Effective exchange rate methodology in the NBS

Introduction

Nominal effective exchange rate (NEER) is a weighted average of bilateral exchange rates of a country to its relevant trading partners. Real effective exchange rate (REER) is represented by a weighted average of relative prices (measured in CPI (consumer prices), PPI (industrial producers prices), PPI-manufacturing (manufacturing prices) or ULC (unit labour costs) as an example) in domestic economy and trading partners economies denominated in single currency. In the NBS the effective exchange rate serves as an indicator of domestic producers competitiveness development in relation to its most significant trading partners. In order to obtain an objective and up-to-date view on this development, the effective exchange has to reflect the changes in foreign trade territorial structure resulting from the gradual transformation of slovak economy, its EU and EMU membership, and from the globalisation process.

The aim of this paper is to describe the methodology used for the nominal and real effective exchange rate compilation in the NBS. The following content of the paper consists of the description of Slovakia's relevant trading partners selection process and their weights computation in chapter 1, reference to the sources and methods used in the input database creation in chapter 2, and finally explanation of the NEER and REER indices computation in chapter 3.

1. Trading partners selection and their corresponding weights

The first step in effective exchange rate compilation is the selection of relevant trading partners. A certain balance between the sufficient coverage of foreign trade and efficiency has to be found.

The evaluation of Slovakia's individual trading partners significance is based on the annual data covering slovak foreign trade territorial structure in 1997 – 2008 from the OECD database[1]. Foreign trade turnover with Slovakia in individual years was calculated for each country. Only exports and imports in sections 5-8 SITC (Standard International Trade Classification) were taken into account: Chemicals and related products, Manufactured goods, Machinery and transport equipment, Miscellaneous manufactured articles. The properties of these goods differ depending on the country of origin, therefore their prices are different and can be compared using the effective exchange rate. Goods belonging to sections 0-4 and 9 (Food and live animals, Beverages and tobacco, Crude materials, Minerals fuels, Oils and fats, Others) were excluded, because their prices are approximately equal on the world market without any dependence on the country of origin and therefore do not reflect the development of price competitiveness of individual countries.

Each selected country had to fulfil the condition to achieve at least 2 % average share on slovak foreign trade turnover in 1997 – 2008. Following countries sorted by significance

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[1] Errors, that occurred in the OECD database in 2004 in the form of higher sum of exports or imports over all countries than the total export or import of Slovakia, were caused by double values in the case of USA, France and Norway in comparison to the Statistical office of the Slovak Republic data. Therefore these values were substituted with the data from the Statistical office of the Slovak Republic.

have fulfilled this condition: **Germany, Czech Republic, Italy, France, Austria, Poland, Hungary, United Kingdom, United States, Netherlands, Belgium, Spain, Russian Federation** and **China**. **Korea** was added to the selection due to the strong growth of its foreign trade with Slovakia in 2003 – 2008. After the selection the shares of above mentioned trading partners were normalised in order to sum up to 1. Weights of the 15 selected countries w_i, that are necessary for the effective exchange rate computation, were obtained in the process.

$$w_i = \frac{X_i + M_i}{\sum_{i=1}^{15}(X_i + M_i)}$$

w_i – weight of trading partner i
X_i – export of goods belonging to sections 5 – 8 SITC from Slovakia to country i
M_i – import of goods belonging to sections 5 – 8 SITC from country i to Slovakia

2. Exchange rates and price indicators data sources

Bilateral exchange rates of domestic currency to the currencies of relevant trading partners and price indicators for individual countries (CPI, PPI, PPI-manufacturing and ULC) represent the input data in the NEER and REER compilation. There is an intention to use data from a single source (bilateral exchange rates from the NBS or from ECB after Slovakia became EMU member and price indices from the OECD database) that should ensure better comparability of individual indicator categories between selected countries. In order to construct the effective exchange rates for the whole history of Slovakia existence it was necessary to complete the database from additional sources and to approximate missing data.

The bilateral exchange rates of domestic currency to the currencies of relevant trading partners are needed for the computation of both the nominal and real effective exchange rate. The NBS is the source of the majority of bilateral exchange rates data. In the case, when the exchange rate of a country (Czech Republic, Poland, Hungary, Russian Federation, China and Korea) was not published by the NBS in the past, it was calculated as a cross rate from the SKK/USD exchange rate and the exchange rate of the particular country to USD obtained from the OECD database. In the case, when a country entered the EMU, the exchange rate to its currency is further calculated as a cross rate from the SKK/EUR exchange rate and its conversion rate. Similarly, after Slovakia became EMU member its exchange rate to the currencies of countries outside euro zone is calculated as a cross rate from the slovak crown conversion rate and of the particular country currency exchange rate to euro. The NBS published the exchange rates in the form of price quotation (the price of a foreign currency unit in terms of the domestic currency). The standard in effective exchange rates compilation is that an increase represents appreciation. Therefore all the bilateral exchange rates were converted to value quotation (the value of the domestic currency unit in terms of a foreign currency). Monthly data on exchange rates were aggregated using geometric average independent on the quotation form in order to compute effective exchange rate on quarterly basis[2].

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[2] Brodsky, D. (1982), "Arithmetic versus Geometric Effective Exchange Rates", in: *Weltwirtschaftliches Archiv,* 118, pp. 546-62.

Several price indicators are used in the effective exchange rate computation distinguishing by their availability and comparability between individual countries, but also by their ability to capture the changes in domestic producers competitiveness.

Consumer price index (CPI) was obtained from the OECD database (item Consumer prices - all items) for all countries on monthly basis since 1993. The time series for China was 1 month shorter, therefore it was completed using the prediction from the set of deflators provided by the ECB for the purpose of effective exchange rates calculation.

Industrial producers prices index – domestic (PPI) was obtained from the OECD database for most countries (item Domestic producer prices - Industrial Activities) on monthly basis since 1993. Missing data for Austria, Poland (1993 – 1999), Hungary, Russian Federation (1993 – 1997) and Slovakia (1993) and the complete time series for the United States were obtained from the IFS database of the IMF (item PPI / WPI or PPI % CHG. OVER PREVIOUS PERIOD in the case of Russian Federation). The time series from the database SDW of the ECB (item Producer Price Index, domestic sales, Total Industry (excluding construction)) was used in the case of France (1993 – 1994). In the case of China the data from the OECD database (item Total producer prices - Industrial Activities) for the period of 1993 – 1999 are available only on annual basis. Therefore it was necessary to interpolate[3] those data to monthly frequency. The resulting index was extended since 2000 using annual changes available in the IFS database of the IMF (item PPI / WPI % CHANGE) on monthly basis. Shorter time series for Austria (by 1 month) and China (by 5 months) were completed using the prediction from the set of deflators provided by the ECB for the purpose of effective exchange rates calculation.

Manufacturing producers prices index – domestic (PPI-manufacturing) was also obtained from the OECD database for most countries (item Domestic producer prices – Manufacturing) on monthly basis since 1993. Missing data for Poland (1993 – 1994), Hungary and Russian Federation (1993 – 1997) were approximated using the PPI dynamics obtained from the IFS database of the IMF (item PPI / WPI or PPI % CHG. OVER PREVIOUS PERIOD in the case of Russian Federation). Data for Poland (1995 – 1999) were approximated with the dynamics of manufacturing producers prices – total obtained from the OECD database (item Total producer prices - Manufacturing). Data for France (1993 – 1994), Austria (1993 – 1999) and United Kingdom (1993 – 1995) were obtained from the SDW database of the ECB (item Producer Price Index, domestic sales, MANUFACTURING). Missing data for Slovakia (1993) were completed using the dynamics obtained from the Slovstat database of the Statistical office of the Slovak Republic (item Industrial producers price indices without excise duties – Inland, Manufactured products). In the case of China the PPI-manufacturing data in the OECD database are the same as the PPI data. Therefore the PPI-manufacturing data were approximated in the same way using the PPI data described in the previous paragraph. Shorter time series for Austria (by 1 month) was again completed using the prediction from the set of deflators provided by the ECB for the purpose of effective exchange rates calculation.

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[3] Average annual data for 1992 - 2000 were assigned to the 6-th month of each year and the data between that month and the corresponding month of the next year were interpolated using constant inflation rate leading to the PPI change to the required level. Such method produces a smoother path of the index than a method maintaining the annual average with linear interpolation between years. Following application of annual changes, that are available on monthly basis since 2000, would introduce artificial seasonality to the index with piecewise (yearwise) linear path.

Unit labour costs (ULC) were obtained from the set of deflators provided by the ECB for the purpose of effective exchange rates calculation for all countries except Russian Federation. Missing data for the Czech Republic (1993 – 1995) were completed using the forecast from the same source. Data for Poland, Hungary and Slovakia (1993 – 1994) were approximated using the dynamics obtained from the SDW database of the ECB (item Unit labour cost in the manufacturing sector). Shorter time series for Poland, United Kingdom, the United States, Korea (by 1 quarter) and China (by 2 quarters) were extended using the above mentioned ECB forecast. ULC for Russian Federation were calculated as a ratio of the compensation of employees at current prices and the seasonally adjusted GDP at constant prices obtained from the OECD database (items Compensation of employees, total and Gross domestic product - output approach). The compensation of employees was seasonally adjusted using the X12 method. Missing data (1993 – 1994) were extrapolated using AR process and quadratic trend[4]. Shorter time series for Russian Federation (by 2 quarters) was extended using the approximation resulting from the geometric average of its own dynamics from the previous period and the geometric average of the remaining 15 countries dynamics from the current period. The reason for the inclusion of lagged ULC dynamics for Russian Federation into the given approximation is its higher volatility in comparison to the data for the remaining countries.

Manufacturing unit labour costs (ULC-manufacturing) were also obtained from the set of deflators provided by the ECB for the purpose of effective exchange rates calculation for all countries except Russian Federation. Missing data at the beginning of the observed period for the Czech Republic (1993 – 1995) and China (1993) were completed using the forecast from the same source. Data for Poland, Hungary and Slovakia (1993 – 1994) were approximated using the dynamics obtained from the SDW database of the ECB (item Unit labour cost in the manufacturing sector). Shorter time series for Poland, United Kingdom, the United States, Korea (by 1 quarter) Hungary and China (by 5 quarters) were extended using the above mentioned ECB forecast. ULC-manufacturing data for Russian Federation were calculated as a ratio of the compensation of employees in manufacturing at current prices and the seasonally adjusted GDP in manufacturing at constant prices obtained from the OECD database (items Compensation of employees, Manufacturing and Gross domestic product - output approach, Manufacturing). The compensation of employees in manufacturing was seasonally adjusted using the X12 method. Due to the missing data (1993 – 2002) an approximation of ULC-manufacturing was required based on the dynamics of the ULC data for the total economy. Shorter time series for Russian Federation (by 2 quarters) was extended using the average of its own lagged dynamics and the ULC-manufacturing dynamics for the remaining countries described in the previous paragraph.

3. Effective exchange rates calculation

Chained weighted geometric averages of monthly (quarterly in the case of REER based on ULC) relative changes of bilateral nominal exchange rates multiplied (in the computation of REER) by relative changes of the ratios of price indices for the domestic economy to the corresponding indicators for the individual trading partners are used to calculate the nominal or real effective exchange rate:

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[4] $ULCT = 0.047042879254 6 * @TREND^2 + 0.791991493861 * ULCT(1)$

$$REER^t = REER^{t-1} \prod_{i=1}^{15} \left(\frac{\dfrac{E_i^t P^t}{P_i^t}}{\dfrac{E_i^{t-1} P^{t-1}}{P_i^{t-1}}} \right)^{w_i^t}$$

$REER^t$ - real effective exchange rate in the current period

$REER^{t-1}$ - real effective exchange rate in the previous period

E_i^t - bilateral nominal exchange rate of domestic currency to the currency of country i in the current period in the form of value quotation (the value of the domestic currency unit in terms of a foreign currency)

E_i^{t-1} - bilateral nominal exchange rate of domestic currency to the currency of country i in the previous period

P^t - domestic price indicator (CPI, PPI, PPI-manufacturing, ULC, ULC-manufacturing) in the current period

P^{t-1} - domestic price indicator in the previous period

P_i^t - price indicator of country i in the current period

P_i^{t-1} - price indicator of country i in the previous period

w_i^t - weight of country i in the current period

The NEER dynamics equals to the weighted geometric average of the changes of bilateral nominal exchange rates to the currencies of selected 15 countries. In the case of REER after extension with the relative prices it equals to the weighted geometric average of the changes of 15 bilateral real exchange rates based on CPI, PPI, PPI-manufacturing, ULC or ULC-manufacturing. An increase of the resulting indices represents effective exchange rate appreciation. **Weights are taken from the year corresponding to the particular time point, for which the effective exchange rate is calculated. The weights are constant until 1997, because no earlier data on territorial and SITC structure of slovak foreign trade are available. Weights resulting from recently published preliminary data on slovak foreign trade structure are used in the last 2 years. Therefore the effective exchange rates for the last 2 years need to be revised regularly after the latest data publication.**

The resulting effective exchange rate indices are available since 1993 at the cost of certain approximations mentioned in the section dealing with the input data sources. Those approximations are related mostly to the countries with relatively lower weights, therefore they should not have significant impact on the direction of effective exchange rates development. As the majority of approximations were necessary in the beginning of observed period, they do not influence the current NEER and REER dynamics.

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Further information on effective exchange rate compiled in the NBS in Slovak:
http://www.nbs.sk/_img/Documents/PUBLIK/MU/MetodikaEER.pdf