Real Exchange Rate and Real Economic Fundamentals in Transition Economy of Bosnia and Herzegovina (BH)

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Abstract: *The paper estimates Equilibrium Real Exchange Rate (ERER) using co-integration methodology to observe relationship between Real Exchange Rate (RER) and selected economic fundamental variables over two different sample periods. Time period of observation influences results and we observe change in signs and direction of relationship between fundamentals and RER suggesting that fundamentals and RER do not have a stable relationship and direction of influence. The findings suggest that RER is not a significant transmission mechanism for real economy towards achieving external balance as RER depreciation is not associated with an improvement in resource balance. Therefore, RER does not have a postulated relationship with resource balance variable. More appreciated RER is associated with an improvement in the external balance of the BH economy which is opposite of an expected role of RER depreciation in brining economy towards external equilibrium. However, pressures on RER sustainability exist due to negative resource balance. Potential disequilibria therefore could not be caught with the existing data which cover the post-war period only, and were marked by continuous negative resource balances.*

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Introduction

Evidence of nonstationarity in Real Exchange Rate (RER) was the basis of work which viewed Equilibrium Real Exchange Rate (ERER) as driven by real economic fundamentals in transition economies. Pons and Lacasta (2003) have used error correction equation and have estimated long-run cointegration equation of the ERER and the corresponding dynamic error correction specification which strongly corroborated the model and produced fairly consistent results across the countries under study. Utilizing the error correction method and corresponding dynamic error specification Omerbegovic (2005) has found similar results for Bosnia and Herzegovina (BH).

The impact of the fundamentals on the RER behavior was suggested to be dependent on the time horizon studied (Egert, 2006).

In this paper, the relationship between RER and fundamental economic variables is examined using the methodology of co-integration and error correction model as found in Omerbegovic (2005) and Omerbegovic-Arapovic (2009). The findings suggest that there are changes in direction of relationship between certain fundamental variables and RER for BH depending on the sample period under consideration. This suggests that direction of relationship between fundamentals and RER is not stable over time.

The attempt to estimate ERER from observable data on RER and economic fundamentals of BH due to existing nonstationarity in RER has resulted in estimated slight RER overvaluation in 2005, that is, before the financial and economic crisis of 2007 (Omerbegovic, 2009). Utilizing same methodology this paper finds support of undervaluation of RER in the first half of 2012. Counterfactual estimation of fundamentals in order to estimate misalignment is resulting in RER undervaluation due to the observed changed direction of relationship between the resource balance variable and RER, so that improvement in resource balance variable is associated with required appreciation in RER, opposite to postulated theoretical relationship, suggesting that RER is not a significant transmission mechanism in achieving external balance.

The findings show that estimated RER misalignment based on co-integration methodology, which uses data over the period of serious external and internal disequilibrium in economy of BH, can't be determined from observable data on

macroeconomic fundamental variables and RER behavior over the sample period, suggesting that RER misalignment in transition is difficult to detect using a time series methods. However, this does not mean that there are no pressures on RER due to fundamentals. Our findings also suggest that other factors, such as monetary phenomena should be examined as potential causes of RER nonstationarity in BH as Kanas (2009) has suggested that shifts between stationary and non-stationary epochs in RER behavior could be mainly determined by the monetary phenomena.

The paper starts by examination of RER nonstationarity by estimation of ERER of BH in order to test the hypothesis of RER misalignment in the middle of 2012 and establish the role of real fundamental variables in RER behavior. Firstly, the literature review on real exchange rate behavior and patterns of real exchange rate behavior observed in transition economies is presented. Section on methodology provides analytical framework used in calculating ERER for BH. It is followed by empirical analysis of estimation of RER misalignment in BH over the two different time horizons. The test of relationship between RER and economic fundamentals of BH extends time series analysis from Omerbegovic (2005) to examine the stability of relationship between real economic fundamentals and RER behavior enabling us to test the effect of time horizon on relationship between fundamental economic variables and RER for BH. Overall, we do not see a large explanatory power of fundamental variables in explaining RER fluctuation in the second period, which is consistent with findings of Kanas (2009) who suggests different phases of RER behavior, where RER could have entered stationary phase compared to the first period. This is followed by discussion of results and concluding remarks.

Literature Review: Equilibrium Real Exchange Rates in Transition Economies

Equilibrium Real Exchange Rate (ERER) is the real exchange rate associated with internal and external balance of the economy and the topics of equilibrium real exchange rate and exchange rate misalignment in transition economies of Central and Eastern Europe (CEE) has been widely researched due to importance of this transmission mechanism in achieving equilibrium for the countries that have started transformation process from planned to market based economies in the late 1980s and early 1990s. In other words, it is very important question whether their currencies are fairly valued at a given point in time. Various methods are used in calculating equilibrium exchange rates, which have provided very different results in terms of conclusions of relationship of fundamental economic variables and real exchange rate. However the single equation approach to determining ERER has been

identified to be applicable to determining RER misalignment both in short-run and long-run (Egert et.al., 2005)

The overview of these studies suggests that transition countries could go through the period of trend appreciation of the currency, so that during the periods of rapid change in relative economic development levels, the ERER may exhibit trending behavior. (Froot and Rogoff, 1994) It has also been observed that there is uncertainty related to fundamentals and that relationship between fundamentals and real exchange rate is not stable over time (Egert, 2006), which corroborates the argument of phases in real exchange rate behavior.

Application of single equation approach to ERER determination has been used to determine potential real exchange rate misalignment in transition countries using real exchange rate as dependent variable and explanatory variables which depend on the theoretical underpinnings of the research methodology. ERER which rests on counterfactual estimation of sustainable level of fundamentals is the basis of NATREX model in which the evolution of net foreign assets is endogenous, so that if investment rises in the open sector, capital inflows, reflected in a decline in net foreign assets, cause the real exchange rate to appreciate in the medium-term. In the long-run, when investment starts working in the open sector, the trade balance improves, resulting in an increase in net foreign assets, and producing an appreciation of the real exchange rate in the second phase. Egert, Lahreche-Revil and Lommatzsch (2003) also provide explanation that countries can have different direction of relationship between net foreign assets (resource balance) and real exchange rate due to the phase in which they are. In the catch-up process they may have a negative steady-state net foreign asset position. In other words, in the medium term, they finance their growth via foreign capital. Strong capital inflows appreciate the real exchange rate in this phase. However, once the desired long-term foreign liabilities position is attained, the countries have to start servicing their debt. Thus, for any additional increase in net foreign liabilities, the real exchange rate depreciates. The panel of transition countries examined indeed confirmed postulated appreciation associated with negative resource balance while variable was positive for OECD countries, indicating depreciation of real exchange rate associated with worsening of the resource balance, which was taken to be reflecting the long run behavior of the transition economies.

In the literature openness is associated with decreasing trade barriers, which raises imports more than exports. The deterioration in the trade balance would in this context depreciate real exchange rate. (Kim and Korhonen, 2005)

Another important factor to consider in real exchange rate behavior in transition economies is role of regulated prices, as services such as public transport, communication, energy and water supply, communal services and government services have a large share in overall economy and could have been left unchanged during price liberalization, resulting in high inflation at the outset of the transition process. According to Zavoico (1995) in setting the price of regulated sectors only operational costs were considered initially because the capital stock of the sectors concerned was inherited from the communist era and because of political considerations. Eventually, once the general price liberalization is over, the progressive replacement of the capital stock at market prices, partly through privatization, led to huge increases in regulated prices because the cost of capital had to be taken into account as well. Therefore, price increases as an adjustment due to liberalization, are an additional argument in support for trend appreciation experienced in transition economies in initial phase.

The above studies suggest that real exchange rate in transition could be going through changes in relationship between fundamentals and RER, which have important implications for policy making. RER settling in its long-term position will mean more depreciated level of RER required in order to service the debt obligations that have accumulated. There are limited studies on real exchange rate behavior in BH. In Omerbegovic (2005) real exchange rate of BH is related to fundamental variables of resource balance, openness, government consumption as share of GDP and debt over the period of 2002 to 2005, which has indicated that there was slight real exchange rate overvaluation in 2005. However, this could have been equilibrating phenomena as well.

In this paper the study of real exchange rate in BH is extended over different time periods in order to answer the question as to whether the level of real exchange rate is appropriate at this point in time. The paper also attempts to provide explanation towards the phase in which BH real exchange rate behavior is in relation to the above mentioned postulated phases in the literature for transition economies. Due to importance of this transmission mechanism in reaching external and internal balance the paper looks at the behavior of BH real exchange rate, testing stability of

relationship of fundamentals and real exchange rate over the period of 2002 to 2012 and estimating RER misalignment in middle 2012.

Methodology: The Cointegration Approach to ERER in BH

The ERER can be estimated from a single equation- relating RER and fundamentals- which is a reduced form solution of an unspecified simultaneous equation system of the theoretical models of the likes of Edwards (1989), Lim and Stein (1995), and Montiel (1999) developed in Omerbegovic Arapovic[i] (2009).

The theoretical model provides for the postulated effects of change in fundamental determinants of trade policy stance, external terms of trade, composition of government spending, sectoral productivity differentials and resource balance and ERER. The improvement in the external terms of trade, increase in productivity differential in favor of traded goods and increased government consumption of nontrade goods are expected to cause ERER appreciation. The relaxation of trade barriers and improvement of resource balance are expected to cause ERER depreciation. Adopted empirical methodology is designed to capture this long-term relationship between economic fundamentals and real exchange rate[ii].

The Empirical Model of ERER Estimation: Two Step Engle-Granger (1987) Cointegration and Error Correction Mechanism

The empirical model consistent with adopted theoretical framework for ERER estimation is consistent with Two Step Engle-Granger (1987) Cointegration and Error Correction Mechanism as shown in Kemme and Roy[iii] (2002).
Translated into stochastic terms the features of the theoretical model of ERER behavior requires that the disturbance term w_t in Equation 1 is a mean-zero stationary random variable.

$$e_t^* = bF_t^* + w_t \qquad (1)$$

Where b is the cointegrating vector and w_t is an uncorrelated random disturbance.

Based on Engle and Granger[iv] (1987) who demonstrated an equivalence between cointegration and error correction for nonstationary variables in case on nonstationary variables the model implies that RER has a reduced-form error correction representation (Equation 2), which allows short run dis-equilibrium to be

treated as 'equilibrium error' and we use it to tie short-term behavior of RER to its long-run value.

$$de_t=a + bdF_t + cu_{t-1} + z_t \quad (2)$$

Where d denotes first difference; u_{t-1} is the one-period lagged value of the residual from regression (Equation 1), the empirical estimate of the equilibrium error term; and z is the error term with usual properties.

Calculating ERER

After long run parameters b of Equation 1 are estimated using appropriate econometric tools given unit root properties of the data series estimation of sustainable fundamentals, F*, is next step in measurement of ERER. The sustainable fundamentals are then combined with b to arrive at ERER, that is $ERER=bF^*$.

The effect of sustainability of the net capital flows and other fundamentals on ERER in BH is captured in this step. The estimation of the value of sustainable fundamentals involves some methodological issues. Time series based (or data based) permanent values of fundamentals are by nature of construction of cointegration methodology unable to detect substantial misalignment (Baffes, Elbadawi and O'Connell[v], 1999:443). However, in case of BH counterfactual estimation of the variables of debt service to export and net sustainable capital flows[vi] does not create pressures towards RER devaluation as the estimated direction of influence of these variables is opposite to theoretically postulated relationship, so that increase in these variables results in more appreciated ERER.

In the case of exogenous variables and those that adjust very slowly the time series based estimates of their sustainable values are used along the methodology of Baffes[vii] et al. (1999) which use moving averages to estimate permanent values of fundamentals in ERER calculation.

The import content of investment already reflected in high value of observed openness variable leaves conclusion that trade policy is already very open (imports and exports to GDP ratio have been above 1 for most of the sample period) and moving average of actual openness variable is used for BH. Government consumption in total expenditure is considered as slower changing so that its

permanent value is obtained as moving average of data series. Moving averages technique is one of simple 3 year moving average for all of the series.

ERER calculation as "sustainable" RER, which is the fitted RER in which the fundamentals have been replaced by their sustainable values[viii], enables us to calculate the RER misalignment for BH in the middle of 2012. Given the equilibrium real exchange rate the misalignment can be calculated as:

$$m_t=e_t^*-e_t \qquad (3)$$

Once the misalignment is calculated we have determined whether the currency is overvalued or undervalued at present and may make statements about the RER misalignment in BH in 2012.

Empirical Analysis: Estimation of ERER Misalignment in BH

In this section the misalignment of the real exchange rate in BH is estimated for the middle of 2012. We begin by defining and documenting the sources of data. After results of the time series properties of the data are obtained, tests for the existence of co-integrating relationship between the fundamentals and real exchange rate are performed. Estimation of the long run parameters b of the ERER vector ($e_t^*=b*F_t$) using the appropriate econometric tools given the time series properties of the data is thenconducted. Lastly, the ERER is calculated given the sustainable values of fundamentals where counterfactual estimate of sustainable resource balance given sustainable net capital flows and time series estimates of slower adjusting fundamentals are combined with the estimated parameters b to calculate the degree of RER misalignment as the difference between the ERER and the actual RER.

Definition and Measurement of the Variables

The variables found in the reduced form single equation are the actual real exchange rate (e_t) and the fundamental determinants of the equilibrium real exchange rate ($F_{t).}$ Real exchange Rate (RER) or e - is taken as the multilateral trade weighted index which is as a measure of RER used in evaluating competitiveness. It is necessary to use or construct a broad multilateral index of the real exchange rate (Edwards[ix], 1989:88), which provides a measure of the degree of competitiveness of a country relative to a group of its trading partners. The Central Bank of Bosnia and

Herzegovina (CBBH) construct of the multilateral index of the real exchange rate is used, which is consistent with the methodology of Edwards (1989: 88).

Openness or OPEN is defined as the ratio of imports (IMP) and exports (EXP) to GDP (GDP): OPEN= (IMP+EXP)/GDP.
Resource Balance to GDP Ratio (RESGDP). The value of exports (EXP) minus the value of imports (IMP), divided by the GDP (GDP). Thus RESGDP= (EXP-IMP)/GDP.[x]
DEBT is the ratio of debt service to exports expressed in percentage.
GOVCON is simply the ratio of government consumption expenditure to total government expenditure.
The data were obtained from two sources: 1) CBBH, 2) the IMF- International Financial Statistics.

Time Series Properties of Data Series

Table 1 presents the results of the standard Augmented Dickey-Fuller (ADF) (1979) statistics and the Philipps-Perron (PP) test (1988), which are used to assess the unit root properties of the data. The MacKinnon critical values (1991) are reported alongside of the results of the ADF and the PP tests.

Table 1: Tests for Stationarity

	ADF	PP	Decision
RER	-3.62	-3.15	I(1)
RESGDP	-1.33	-1.40	I(1)
OPEN	-3.78	-3.80	I(0)
GOVCON	-2.57	-2.37	I(1)
DEBT	-1.02	-3.96	I(1)

Notes: test assumption includes constant in test equation. For the Augmented

Dickey-Fuller statistics (ADF), the MacKinnon critical values are: 1%=-3.62, 5%=-2.94, 10%=-2.60. Critical values for the PP test are: 1%=-3.61, 5%=-2.93, 10%=-2.60. Sample period is 2002Q2 to 2012Q2.

The results obtained from the standard ADF and the PP test suggest that almost all of the variables under consideration exhibit unit root properties, that is, they are integrated of order one and their first differences are stationary.

Test of Cointegration

Since the relevant data series used in the empirical analysis are nonstationary (integrated of order one) it follows that a cointegrating regression can potentially be formed if the series are found to be cointegrated. Table 2 contains the Johansen (1998) test for the number of cointegrating vectors for BH. The Johansen maximum-likelihood procedure which tests for the number of co-integrating vectors in Table 2, shows that there is 1 co-integrating vector for BH over the period of 2001Q1 to 2012Q2, consistent with findings of Omerbegovic (2005) over the shorter time span.

Table 2: BH- Johansen Maximum Likelihood Procedure for Testing the Number of Cointegrating Vectors[xi]

Null (1)	Likelihood Ratio (2)	Max. eig. Stat. [95% crit] (3)
R=0	0.57	69.82
R<=1	0.40	47.86
R<=2	0.27	29.78
R<=3	0.13	15.50

The variable set is (RER, RESGDP, OPEN, DEBT, GOVCON)

Sample period is 2002Q2 to 2012Q2.
Trace test indicates 1 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Testing for Breaks

Since the paper postulates that real exchange rate might be going through different phases in its behavior it tests for breaks in a time series regression function over the sample time period. Using the Chow test it is found that the suggested break point is 2005, which is a year when observation of time series data on resource balance indicates significant improvement in resource balance variable. This could have been situation of resource balance variable moving towards its long term position. The paper reports results of cointegrating equation over the whole sample as well, as these are then considered to be relationships that hold on 'average', in the sense that the estimate combines the two different periods. (Stock and Watson, 2012:599)

Besides having these overall 'average' results reported, the paper estimates cointegrating equation over two sample periods divided by postulated structural break in data: first sample includes observations from 2001Q1 to 2005Q4 and second sample includes observations from 2006Q1 to 2012Q2. The examination of stationarity and cointegration indicators for these two sample periods indicates that series under examination are nonstationary over these periods and that there are cointegrating equations in these two periods as well.

Estimation of Cointegrating Relationship between RER and Fundamentals

The existence of cointegration between the variables of RER and the fundamentals suggests that the econometric techniques of Cointegration and Error Correction Mechanism are appropriate for estimating the relationship between RER and its fundamental determinants. Table 3 presents estimated cointegrating parameters, b, in using the two step Engle-Granger (1987) cointegration and error correction methodology (1987).

Cointegration implies that the residuals of Equation 1, w_t, are stationary, and this restriction provides a test for cointegration[xii]. Table 4 provides results of this Engle-Granger (1987) two-step procedure test for cointegration. There is strong evidence of cointegration, as indicated by the unit-root test applied to the estimated residuals: the calculated value rejects nonstationarity in favor of stationarity at standard levels[xiii].

Finally, the short-term dynamics of real exchange rate, e, is examined by estimating an error correction model of Equation 2, where residuals from static regression (w_t) in Equation 1, are used in place of the equilibrium error on the right hand side of the error correction equation to tie short-term behavior of RER (e) to its long-run value. Table 5 provides results of estimation of Equation 2 for BH, over the two sample periods.

The findings suggest that the short run effects are generally in the same direction as the long run effects. A crucial parameter in estimation of short-term dynamics is the coefficient of the ERROR (w in Equation 1) in the second step of the Error Correction Procedure, which measures the speed of adjustment of the RER to its equilibrium level. Importantly, the error term is less than one in absolute terms and

statistically significant, hence the equilibrium real exchange rate is stable (Lim and Stein, 1995).

Table 3: Step One Engle-Granger (1987) Cointegration and Error Correction Procedure-Long Run Parameter Estimates: BH

	Sample 2002Q2 to 2005Q4			Sample 2006Q1 to 2012Q2			Sample 2002Q2 to 2012Q2		
	1	2	3	4	5	6	7	8	9
Variable	Coefficient	t-stat	2-tail significa	Coeffic ient	t-stat	2-tail signific	Coefficient	t-stat	2-tail signific
Coefficient	95.12	4.41	0.0000	105.32	47.49	0.0000	105.02	51.6	0.0000
OPEN	15.45	5.42	0.0173	0.45	2.86	0.8763	1.65	0.78	0.4358
RESGDP	0.13	1.41	0.1868	-0.05	-0.65	0.5204	-0.04	-1.20	0.2350
DEBT	-0.17	-0.86	0.4083	0.11	0.74	0.4619	-0.11	-1.05	0.2972
GOVCON	-0.07	-2.20	0.0332	-0.26	-3.07	0.0058	-0.24	-3.53	0.0011

Dependent variable: RER

Notes column 1 to 3: Adjusted R-Square= 0.7449; Durbin-Watson=1.6745 ADF (e-bF): UROOT (N,0) = -3.06; ADF critical value 5%= -2.92; Sample period is 2002Q2 to 2005Q4 for columns 1 to 3.
Notes column 4 to 6: Adjusted R-Square= 0.1857; Durbin-Watson=1.2362 ADF (e-bF): UROOT (N,0) =-4.64; ADF critical value 5%= -2.99; Sample period is 2006Q1 to 2012Q2.
Notes column 7 to 9: Adjusted R-Square= 0.3106; Durbin-Watson=1.4355 ADF (e-bF): UROOT (N,0) =-4.64; ADF critical value 5%= -2.93; Sample period is 2002Q2 to 2012Q:2.

The explicit form of Equation 1 tested is:
$RER=c(1)+c(2)*OPEN+c(3)*RESGDP+c(4)*GOVCON+c(5)*DEBT+w_t$

Table 4: Results on Engle-Granger (1987) Two Step Procedure for Testing Cointegration Unit Root Test of the Residuals From the Long Run Relations.

	Sample 2002Q2 to		Sample 2006Q1 to		Sample 2002Q2	
Long run equation 1	ADF Test	Order of	ADF Test	Order	ADF	Order
	-3.06	I(0)	-4.64	I(0)	-4.64	I(0)

MacKinnon (1991) critical values for rejection of null of no cointegration are -2.92 at 5% level for Sample 2002Q2 to 2005Q4, -2.99 at 5% level for Sample 2006Q1 to 2012Q2 and -2.93 at 5% level for Sample 2002Q2 to 2012Q2.

The important factor in considering the volatility of the model is to observe for serial correlation diagnostic since low Durbin-Watson statistic (DW) values accompanied by high R^2 alert to the potential problem of spurious regression[xiv]. (Gujarati[xv], 1995: 724) There are relatively lower AR^2 values (0.22) accompanied by DW test statistic values of less than two as we observe DW to be 1.23 to 1.67 depending on the sample. Therefore, the problem of spurious regression is not suspected. These results are similar to those found in Baffes et al.[xvi] (1999) where the same empirical methodology produces results of DW in the range of 1.14 to 1.16, whereas others like AtiqurRahman and Abdul Basher[xvii] (2002) study for Bangladesh do not report the DW diagnostics test statistic while using similar time series fundamental determinants of ERER and empirical model of two-step ECM.

Table 5: Short Run Dynamics: BH
(Two-Step Engle–Granger (1987) Cointegration And Error Correction Mechanism)

	1	2	3	4	5	6	7	8	9
Variable	Coefficient	t-stat	2-tail	Coefficient	t-stat	2-tail	Coefficie	t-stat	2-tail
Coefficient	0.50	0.08	0.9349	0.02	0.01	0.9873	0.25	0.19	0.850
ERROR(-1)	-0.55	-1.18	0.2708	-0.58	-3.15	0.0052	-0.51	-3.83	0.000
DOPEN	-0.33	-0.05	0.9569	0.12	0.07	0.9422	-0.09	-0.07	0.946
DGOVCON	-0.06	-0.79	0.4505	-0.08	-1.02	0.3194	-0.06	-1.34	0.186
DRESGDP	-0.13	-1.41	0.1942	-0.12	-2.04	0.0548	-0.16	-5.34	0.000
DDEBT	-0.20	-1.59	0.1491	0.06	0.82	0.4180	-0.06	-1.09	0.282

Notes to columns 1 to 3: Dependent variable: DRER; Adjusted R-Square=0.4082; Durbin-Watson= 1.09; Sample period is 2002Q2 to 2005Q4.
Notes to columns 4 to 6: Dependent variable: DRER; Adjusted R-Square=0.5396; Durbin-Watson=1.6657; Sample period is 2006Q1 to 2012Q2.
Notes to columns 7 to 9: Dependent variable: DRER; Adjusted R-Square=0.6203; Durbin-Watson= 1.8374; Sample period is 2002Q2 to 2012Q2.
The explicit form of Equation 2 tested is:
$dRER=c(1)+c(2)*dRESGDP+c(3)*dDEBT+c(4)*dGOVCON+c(5)*dOPEN+c(6)*w_{(t-1)}+z_t$

Calculating ERER and Degree of Misalignment

The ERER is obtained as a fitted value of the estimated long run cointegrating equation using the sustainable values of fundamentals[xviii]. This ERER is referred to as "sustainable" ERER and is reported in column three of Table 6 for BH for the two step Engle-Granger (1987) Cointegration and Error Correction Mechanism.

Column 1 reports the actual real exchange rate while column 2 presents the fitted exchange rate from the first equation of Table 3 by using actual values of fundamentals. Column 4 shows the gap between the observed and equilibrium real exchange rates using the "sustainable" simulations for the equilibrium rate. The gap between these two series provides a measure of the real exchange rate misalignment. Since RER is measured as index where 100=1, the difference between RER and ERER is equal to percent overvaluation/undervaluation, with the positive sign representing overvaluation and the negative sign indicating undervaluation of RER.
Figure 1 depicts graphically the observed, fitted and sustainable RER for BH based on Two Step Engle-Granger (1987) Cointegration and Error Correction Mechanism. The gap between the observed RER and ERER-sustainable represents graphically the percent misalignment for BH for each year from 2001Q1 to 2012Q2 based on the results of the Two Step Engle-Granger (1987) Procedure.

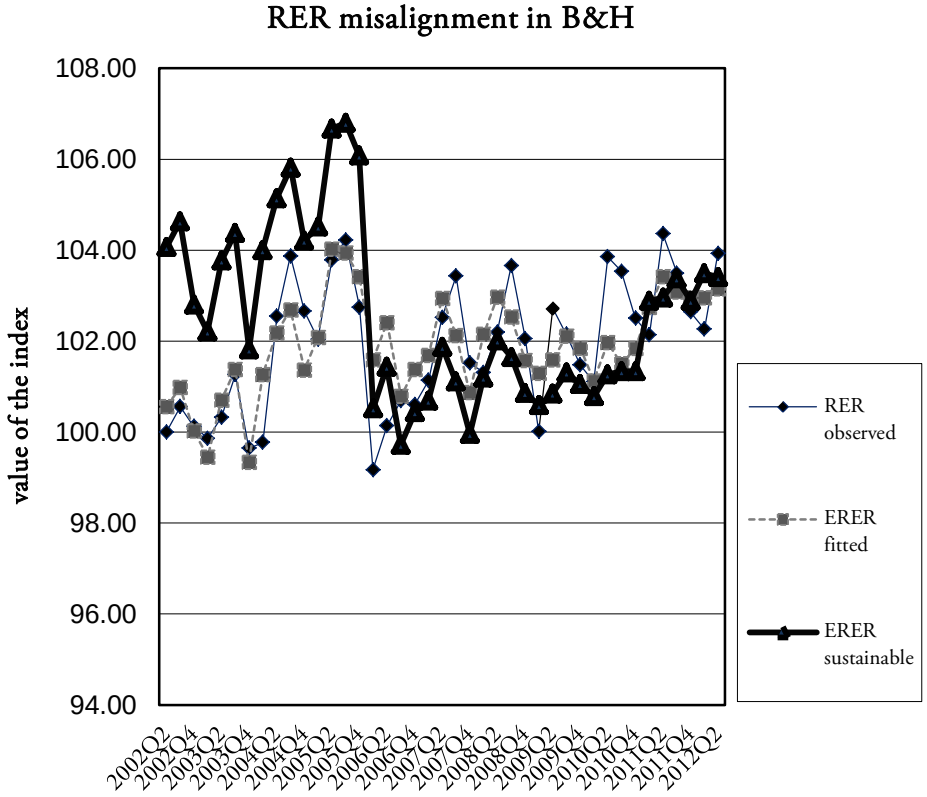
Table 6: Observed and Equilibrium RER Indexes for BH 2002Q2 to 2012Q2 (2002=100) (Two Step Engle-Granger (1987) Cointegration and Error Correction Mechanism)

Column	1	2	3	4
Period	Observed	Fitted	"Sustainable"	Misalignment (%)
2002Q1				
2002Q2	100.00	100.56	104.07	4.07
2002Q3	100.56	100.98	104.63	4.05
2002Q4	100.12	100.03	102.81	2.68
2003Q1	99.87	99.45	102.21	2.34
2003Q2	100.32	100.70	103.77	3.44
2003Q3	101.26	101.38	104.37	3.08
2003Q4	99.65	99.34	101.81	2.17
2004Q1	99.77	101.27	103.99	4.23
2004Q2	102.54	102.19	105.13	2.52
2004Q3	103.87	102.69	105.81	1.86
2004Q4	102.65	101.37	104.21	1.52
2005Q1	102.05	102.09	104.52	2.43
2005Q2	103.79	104.02	106.66	2.77
2005Q3	104.21	103.95	106.79	2.47
2005Q4	102.75	103.41	106.07	3.23
2006Q1	99.17	101.59	100.53	1.36
2006Q2	100.13	102.41	101.44	1.30
2006Q3	100.69	100.78	99.72	-0.97
2006Q4	100.60	101.38	100.44	-0.16
2007Q1	101.14	101.69	100.70	-0.44
2007Q2	102.52	102.94	101.87	-0.63
2007Q3	103.43	102.13	101.12	-2.24
2007Q4	101.52	100.87	99.96	-1.54
2008Q1	101.31	102.15	101.20	-0.11
2008Q2	102.19	102.96	102.01	-0.17
2008Q3	103.66	102.53	101.65	-1.94
2008Q4	102.06	101.57	100.85	-1.18
2009Q1	100.01	101.30	100.59	0.58
2009Q2	102.72	101.59	100.84	-1.83
2009Q3	102.15	102.11	101.31	-0.82
2009Q4	101.48	101.84	101.05	-0.42
2010Q1	101.11	101.13	100.39	-0.31
2010Q2	103.85	101.97	101.14	-2.50
2010Q3	103.53	101.50	100.67	-2.12
2010Q4	102.50	101.84	100.99	-1.13
2011Q1	102.14	102.75	102.02	0.72
2011Q2	104.36	103.42	102.64	-1.34
2011Q3	103.49	103.08	102.28	-0.12
2011Q4	102.64	102.95	102.16	0.24
2012Q1	102.26	102.96	102.27	1.20
2012Q2	103.93	103.15	102.42	-0.50

Note: The observed RER is the one used in the econometric analysis. The fitted RER is the one estimated from the cointegration regression. The "sustainable" RER is the fitted RER in which the fundamentals have been replaced by their sustainable counterparts. The RESGDP sustainable is equal to actual RESGDP adjusted for the change in RESGDP required in case of capital flows outflows comprising 100 percent of foreign portfolio inflows and transfers. The OPEN and GOVCON are given by 3 year moving averages. Following the suggestion made by Klein (1994) we assumed that sustainable debt service to export ratio is at most 20% but slowly increasing from the current levels in view of the higher repayment obligations.

Misalignment is defined as 100(sustainable RER-observed RER)/observed RER. Misalignment over the sample period 2002Q2 to 2005Q4 and 2006Q1 to 2012Q2 is estimated using parameters presented in Table 3 for the respective sample.

Figure 1: Misalignment – BH (as the Gap Between Real Exchange Rate And ERER) Two Step Engle-Granger (1987) Cointegration and Error Correction Mechanism



Note: Misalignment is given by the gap between the RER and ERER. Higher level of the index indicates more depreciated level required by ERER compared to observed RER, indicating situation of RER overvaluation (misalignment).

Discussion

Finally, the paper evaluates the observed results in relation to the postulated theoretical relationships between real exchange rate and economic fundamental variables and postulated phase like behavior of RER in transition economies.

In terms of overall ability of fundamentals to explain real exchange rate behavior it is concluded that fundamentals had much more power in explaining real exchange rate behavior over the period of 2002Q2 to 2005Q4. Figure 1 indicates that there was appreciating move in RER in 2006Q1 which then marks the period of change in relationship between fundamental variables and RER and much smaller explanatory power of fundamentals in RER behavior, as indicated by adjusted-R^2 in Table 3 observed over these two sample periods. This evidence corroborates findings in the literature which claim the phase like behavior of RER in transition. Therefore, RER behavior first takes one pattern and then moves to another pattern, while these phases are due to the initial adjustments and transition that country has to go through until it reaches the pattern of RER behavior which is observed in developed matured market economies.

In terms of the postulated theoretical relationship between fundamentals and RER, the evidence indicates change in sign and significance of resource balance (RESGDP) variable, which is in the second period (from 2006 onwards) having a negative sign and indicates that improvement in resource balance is associated with RER appreciation. As explained before, relationship between resource balance variable (which implies the change in net foreign assets) can be changing due to the phases that the country goes through in the catch up process. Country may have a negative steady state net foreign assets position. In other words capital inflows appreciate the real exchange rate in this phase. However, once the desired long-term foreign liabilities position is attained, BH will have to start servicing its debt, so that for any additional increase in net foreign liabilities RER will have to depreciate. It is suspected that BH is currently accumulating net foreign liabilities and once the servicing of that debt start RER will have to depreciate. The findings suggest that this momenthas not yet arrived so that we can expect much bigger shock to RER. Dueto the current exchange rate regime of the currency board required RER depreciation can be achieved only through flexibility of prices in product and factor markets if it is not to endanger the sustainability of the currency board arrangement itself.

A significant and negative relationship between GOVCON and RER is observed, which indicates that increased government consumption is associated with RER appreciation. This sign is consistent with studies for other transition countries listed in Egert et.al. (2005:37) and in accordance to theoretically postulated relationship underpinning the single equation reduced form equation used to determine ERER.

This is due to the fact that GOVCON is expected to be increasing the price of non-traded goods sector, appreciating these prices in relationship to the price of traded goods prices, which causes RER to appreciate. As previously explained it is also expected that the size of non-traded prices (water, waste, energy, taxes) is large in transition economies Also due to administered and regulated prices, which are composed mainly of services representing a large component of CPI in transition economies and the fact that these prices initially did not represent true costs which are necessary in the long run in order to include cost of capital or in order to comply with competition rules in acquis communautaire, these prices have kept rising and this process may not be over yet. This price increase, known as the Baumol-Bowen effect (Baumol, 1996), might not have yet fully completed in BH and the price increase could be dampened via privatization and market liberalization, which are still processes to be undertaken in energy, water, communal services etc.

The DEBT variable has not been statistically significant and there is change in relationship on DEBT variable in terms of direction of relationship with RER. In later period worsening in DEBT (which is measured as debt service to export ratio increasing) would be associated with more depreciated RER. This is expected since increase in debt servicing in relation to exports puts higher burden on the country in terms of servicing its debt and therefore is likely to lead to RER depreciation. In the future BH is likely to experience worsening of this ratio due to increased foreign debt which is likely to put depreciating pressure on RER in the future period.

Observed sign on variable OPEN is capturing a theoretically postulated relationship as increased openness is assumed to be associated with trade liberalization, which raises imports more than exports. This variable has same sign in both samples, however it is not statistically significant. Number of studies on CEE transition countries cited in Egert et.al. (2005:37) observe the same relationship.

The results are suggesting that cointegration methodology captures relationship between the fundamentals and RER which is specific to the situation of the post-war economy of BH characterized with high donations and transfers after the war, thathave coincided with negative resource balance. Exchange rate regime of the currency board has at the same time ensured stability of the exchange rate and low inflation, but it has taken away from RER as an important transmission mechanism in the economy, leaving only flexibility of goods and services and labor markets to cure for macroeconomic internal and external disequilibria.

The results on relationship between RER and real economic variables in terms of the direction of relationship and significance of the fundamental variables in explaining RER behaviour indicate that the small open economy of BH has lost RER as a transmission variable in curing its external and internal disequilibria in its transition period towards a functioning free market economy. This result goes towards support of results obtained in Omerbegovic Arapovic (2011) which has indicated that choice of the exchange rate regime of currency board has been associated with much slower convergence of RER of BH towards the sample average, compared to Croatia and Macedonia, which have adopted more flexible exchange rate regime and, therefore, exhibited much faster convergence. From this we can deduce that their exchange rates were much more linked to the behavior of the fundamental economic variables compared to BH.

Results obtained in this study and Omerbegovic Arapovic (2011) suggest that in order to access the readiness of each individual country in the region to join EU it is necessary to view the fundamental economic variables such as interest rates, inflation, government debt and deficits. The trends in fundamental economic variables of increased government debt and current account deficit create pressures which can notbe captured with our equilibrium real exchange rate misalignment approach as we do not show significant misalignment at present period. The existing relationship between real exchange rate and economic fundamentals for BH suggest detachment of RER from the fundamental economic variables. The resource balance variable does not show the expected direction of influence with RER, which is likely to occur once debt servicing becomes priority. The overall explanatory power of fundamentals in the period from 2006 to 2012 is low, which goes in support of the studies that find relationship between economic fundamentals and RER behavior to weaken once the RER enters a stationary period (Egert, 2006). Further studies on RER in BH should test the power of monetary variables in explaining RER as they are postulated to have more influence on RER once country enters the stationary mode of RER behavior.

Conclusion

Recognizing the endogeneity of the equilibrium real exchange rate and adopting a mild and testable assumption that distance between the actual and the equilibrium real exchange rate is a stationary random variable justifies the use of the cointegration method for estimating the long-run relationship between the real exchange rate and its fundamentals. Since the methodology adopted assumes that the economy was in

internal and external equilibrium on average over the sample period, it implies that the average degree of misalignment in the sample will tend, by construction, to be small, if depending only on the time series estimates of sustainable value of fundamental variable of resource balance. Due to this fact counterfactual estimation of sustainable values of fundamental economic variables was used to determine sustainable ERER. The findings do not suggest RER overvaluation in middle 2012. However, the fact that BH in its post-war history has observed stable RER with continuous external disequilibrium could limit the ability of detecting ERER misalignment using time series estimates of fundamental variables alone.

The counterfactual estimation of change in sustainable value of net capital flows on ERER indicates that in BH, the real exchange rate was under-valued by less than 1 percent in April 2012 using the Two Step Engle Granger Methodology. In counterfactual estimation for BH, the smaller trade deficit associated with the smaller current account deficit produces an appreciation of the equilibrium rate and therefore tends to decrease the estimated degree of misalignment. This is evident in lower sustainable RER (ERER), or more appreciated value of sustainable RER compared to the fitted RER value calculated using the actual resource balance variable. This finding is due to observed negative relationship between resource balance variable and RER, which theoretical models associate with initial stages of capital account liberalization when price of non-tradable goods increases and causes RER to appreciate.

These findings go in support of an argument that structural adjustments which would bring flexibility to labor and markets for goods and services are required in order to bring about external balance as RER is not found as significant transmission mechanism in correcting external disequilibria in BH economy. Labor market reforms in direction of more flexibility and inaction of more flexible hiring and firing rules compared to the existing law, which was inherited from the socialist era and practically makes firing impossible for employers, should be priority for policy makers in order to move BH economy towards equilibrium.

The paper tested relationship between fundamentals and RER in BH over two different time periods and discovers that time period of consideration influences the direction of relationship between fundamentals and RER. Direction of relationship between resource balance and RER indicates that worsening of resource balance variable is associated with RER appreciation, opposite to postulated theoretical relationship and relationship between these two variables observed in shorter sample

which included data until 2005. Examination of current account, and associated capital inflows that support current account deficit, indicates that negative correlation between capital inflows and RER is present, leading us to conclude that capital inflows associated with worsening of the current account deficit put appreciating pressure on RER. In the absence of these capital inflows there would likely exist the depreciating pressures on RER.

This study also suggests that RER behavior exhibits phases in which RER initially exhibits much bigger connection to fundamental variables compared to the later period. This is in line with studies which suggest that RER could be first exhibiting trend appreciation after which it enters stationary periods. This needs to be further examined in future studies. Further research should also extend analysis and test whether other reasons exist for RER non-stationarity such as monetary phenomena and Balassa-Samuelson effect, which could not be fully assessed from the secondary data used in this analysis over the sample period.

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[i] Omerbegovic Arapovic A. (2009) *Real Exchange Rates in South East Asia: Misalignment and Currency Crisis*, VDM Verlag Dr. Muller, Saarbrucken., 57-79.

[ii]However, empirical considerations require compromise. First, it is not possible to construct a meaningful time series regarding productivity differential between traded and non-traded goods producing sectors because of data limitations. So the Balassa- Samuelson effect is ignored. Second data on government spending on tradables and non-tradables are not available as such. Government consumption mostly includes non-tradable items. Hence, the ratio of government consumption to total government spending is taken to capture the effects of government spending of tradables and nontradables following the methodology of AtiqurRahman and Abd. Basher (2002).

Unit prices of exports and imports were not available for BH so the external terms of trade could not be captured meaningfully, and we ignored this effect. It is also very difficult to a have a correct and comprehensive measure of trade policy over a long time series. Hence, like other studies in the present field, the proxy for the trade policy is taken by a measure of openness following Edwards (1989), i.e., the ratio of export plus import to GDP. An increase in this ratio is supposed to be associated with trade liberalization. Thus the list of fundamentals affecting equilibrium real exchange rate includes ratio of government consumption to total government spending, resource balance, openness, and debt service to export ratio.

The proxies for the fundamentals were:

- Trade policy stance is captured by construct of openness measured as ratio of trade volume measure (imports plus exports) to GDP.
- Debt is the ratio of debt service to exports expressed as percentage.
- Government consumption is simply the ratio of government consumption expenditure to total government expenditure.

- And finally resource balance is given by the difference between exports of goods and nonfactor services and imports of goods and nonfactor services. These proxies are henceforward referred to as fundamentals.

[iii]Kemme D.M., Roy S. (2002). *Exchange Rate Misalignment: Macroeconomic Fundamentals as an Indicator of Exchange Rate Crisis in Transition Economies*. Prepared for the European Association of Comparative Economics Meetings, Forli, Italy, June 6-8, 2002

[iv]Engle, R. and C. Granger (1987). Cointegration and Error Correction: Representation, Estimation and Testing.*Econometrica*.55. 251-76.

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[vi]In view of the likely rise in debt of BH and macroeconomic sustainability, the paper considers direction of change necessary for the debt service to export ratio and the resource balance variable. This is done by excluding part of the "unsustainable" net capital inflows used to finance resource balance following the argument by Williamson and Mahar[vi] (1998), so that paper differentiates between private direct investment, which tends to be long-term in nature, and liquid private portfolio investment, remittances and grants by excluding these later inflows to arrive at the "sustainable" resource balance. The other fundamental determinants of ERER should also be in their permanent state in equilibrium. Following the suggestion made by Klein[vi] (1994) the paper assumes that sustainable debt service to export ratio is at most 20% but slowly increasing from levels observed in the sample (around 5% in 2001) in view of the higher repayment obligations due to increased external debt, and reduced grants and transfers.

[vii]BaffesJ., ElbadawiI.A., O'ConnellS.A. (1999). Single-Equation Estimation of the Equilibrium Real Exchange Rate. In Hinkle L.E., Montiel P.J. (1999) *Exchange Rate Misalignment, Concepts and Measurement for Developing Countries*. A World Bank Research Publication. Oxford University Press. 405-465

[viii] The equilibrium real exchange rate is then the predicted value from co-integrating equation ($e_t=bF_t$) based on a given vector of macroeconomic fundamentals, Ft*, assumed to be sustainable long run equilibrium values, $e_t^*=bF_t^*$.

[ix]Edwards S. (1989). *Real Exchange Rate, Devaluation, and Adjustment*. London: The MIT Press.

[x]Two RESGDP variables were tested. One was found using our estimate of quarterly GDP following moves in Index of Industrial Production and the other using GDP estimates from CBBH publication on estimates of quarterly GDP figures. No differences were found in observed relationship between RER and RESGDP and the paper continues using the estimated quarterly GDP figures.

[xi]The Johansen (1988) cointegration imposes a restriction on the reduced form or VAR representation of the joint distribution of the real exchange rate and its fundamentals. (Baffes, Elbadawi and O'Connell[xi], 1999) We use a lag length of one for the underlying VAR system;

this is very restrictive even for annual data, but a longer length leaves us with very few degrees of freedom. The asymptotic tests indicate one co-integrating vector for B&H at the 1 % confidence interval.

[xii]Baffes, Elbadawi and O'Connel (1999) note that estimates of b from the static regression are super-consistent, approaching the true parameters at a rate proportional to the sample size rather than the square root of the sample size; and they remain so even in the absence of weak exogeneity.

[xiii]Note that the critical values for this test are more demanding than when testing for a unit root in a single variable since the OLS estimation tends to induce stationarity in the residual. (Gujarati, 1995)

[xiv] Granger and Newbold, quoted by Gujarati (1995:724) have suggested: an $R^2 > d$ (Durbin Watson statistic) is a good rule of thumb to suspect that the estimated regression suffers from spurious regression.

[xv]Gujarati, D.N. (1995). *Basic Econometrics*. Mc Grow Hill Singapore.

[xvi]Baffes J., Elbadawi I.A., O'Connell S.A. (1999). Single-Equation Estimation of the Equilibrium Real Exchange Rate. In Hinkle L.E., Montiel P.J. (1999) *Exchange Rate Misalignment, Concepts and Measurement for Developing Countries.* A World Bank Research Publication. Oxford University Press. 405-465

[xvii]AtiqurRahman A.K.M.A., Abdul Basher S. (2002). Real Exchange Rate Behavior And Exchange Rate Misalignments In Bangladesh: A Single Equation Approach. NorthSouthUniversity. Dhaka. Bangladesh.

[xviii]Once the long run parameters b in Equation 1 relating RER and the fundamentals are estimated, the next step in the calculation of ERER is the estimation of sustainable fundamentals, F*, so that ERER (e*) is given by $e^*=bF^*$.