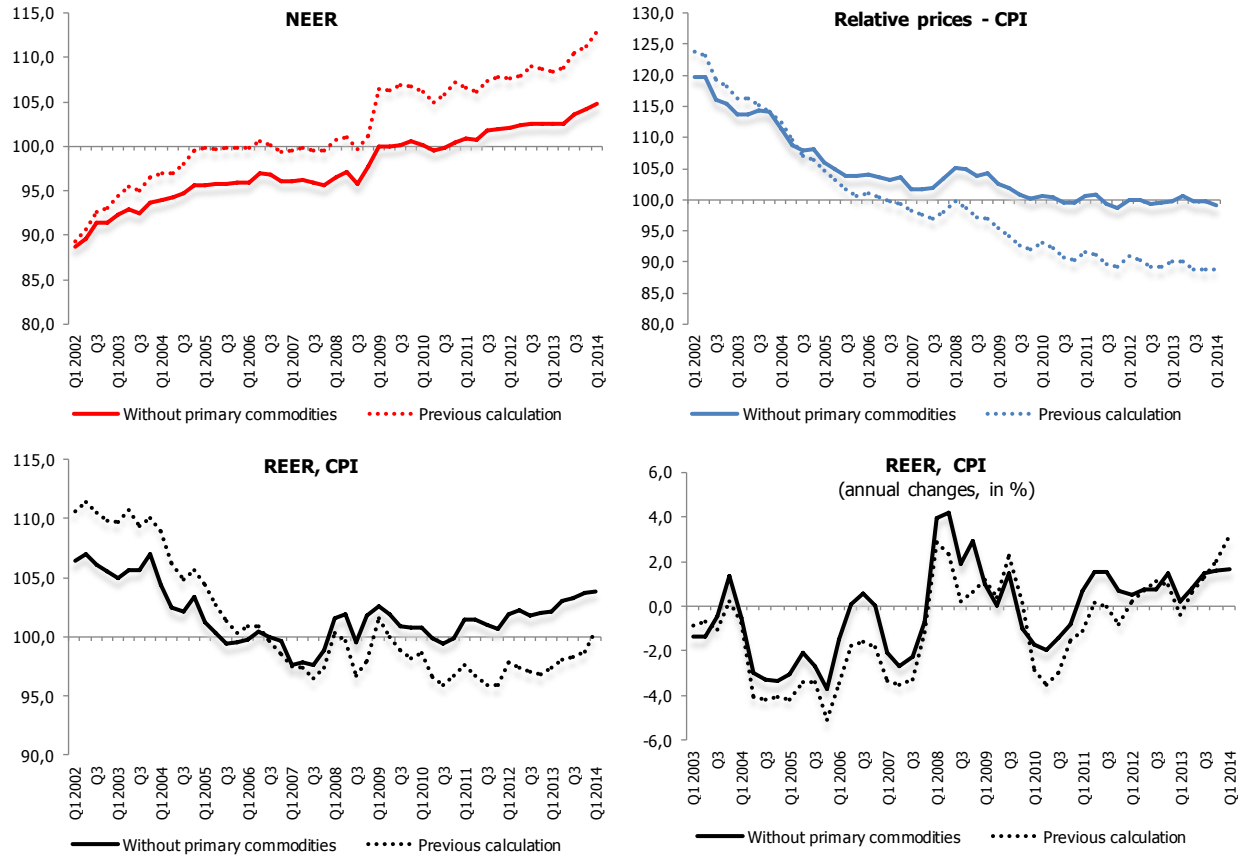
Figure 5
Change in the selected countries and in the currency basket



Source: NBRM.

In general, the analysis of REER calculated in this way (without primary commodities) and the previous methodology do not suggest major differences in the movements of the indices. The figure presenting NEER and REER based on the consumer price index calculated in this way, shows lower appreciation of the NEER, especially in the last period. On average, in the period between Q1 2002 - Q1 2014, according to this calculation, the NEER appreciated by 1.3% as opposed to the appreciation of 1.7% according to the previous methodology. On the other hand, the new relative prices show less favorable changes relative to the previous methodology. As a result of these developments, the new REER shows less improvement in the price competitiveness compared with the previous calculation. On average, during the analyzed period, REER calculated according to the new methodology depreciated minimally, by 0.2%, compared with the depreciation of the previously calculated REER of 1%.

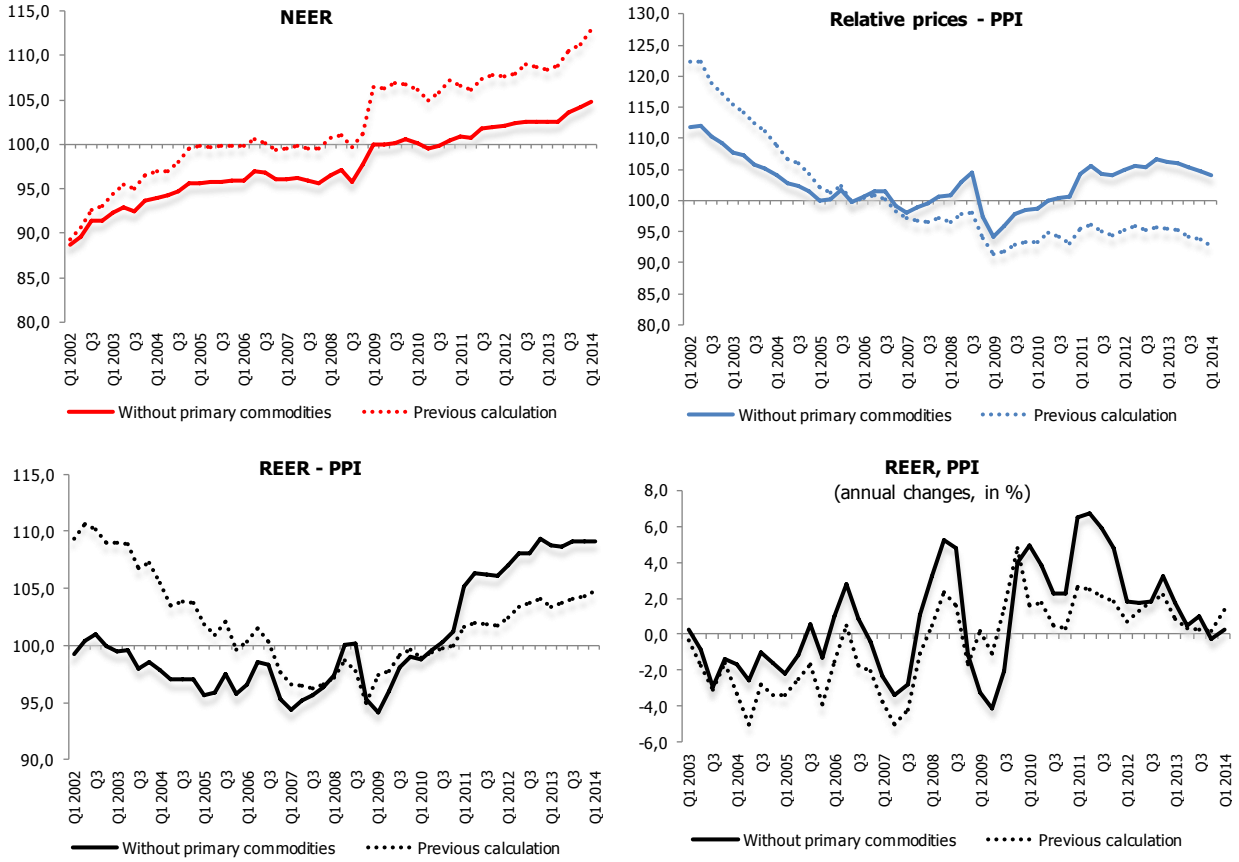
Figure 6
Comparison of REER based on consumer prices - previous methodology and new calculation excluding primary commodities



Source: NBRM.

The calculation of the REER (excluding primary commodities) based on the producer price index shows appreciation, compared with the slight depreciation according to the previous methodology. With this method of calculation, the significantly lesser improvement in the relative prices is not sufficient to cover the lower appreciation of NEER entirely. On average, in the period between Q1 2002 - Q1 2014, REER calculated according to the new methodology appreciated by 0.8%, contrary to the average depreciation of the previously calculated REER of 0.4%.

Figure 7
Comparison of REER based on producer prices - previous methodology and new calculation excluding primary commodities



Source: NBRM.