Equilibrium Exchange Rates in EU New Members: Applicable for Setting the ERM II Central Parity?

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ABSTRACT

In this paper we discuss the estimation and methodology of the real equilibrium exchange rate partial equilibrium models and analyze to what extent the resulting estimates are applicable for setting the central parity prior to ERM II entry in the new EU member states. Given the uncertainty surrounding the estimates, we argue that they are informative in the sign rather than the size of the misalignment of the exchange rate, but may still serve as useful consistency checks for the decision on the setting of the central parity. We argue that policy makers should consider the estimates in their decision-making only if the real exchange rate is substantially misaligned.

Keywords: Equilibrium Exchange Rate, ERM II, EU New Member States
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1. Introduction

The equilibrium exchange rate plays an important role in modern macroeconomics. Estimating it is a challenge both for academicians and for central bankers. Recently, ten new countries became members of the European Union (EU) and are likely to join the Eurozone in the near future (see Buiter, 2004, Hochreiter and Tavlas, 2004, and de Grauwe and Schnabel, 2005 on euro adoption strategy for the EU new member states). In order to do so, they are required to spend at least two years in the exchange rate mechanism (ERM) II. One of the primary issues in this case is what level to set the exchange rate (central parity) at prior to entering the ERM II. To ensure a stable economic environment, this parity should be set close to the equilibrium exchange rate. The focus of this paper is whether central bankers can make use of equilibrium exchange rate estimates when setting this parity.

In general, estimates of the equilibrium exchange rate are useful for various closely related reasons. First, it is useful to understand whether the current exchange rate is different from its equilibrium value, as this provides information on the likely future development of the exchange rate. Second, if the authorities want to peg the value of the currency (as in the case of ERM II entry), it is useful to know the equilibrium exchange rate as precisely as possible. This is important in order to determine the optimal strategy for entering the ERM II (and consequently the euro-locking rate) and, as a by-product, to minimize the costs associated with potentially restoring equilibrium via the real sector.

In this regard, European Central Bank (2003) states that "*...the central rate should reflect the best possible assessment of the equilibrium exchange rate at the time of entry into the mechanism. This assessment should be based on a broad range of economic indicators and developments while also taking account of the market rate.*" Thus, one may ask to what extent we are able to estimate precisely the equilibrium exchange rate, and what are these indicators

that influence the dynamics of the exchange rate in the EU new Member States (NMSs). In this paper, we discuss to what extent estimates of the EER may provide a guide for setting the central parity in the ERM II.

The paper is organized as follows. In section 2, we briefly discuss the concept of the equilibrium exchange rate from both the methodological and operational points of view. Section 3 contains a brief overview of the theoretical underpinnings of equilibrium exchange rate estimation. Section 4 provides a discussion of the empirical approaches to estimating real equilibrium exchange rates. Section 5 offers some arguments on how estimates of the equilibrium level in the NMSs may (not) be used for setting the central parity. In this section, we provide some suggestions on how to discriminate between the various approaches, but we also emphasize the limitations of these approaches, i.e. the large uncertainty associated with the estimates. Section 6 concludes.

2. The Concept of the Equilibrium Exchange Rate

2.1 Equilibrium Exchange Rate Methodology

While there is abundant literature estimating the equilibrium exchange rate (EER) in the NMSs, it is actually quite difficult to define the concept of the equilibrium exchange rate appropriately, and most studies tackle this methodological issue only implicitly. Notable exceptions are the studies by Driver and Westaway (2005), Maeso-Fernandez *et al.* (2004) and MacDonald (2000).

Typically, when authors estimating the EER find that the current exchange rate is not at its equilibrium level (i.e. is misaligned), they are obviously not implying that market forces are not at work. They mean, rather, that it is reasonable to expect that the exchange rate will have

a tendency to move in a certain direction in the future. As a result, the concept of the equilibrium exchange rate goes beyond the simple truism saying that the exchange rate is always at its equilibrium value, as it is continuously determined by supply and demand in the foreign exchange market. Thus, the EER is to some extent a normative concept specifying the conditions under which the exchange rate is considered to be at its equilibrium level (Driver and Westaway, 2005).

Naturally, one may ask which factors can cause this deviation from normative equilibrium. The consensus in the contemporary exchange rate literature is that the main culprits are either barriers to cross-country commodity arbitrage due to various transaction costs, or different information sets and heterogeneous beliefs of market participants (Sarno and Taylor, 2002). Apparently, while the former is more a medium-run issue, the latter is much more oriented toward the short term.

Therefore, an additional aspect of the EER is its time horizon. It may happen that the exchange rate is fairly valued at one time horizon, but misaligned at others. Typically, the exchange rate can be misaligned in the short run, reflecting the different opinions of market participants about the prospects of the FX market. Some studies claim that the current exchange rate in catching-up economies is largely fairly valued at the medium-term horizon (for example, Égert, 2003). However, it is still expected that some real exchange rate appreciation may occur in the long term, as purchasing power parity will hold to a large extent in the very long run. Therefore, it is necessary to understand the time horizon of the estimated EER when drawing policy conclusions. For our purposes, with some level of simplification, one may distinguish between short-term, medium-term and long-term equilibrium.

Williamson (1983) defines short-term equilibrium as the one prevailing if the market is fully informed and rational. Second, medium-term equilibrium is defined as being when the economy is at internal and external balance (Driver and Westaway, 2005). Internal balance may be defined in terms of a zero output gap and inflation at the target level, while external balance can be thought of as sustainable net flows of resources between countries when in internal balance. Thus, this equilibrium is of special relevance for policy makers. Third, long-term equilibrium is defined as being when stock-flow equilibrium is achieved and thus changes in asset stocks are zero.

2.2 Operational Aspects of the Equilibrium Exchange Rate

Besides the difficulties of defining the equilibrium level of the real exchange rate at the methodological level, there are also operational issues. In order to calculate the real exchange rate (RER)[1], a measure of the domestic and foreign price level is required. For the domestic price level, one may generally use the consumer price index (CPI), the producer price index (PPI), the GDP deflator or unit labor costs. The same holds for the foreign price level. For the effective exchange rate, an additional caveat is to specify which countries' price levels (and nominal exchange rates) should be considered for the calculation. Typically, one may select the price level of the nation's main trading partner or construct an "artificial" foreign price level as a weighted average, where the weights are given typically in terms of the volume of bilateral trade.

If the various measures of price levels record substantially different developments (e.g. a rising PPI and a stagnating CPI), it typically leads to different conclusions about the magnitude of exchange rate misalignment. As a result, it is advisable to use more than one

RER measure in order to examine the robustness of the results to various specifications.[2] Obviously, if a country explicitly targets inflation in terms of the yearly change in its CPI, a CPI-based RER might be preferable for the policy decision-making process. Ideally, one would like to construct the real exchange rate using the price levels in tradable sectors, so as to capture the competitiveness of the economy to the greatest possible extent. Such an effort is presented in Sarno and Chowdhury (2003).[3] Lipschitz and MacDonald (1991) discuss the pros and cons of various price indexes for assessing competitiveness in greater detail.

Once the current real exchange rate and real equilibrium exchange rate (REER) have been defined, the difference between the two is interpreted as the exchange rate misalignment (disparity or disequilibrium, alternatively). The literature also distinguishes between so-called actual and total misalignment.[4] Both actual misalignment and total misalignment are the difference between the actual and fitted values of the RER. However, total misalignment uses the equilibrium values of the explanatory variables rather than their actual values (as is the case for calculating actual misalignment) to determine the misalignment. Theoretically, the results for total misalignment are more consistent than those for actual misalignment, as the former disentangles the equilibrium state from the actual conditions. Nevertheless, in practice there is great uncertainty, especially in (former) transition economies, about the equilibrium values of the fundamentals affecting the exchange rate. As a result, this uncertainty may be transmitted into the estimate of the misalignment. In other words, this problem may have an effect on the estimated size of the misalignment. An additional caveat is that increasing the number of explanatory variables may lead to a smaller estimated actual misalignment (but not necessarily total misalignment).

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[1] RER=NER.P*/P, where NER is the nominal exchange rate, P* is the foreign price level and P is the domestic price level.
[2] Similar operational issues arise for the explanatory variables (fundamental determinants).
[3] Interestingly, Sarno and Chowdhury (2003) find that the real exchange rate reverts to its equilibrium value faster if it is based on tradable sector price levels, as compared to the CPI-based real exchange rate.

In addition, researchers tend to use several univariate filters such as the Hodrick–Prescott filter (HP) in order to estimate the equilibrium trend in the fundamentals.[5] It is known that these filters suffer from so-called "end-point bias". As a result, the current estimated value of the misalignment is biased as well.

In addition, for considerations about setting the central parity for ERM II, one may need an estimate of the nominal equilibrium exchange rate (NEER) rather than the REER. However, equilibrium exchange rate models typically use the real exchange rate (the monetary model being the exception, see Crespo-Cuaresma, Fidrmuc and MacDonald, 2005). Therefore, it is necessary to recalculate the NEER from the REER. To do this, some estimate of equilibrium domestic and foreign inflation rates is needed. In the case of an inflation-targeting country, the targeted inflation level may be considered the equilibrium one. Nevertheless, if actual inflation differs from the target for a long period of time, it is advisable to consider actual inflation for calculating the NEER as well. Calculation of the NEER is critical if inflation rates differ substantially. However, the benefits of recalculating the NEER from the REER are rather limited where the actual inflation rate is typically low (as is the case in the Czech Republic), as the inflation differential with respect to the country's main trading partners is generally small.

3. Theoretical Foundations of Equilibrium Exchange Rate Estimations

In this section we provide a short description of the main theoretical underpinnings of REER partial equilibrium models.[6]

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[4] See, for example, Babetskii and Égert (2005) for this application.
[5] See Canova (1998) on the limitations of the univariate methods in general.
[6] A detailed description of the general equilibrium models is beyond the scope of this paper. For more thorough surveys of the theoretical aspects of the REER, see Driver and Westaway (2005), Égert (2003) or MacDonald

The basic modeling approach is purchasing power parity (PPP). The so-called absolute version of this approach states that the foreign and domestic price level should expressed in the same currency to the nominal exchange rate in order to eliminate cross-country commodity arbitrage.[7] Thus, the PPP is supposed to determine the long-term nominal exchange rate. However, the PPP may not hold for a number of reasons, such as different consumer and production patterns (reflected in different consumer baskets), the extent of non-tradable goods, imperfect competition, and pricing to market (Égert, 2003, p. 40). Additionally, the PPP is not particularly suited to analysis of countries at different stages of economic development. Less developed countries tend to have cheaper non-tradable products and often exhibit trend appreciation of their real exchange rates, as described by the Balassa–Samuelson effect. Notably, this appreciation may be a medium-term or long-term equilibrium phenomenon. It is also noteworthy that the appreciation may also be caused by improvements in goods quality or price deregulation.

For policy purposes, it is useful to work with medium-term REER models, as they largely match the monetary policy target horizon. Typically, the models link the exchange rate (the nominal exchange rate, the real exchange rate or the real effective exchange rate) to a number of fundamentals. The choice of fundamentals is based on various theories, as mentioned above; nevertheless, some fundamentals are added to the list of potential explanatory variables in an ad hoc way. We list the major approaches below and describe them in brief. It is noteworthy that some of the approaches are quite similar to each other.

3.1 Main Partial Equilibrium Approaches to Estimating the Medium-term REER

(2001). Driver and Westaway (2005, p.20) provide a table summarizing the various empirical approaches to estimating the REER.

BEER

BEER stands for Behavioral Exchange Rate, a concept developed by MacDonald (1997) and Clark and MacDonald (1998). The approach is based on the standard UIP condition. The expected inflation differential is subtracted from this condition. As a result, the real exchange rate is linked to the expected real exchange rate, the real interest rate differential and the risk premium. Furthermore, it is assumed that the risk premium depends on domestic and foreign government debt. The expected real exchange rate is a function of fundamentals in the long run. Typically, it is assumed that the list of fundamentals that affect the real exchange rate are as follows: the terms of trade, the Balassa–Samuelson effect (the ratio of non-tradable to tradable prices) and net foreign assets. To summarize the BEER approach, the real exchange rate depends on the real interest rate, the ratio of domestic to foreign government debt, the terms of trade, the Balassa–Samuelson effect and net foreign assets.

Obviously, the BEER is rather a statistical approach which is meant to link the real exchange rate to a set of macroeconomic variables in a single equation setting. The choice of the fundamentals is to some extent ad hoc, as the underlying theory gives relatively large room in terms of which fundamentals will be included in the model. The fitted value of the estimated equation, which may be derived either on the basis of observed series or using long-term values of the fundamentals, represents the estimated equilibrium exchange rate. Examples of the application of the BEER approach to the NMSs include Babetskii and Égert (2005), Csajbók (2003), Komárek and Melecký (2005), and Rubaszek (2004).

CHEER

CHEER stands for Capital-enhanced Equilibrium Exchange Rate and builds on the PPP condition. This approach states that the exchange rate is determined by the nominal interest

[7] Alternatively, the relative version states that prices and the exchange rate should move in such a direction that

rate differential (UIP condition) and relative prices (PPP condition) in the medium term. As Driver and Westaway (2005) note, the implicit assumption of the CHEER is that the interest rate differential vanishes in the long run and the exchange rate is determined in line with PPP.

FEER

FEER is an abbreviation of Fundamental Equilibrium Exchange Rate. The approach focuses on finding out which real exchange rate would be likely to emerge if the economy were in internal and external equilibrium simultaneously. The variant of the FEER used by the IMF is the DEER, which stands for the desired equilibrium exchange rate. The DEER is an alternative to the FEER to some extent. This approach conditions the REER on optimal fiscal policy instead of focusing on current account sustainability.

In its simplest version, it is assumed that the current account is influenced by domestic and foreign potential output and the real effective exchange rate. The model is then solved for the real effective exchange rate, which is a function of domestic and foreign potential output and the sustainable current account. The current account is modeled by export and import equations. The approach also hinges on judgment about the sustainable net external debt. Typically, the FEER estimates are derived from large-scale macroeconometric models or partial trade blocks of the given economy.

Recent examples of the FEER applied to the NMSs include Šmídková, Barrell and Holland (2002), Csajbók (2003) and Égert and Lahrèche-Révil (2003). Labeling their approach as SRER – sustainable real exchange rate, Bulíř and Šmídková (2005) enrich the FEER concept by assigning a special role to foreign direct investment i.e. that of determining factor behind the real exchange rate appreciation in the NMSs.

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the absolute PPP will hold over the longer term.

ITMEER

ITMEER is an abbreviation of Intermediate-term Model-based Equilibrium Exchange Rate. This approach has been put forward by Wadhwani (1999). As opposed to the CHEER, this approach also models the risk premium in nominal UIP. The risk premium is assumed to be influenced by two factors: the return on other assets (such as stocks and bonds) and the deviation from equilibrium. The latter is assumed to be affected by the relative current accounts (normalized by GDP), relative unemployment, relative net foreign assets to GDP and the relative ratio of producer to consumer prices. As a result, the exchange rate is linked to relative interest rates, the return on assets, the current account, unemployment, net foreign assets and the producer to consumer price ratio.

Macroeconomic balance

The macroeconomic balance approach is a variant of the FEER. To circumvent the normativity of the FEER, this approach, which has been honed and widely used by the IMF, estimates directly the sustainable level of current account deficits (surpluses) based on the saving and investment balance (see MacDonald, 2000, p. 41). This approach has been applied to the selected NMSs in Csajbók (2003) and Rubaszek (2004).

Monetary model

The monetary model focuses on the short-term or medium-term determination of the exchange rate. It states that the exchange rate is influenced by both the goods and asset markets. The model assumes the standard money demand function (in both countries, as the model typically comprises two countries), i.e. the ratio of money to prices is a function of output and interest rates. Furthermore, it is assumed that money demand and money supply

are equal for both countries at any moment in time. The exchange rate is linked to the domestic and foreign price level and fully reflects the purchasing power parity (PPP) condition. Combining these assumptions, it is simple to show that the exchange rate is determined by the ratio (or difference, if the data are in logarithms) between domestic and foreign money supply, output and interest rates.

Certainly, the assumption of PPP is often too restrictive. Therefore, the literature typically introduces the Balassa–Samuelson effect. Namely, it is assumed that the overall price level is a weighted average of tradable and non-tradable prices, and PPP holds only in the tradable sector. Combining this decomposition of the price level and tradable-based PPP in the original monetary model, it is easy to show that the exchange rate is now determined by the difference between domestic and foreign money supply, output and interest rates and by the difference between the domestic and foreign "Balassa–Samuelson effect". This effect is defined in the standard way as the difference between non-tradable and tradable prices. The study of Crespo-Cuaresma, Fidrmuc and MacDonald (2005) is an example of a recent application of the monetary model to several currencies in the NMSs.

NATREX

NATREX is short for Natural Real Exchange Rate. The NATREX, as proposed by Stein and Allen (1995), builds on the relationships between investment, savings and the current account. The approach assumes that while savings are largely influenced by the rate of time preference and net foreign assets, investment depends on Tobin's 'q'. The latter is a function of the capital stock, productivity and the real exchange rate. The model is then solved for the real exchange rate. Csajbók (2003) and Frait and Komárek (2001) are examples of the NATREX approach applied to NMSs.

PEER

PEER stands for Permanent Equilibrium Exchange Rate. The PEER is similar to the BEER approach, but disentangles the permanent and transitory components of the fundamentals. Thus, when calculating misalignment it imposes that all fundamentals are at their steady state, which is achieved by the statistical technique of Gonzalo and Granger (1995). Komárek and Melecký (2005), Rahn (2003) and Rubaszek (2004) are recent examples of the application of the PEER approach to the NMSs.

Typically, the aforementioned models are relatively simple to estimate, but there are some pitfalls associated with their theoretical underpinnings. The models are primarily of a macroeconomic nature and lack sound microeconomic foundations (as opposed to recent stochastic dynamic general equilibrium models) and also do not identify the nature of shocks (as in the structural vector autoregressive – SVAR – models applied to study the sources of exchange rate fluctuations[8]). These models also assume that the exchange rate is endogenous to the fundamentals; in fact, however, the exchange rate affects the fundamentals as well. Indeed, there is some evidence that the exchange rate may be a shock generator rather than a shock absorber, as these models typically assume. In this respect, Borghijs and Kuijs (2004) find that all the exchange rates in Central Europe have served as propagators of financial and monetary shocks rather than as shock absorbers.

4. Empirical Methods for Estimating the Equilibrium Exchange Rate

In this section we briefly discuss the empirical methods used to estimate the equilibrium exchange rate. Specifically, we discuss the econometric techniques applied and the pros and cons of these techniques for EER estimation.

4.1 Methodology

First, an important expert-based judgment is made about the sample length[9] and the number of countries to be included in the estimation. Basically, the analytical methods can be classified into several groups (as described in Maeso-Fernandez *et al.*, 2004): country-by-country analysis, cross section analysis and panel data analysis. Panel data analysis may be further classified into the so-called "in-sample" and "out-of-sample" approaches. We discuss each classification successively.

The advantage of country-by-country analysis is that it can take country specificity fully into account. Nevertheless, the time series is rather short in this case, and this may substantially influence the power of the statistical tests. An additional problem arises from the possibility that the exchange rate was largely undervalued at the outset of the transition (Halpern and Wyplosz, 1997). This undervaluation was associated with the lack of market forces at work, in particular widespread price regulation. One way of tackling this issue empirically is to control for the overall economic reform efforts, assuming a positive correlation between the lack of reform at the outset of the transition and the size of the initial undervaluation of the exchange rate. If the undervaluation is not accounted for properly, the constant term will be biased in the estimated reduced-form equations. As a result, the estimate of exchange rate misalignment will be biased. In the case of trend appreciation of the RER, the overvaluation of the currency would seem larger than it actually is (see Maeso-Fernandez *et al.*, 2004).

Next, several authors apply cross-sectional analysis. The benefit of cross-sectional analysis is that it simply eliminates the likely presence of structural breaks in the time series of a

[8] See Clarida and Galí (1994) or Detken *et al.* (2002).
[9] On the one hand, a greater sample length increases the number of observations and improves inference, but on the other hand it increases the probability of structural breaks in the data sample. Ignoring structural breaks is likely to lead to bias in the misalignment estimation. Sometimes, data quality may also affect the choice of sample.

transition economy. Typically, the authors estimate the exchange rate misalignment as the difference between the PPP exchange rate and the actual exchange rate (eventually accounting for other factors such as the role of regulated prices, the terms of trade and non-tradables prices, see Čihák and Holub, 2003). The PPP exchange rate is defined in the standard way, i.e. as the number of units of domestic currency that are needed in order to buy the same basket in the "numeraire country".

The short times series in transition countries encourage researchers to estimate the REER by employing panel data analysis. Forming a panel of countries can substantially increase the power of the statistical tests applied. Basically, there are two approaches to estimating the determinants of exchange rate fluctuations. The "in-sample" approach makes use of transition countries only (or a subset of these countries). The advantage of the "in-sample" approach lies in the fact that transition countries form a relatively homogenous group as compared to an analysis including both transition and non-transition countries.

However, if the countries are experiencing substantial structural changes in their economies, the "out-of-sample" approach is a plausible alternative (Halpern and Wyplosz, 1997). This approach estimates the equilibrium relationship between the fundamentals and the exchange rate for (a subset of) developed economies, as it is believed that largely similar structural relationships will also prevail in the transition economies in the future. Moreover, the "out-of-sample" approach overcomes weaknesses in data quality and structural breaks in time series. Next, the estimated equilibrium relation is used and the corresponding values of the fundamentals for transition countries are imputed. A resulting difference between the fitted value of the exchange rate and the actual value is interpreted again as misalignment. The apparent drawback of this approach is that even after transition countries possibly catch up in the future, the equilibrium relations between the fundamentals and the exchange rate may still

differ significantly from those of the developed countries. In other words, the sample of countries is not homogenous and the common estimated parameters are likely to be too restrictive for this reason. In addition, no constant term is available for the transition country. The constant has to be chosen in a rather ad hoc way. Maeso-Fernandez *et al.* (2004, p. 29) discuss the possible strategies for the choice of the constant term.

4.2 Econometric Estimation Methods

As the uncertainty of the EER estimates tends to be rather large, applying more econometric techniques is one way of addressing the robustness of the results. Typically, studies either calibrate a structural model or estimate the cointegrating relationships between the relevant variables in a single equation setting. In some cases, simple filtering of the data is also used.

Most simply, univariate filters on the actual real exchange rate are used to obtain a certain trend. While relatively easy to apply, the obvious disadvantage of these methods is that they do not alone have any underlying economic theory, hence it is very difficult to interpret the filtered exchange rate path as the equilibrium one. An additional drawback of these methods is that they suffer from end-point bias (e.g. the series has an exaggerated influence on the trend at the beginning and end of the sample) and thus are unlikely to be used for determining the current exchange rate misalignment.[10] Nevertheless, the statistical approaches are simple to use and may provide some additional consistency checks of the results of more advanced models based on economic theory.

A more plausible way of estimating the EER is to apply cointegration analysis. Several cointegration techniques have recently been developed and widely applied to estimating the EER. Cointegration techniques are particularly suited for single equation models such as the

BEER or PEER. Babetskii and Égert (2005) and Komárek and Melecký (2005) are recent examples of the application of cointegration for examining the EER for the Czech economy. Typically, the authors use several cointegration methods, such as the autoregressive distributed lag (ARDL), dynamic ordinary least squares (DOLS), fully modified ordinary least squares (FM-OLS), Engle–Granger and Johansen techniques. It is beyond the scope of this paper to discuss the pros and cons of these techniques. Importantly, Égert and Halpern (2005), using meta-regression analysis, find that the econometric method may actually affect the estimated size of the misalignment. In addition, the cointegration model should be parsimonious, as it is very likely that the results will not be robust with a large number of explanatory variables.

Another way of calculating the EER is to calibrate a multi-equation structural model, as is typical of the FEER and NATREX approaches (see, for example, Bulíř and Šmídková, 2005). The advantage of the calibration is that it overcomes certain drawbacks inherent in time series analysis (such as short sample length). Besides, the models typically have better theoretical underpinnings than single equation cointegration models. This is especially the case for models that build on proper microeconomic foundations. In addition, structural models may be forward-looking and provide the likely future path of the RER. Another advantage of structural models is the identification of the sources of shocks. On the other hand, it seems that there is great uncertainty about the particular parameters used for the calibration, and this may substantially influence the misalignment estimate.

5. Are EER Estimates Useful for Setting the Central Parity?

In this section, we discuss what properties the REER estimates should ideally have in order to provide some clues about the "optimal-strategy" central parity for future ERM II

[10] One option is to widen the sample by including forecasted values. However, the success of this approach

participation.[11] To a certain extent, we also summarize some of the arguments mentioned earlier in this note.

Given the aforementioned uncertainty surrounding the estimate of the REER and the non-existence of any superior estimation method, it is necessary to provide substantial sensitivity analysis of the results. This applies to both the theoretical model and the econometric technique. Thus, the comprehensive report on the REER estimates in relation to setting the central parity should discuss results based on various models, such as the BEER, PEER and FEER. Regarding the latter, the single equation models should be estimated with up-to-date data and using various cointegration techniques, such as the ARDL, DOLS, FM-OLS, Engle–Granger and Johansen techniques. In addition, one may alternate/rotate the explanatory variables and estimate the identical model applying the same technique but with a different set of explanatory variables. Consequently, it is possible to construct the confidence interval for the mean exchange rate misalignment estimated by each model and eventually weight the size of misalignment according to their relative variability (Komárek and Melecký, 2005). An additional robustness analysis is provided by estimating both the actual and total misalignment. There are both pros and cons associated with both methods, as mentioned above. All this together provides substantial checks of the sensitivity of the results.

A comparison of the results based on various specifications provides additional insights, in particular to what extent do the confidence intervals coincide with each other, or, alternatively, why do they differ. In the next step, the results for the RER misalignment could

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crucially depends on the accuracy of the forecast.

[11] The central parity does not have to be set at the EER level, but the size of the misalignment should be taken into account. The choice of parity depends not only on the current equilibrium exchange rate, but also on the pace of real equilibrium exchange rate appreciation. In the case of positive equilibrium appreciation, the parity might be set at the "depreciated" level to cushion the potential appreciation during ERM II participation. However, it is useful to have the best possible estimate of the EER regardless of whether the parity is set at the equilibrium level or not.

be recalculated for the nominal exchange rate misalignment, as the central parity is obviously set in nominal terms.[12] The recalculation should be carried out with either the equilibrium/targeted or actual domestic and foreign inflation rates. Targeted inflation might be preferable on a theoretical basis, but actual inflation is definitively a plausible alternative for the short run.

Next, it is self-evident that the chosen theoretical models should be oriented toward the medium term. Fluctuations in the exchange rate are largely unpredictable in the short term, and models such as the standard PPP are oriented toward a horizon that is beyond the monetary policy target horizon. Besides, the definition of the REER in theoretical models should be general; it should be defined as the rate fulfilling internal and external equilibrium in the economy rather than in terms of some specific aspect such as optimal indebtedness. The estimated equations arising from these models should be parsimonious and ideally stable over time to a large extent.

An additional property of the results is that the equilibrium exchange rate should be less volatile than the actual corresponding exchange rate (under a floating exchange rate regime). This is so because the actual exchange rate volatility is temporarily influenced by the heterogeneous beliefs and different information sets of market participants.

Generally, as the result of the large uncertainty associated with the equilibrium value of the exchange rate, there are concerns about the applicability of REER models for setting the central parity.[13] This idea holds more generally as regards any monetary policy decision-making, too. The REER models seem to be more informative in terms of the sign rather than

[12] This adjustment can be omitted if the inflation differential is low.
[13] The uncertainty is amplified if one uses a theoretical model focusing on a different time horizon than that of the policy question to be analyzed.

the size of the misalignment. This leads us to believe that the resulting misalignments based on the aforementioned REER models should be largely "ignored" if they suggest that the magnitude of the exchange rate misalignment is less than 10%. Obviously, the choice of this 10% "ignorance band" reflects expert judgment regarding the various types of uncertainties inherent in the REER estimation. In our opinion, part of the parameter uncertainty is not quantifiable, thus it is very difficult to come up with any sophisticated method for deriving the size of the "ignorance band". This uncertainty is associated in particular with rather weak theoretical foundations of REER models.

Despite the aforementioned uncertainties, one may claim that if the majority of the results suggest a substantial misalignment of the exchange rate (say by more than 10%), this fact should be cautiously considered by policy makers. It would lead to some concerns about the strategy and timing of ERM II entry. In our opinion, both options, i.e. entering the ERM II with a misaligned exchange rate, or setting the central parity at a level significantly different from the market level, are too risky, as they lack credibility.

In addition, the Maastricht exchange rate criterion is in fact somewhat asymmetric (fluctuation band: -2.25% to +15%)[14], while there is also a tendency for the RER to appreciate. Meanwhile, the country opting for future Eurozone membership has to exhibit low inflation rates in order to fulfill Maastricht inflation criterion. These issues have an implication for the "ignorance" band, which is, in turn, asymmetric too. Indeed, overvaluation of the exchange rate is a greater concern in this case (Bulíř and Šmídková, 2005).

[14] See Čech, Horváth and Komárek (2003) on the institutional aspects of the ERM II.

6. Conclusions

This paper provides a description of the methodological, operational, empirical and theoretical aspects of REER partial equilibrium models. It then discusses the applicability of the estimates of the REER in relation to the setting of the central parity for the ERM II.

In general, there is relatively large uncertainty surrounding the estimates of exchange rate misalignment, and thus substantial sensitivity analysis has to be undertaken. This requires the application of various theoretical models, econometric techniques and empirical specifications.

All in all, estimating REERs is rather like trying to throw a basketball into a golf hole, as the uncertainty about confidence intervals of the estimates tends to be rather large. This leads us to believe that the estimates are informative in terms of the sign rather than the size of the misalignment. Consequently, as a rule of thumb, equilibrium exchange rate estimates should be considered in the decision on the setting of the ERM II central parity only if the majority of the estimates suggest that the exchange rate is misaligned by more than roughly 10% (although an overvaluation may get special treatment due to a perceived EER appreciation). In such case, ERM II entry is in our opinion too risky, as entering the ERM II with a misaligned exchange rate, or setting the central parity at a level significantly different from the market level, is likely to invite speculative attacks.

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