



Original Article

Exchange Rate Misalignment: An Application of Purchasing Power Parity and the Behavioral Equilibrium Exchange Rate in Vietnam

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Abstract: The impact of exchange rate misalignment on economic growth has become an important research topic in recent years in many different countries. Especially, in the context of global economic turmoil and trading conflicts between China and the United States, many countries raised interest rates to combat rising inflation. Governments tried to find suitable exchange rate policies to help stabilize inflation and develop their economies. This paper aims to analyze the misalignment of the real effective exchange rate in Vietnam by using the behavioral equilibrium exchange rate and purchasing power parity models. The result shows that the Vietnam Dong was undervalued in the period 2000-2010 and overvalued in the period 2010-2020.

Keywords: Currency, exchange rate misalignment, real exchange rate.

1. Introduction

The concept of exchange rate misalignment: according to Edward (1989) exchange rate deviation is a situation in which an economy's real exchange rate deviates from its long-run equilibrium value. In particular, the domestic currency is overvalued or undervalued

disturbing its equilibrium level in the long run, and this "misalignment" can lead to economic losses for society. If domestic currency is priced under or higher than its equilibrium, it can lead to an unbalanced external sector. Overvalued currency makes export goods more expensive and import goods relatively cheaper, which erodes international trade competitiveness and

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causes a trade deficit. In addition, higher currency valuations deplete national foreign currency reserves and limit their ability to intervene in the foreign exchange market. The undervalued local currency will support the export of goods, but it also increases the cost of import goods, especially in developing countries like Vietnam, which depend heavily on imported intermediate goods for processing. This will lead to exchange rate pass-through effects on consumer prices, increasing inflation, and destabilizing the macroeconomy.

Currently, there are several approaches to determining an exchange rate misalignment in the economy. This research will use the following two popular ones. The first method is the purchasing power parity (PPP) approach; the second approach is to regress the real effective exchange rate (REER) on fundamental macroeconomic variables by the behavioral equilibrium exchange rate (BEER) model. This latter method investigates the possibility that real exchange rates are non-stationary and hence tries to explain their dynamics in terms of other macroeconomic fundamentals, typically within a cointegrating framework.

The content of this paper is structured as follows. Section 2 summarizes the research about REER, BEER, and exchange rate misalignment. Section 3 uses data about the exchange rate, the external sector, and the price index to calculate REER. Then, Section 4 applies the PPP and BEER models to identify the misalignment. Finally, section 5 presents and explains the main results of the paper and gives recommendations for exchange rate interventions.

2. Literature review

Economic theories show that macroeconomic fundamental variables and real exchange rates are linked in the long run, which helps explain why policymakers are so interested in the concept of the economy's equilibrium exchange rate. The calculation of exchange rate misalignment from REER has been mentioned in

studies from major financial institutions such as the World Bank (WB) and the International Monetary Fund (IMF). PPP is one of the oldest theories of exchange rate determination. This method tells us that nominal exchange rates should participate to neutralize competitiveness changes induced by changes in price indexes across countries, so that real exchange rates are mean reverting processes (Lothian and Taylor, 1996). PPP is not a short-run theory of exchange rate determination. It is a long-term concept to forecast the fluctuation of the exchange rate (Taylor, 2004). The relative version of the PPP theory is in more common usage from the economic point of view. It does not assume that prices in two economies are the same, but rather that the relative purchasing power of two different currency units remains unchanged over the long run. The important implication of this hypothesis is that the sample mean of REER (\overline{REER}) is a good representation of the PPP-implied equilibrium real effective exchange rate ($REER^{PPP}$):

$$REER_{it}^{PPP} = \overline{REER}_i \quad (1)$$

The applying of PPP theory means that REER should act as a mean-reverting stationary processes. However, many researchers argue that the process of mean reversion is extremely slow if a complete return happens at all. The rigidity of adjustment is often referred to as the "PPP puzzle" (Rogoff, 1996), there are several plausible explanations that could justify the sluggishness of the process (Taylor et al., 2001). Other research attempts to explain REER dynamics in terms of other economic fundamentals are normally within a cointegrating framework. This methodology is most widely known as the Behavioral Equilibrium Exchange Rate model (MacDonald, 1998).

The literature discussed that the most potential choice of fundamental variables should be included in the model and the expected sign and magnitude of the parameters (Fidora et al., 2017). For this study, the variables that enter the model were selected based on economic theory, the empirical literature, and data availability used to determine exchange rate movements in

Vietnam. The following variables were selected to include in the final long-run BEER model. The first one is trade openness. It is measured as the sum of exports plus imports divided by GDP and the extent to which the country is connected to the rest of the world. Trade openness is considered as an approximation of the level of trade liberalization on the nation. The level of trade openness may connect to a country's REER, but the direct effect is unclear. There is an enormous volume of literature pointing to the advantages of trade openness on economic growth. Competition from foreign firms can encourage domestic innovation and productivity, with positive spillovers for wages and prices in the non-tradable sector. However, a high level of trade liberalization leads to a depreciation of the REER; since it allows for increased trade and price convergence (Goldfajn and Valdes, 1999). Trade openness could therefore lead to real depreciation due to foreign competition in the tradable sector. The second variable is the term of trade (TOT). The term of trade represents a channel for the transmission of global macroeconomic disturbance to the domestic economy. The term of trade is known as the ratio of country export prices to import prices and might affect REER in many ways. An increase in terms of trade, caused, for example, by higher export prices, boosts domestic income and spending on both types of goods. The total demand will be higher, which can lead to an increase in domestic prices if some of it is spent in the non-tradable sector. An improvement in the current account and a higher domestic price level makes the domestic currency appreciate or causes an increase of REER (Domaç and Shabsigh, 1999). The third variable is monetary policy. To assess the effectiveness of a monetary policy, the ratio of liquidity to nominal GDP ratio (M2 to GDP) can be used. When the liquidity ratio increases, the domestic price level increases, leading to an appreciation of REER. Thus, a positive effect on REER is expected in the model. The equilibrium of the REER is calculated by using the cointegration technique and adoption of a vector error correction model

(VECM) model for the BEER approach. The difference is derived when we compare the equilibrium with observed data used to measure the actual misalignment. The results obtained highlight the existence of a relation between REER with its macroeconomic fundamentals. From the three explanatory variables described above the BEER model is formulated as:

$$REER_t^{BEER} = \alpha_1 OPEN_t + \alpha_2 M2_t + \alpha_3 TOT_t + \mu_i \quad (2)$$

Research on exchange rate misalignment in Vietnam was studied by Nguyen Thi Thu Hang (2011), Nguyen Tran Phuc and Nguyen Duc Tho (2009) calculating the REER index in the periods 2000-2010 and 1992-2007 - in which, Vu Quoc Huy et al. (2012) calculated the exchange rate misalignment by the BEER method in the period from 2000 to 2010, with the addition of variables on productivity gap and fiscal policy. However, the above studies are relatively short of exchange rate data and simply calculate REER with a lack of intensive analyzing about exchange rate misalignment. This study will use longer period data and focus more on the analysis of misalignment of the exchange rate.

3. Exchange rate policies for the period 2000-2020

Exchange rates affect the economy through a variety of channels, including effects on imports and exports, international capital flows, level of inflation, and interest rates. Firstly, when a country's currency depreciates, imported goods tend to be more expensive, and the value of exports may increase because cheaper domestic goods stimulate overseas buyers. A rise or fall in the real exchange rate impacts a country's trade balance over time. Therefore, the government can use the exchange rate as an economic tool to manage the macro economy. A decrease in the value of the domestic currency can increase exports and gain advantages in the international goods market, but it can increase the cost of purchasing imported raw materials or

intermediated goods, which leads to a higher inflation rate. Secondly, international capital tends to flow into countries that have stable political regimes, developing economies, and a stable currency. A country with a relatively stable domestic currency will attract foreign direct investment inflows, whereas a large depreciation of the domestic currency will discourage investors due to exchange rate losses. For developing countries, the capital flow, including direct and indirect, is one of the most important growth sources in the long run. Finally, a weak currency can cause inflation since it increases the cost of importing inputs and increases aggregate demand for domestic goods. A strong local currency affects the economy with the same effect as a tight monetary policy, and the problem is exacerbated as capital continues to flow into the country to search for higher returns and make the domestic currency stronger. Exchange rate fluctuations have a wide-ranging impact on the economy, especially in a country with an extremely high degree of openness such as Vietnam. Understanding the impact of the exchange rate will help the State Bank of Vietnam to find an exchange rate policy suitable to the country's macroeconomic conditions.

The exchange rate policy in Vietnam is one of the key factors in monetary policy, including the exchange rate regime, depreciating or appreciating the domestic currency price and stabilizing exchange rates. The purpose of these tools is to influence the supply and demand of foreign currencies in the foreign exchange market to achieve macroeconomic objectives such as controlling inflation, stabilizing the value of the local currency, and fostering economic growth. In addition, it also affects the trade balance, current account, and the balance of payments, helping to stabilize the economy and resist external shocks.

The intervention of the State Bank of Vietnam and exchange rate movement from the early 90s to the present will be briefly described as follows: The interbank market for foreign currencies of Vietnam was established in

September 1994, and the official exchange rate was set by the State Bank of Vietnam based on the exchange rate on this market. In order to increase flexibility, the currency band was widened from 0.5% to 1% in November 1996, to 5% in February 1997, to 10% in October 1997, and fell to 7% in August 1998. Due to the impact of macroeconomic factors such as inflation and trade balance imbalance, the State Bank of Vietnam had to devalue the local currency twice in a row in 1998 up to 16.3%. By February 1999, the official exchange rate announced was the average interbank exchange rate of the previous working day.

After becoming a member of the World Trade Organization, Vietnam experienced a significant increase in trade balance and capital flows. The inflow of foreign direct investment into the economy increased dramatically in the period 2007-2008, causing the supply of foreign currency to increase sharply and the domestic currency to appreciate. At this time, the world economy experienced a higher inflation rate and the U.S. economy suffered the largest recession in the past 30 years, leading to a slowdown of the global economy. Vietnam's trade balance turned into a deficit, and double-digit inflation happened this year, causing an afraid of the local currency depreciating. Due to negative impacts, the State Bank of Vietnam had to increase the official exchange rate and loosen the allowed currency band to 5%. With the devaluation pressure, the State Bank of Vietnam was forced to increase the exchange rate to 5.4% on November 26, 2009, the highest adjustment rate in a day within the past 10 years. To stabilize the economy, the Government issued 11/NQ-CP with the goal of stabilizing the macro-economy and eliminating inflation in February 2011. The above policies made the exchange rate stabilized. The difference in the exchange rate between the free market and the official market decreased sharply in the end of April 2011.

In the period 2012-2013, the economy experienced the stabilization of the exchange rate, both on the official market and the free market. The average interbank exchange rate

was kept fixed at 20.828 VND/USD. During this period, the State Bank of Vietnam played an important role in monitoring the exchange rate. In 2015, the value of the VND fell by 5.34% for the whole year. Under the pressure of China's renminbi devaluation, on August 2015, the State Bank of Vietnam adjusted the currency band from +/-1% to +/-2%. The USD buying and selling price of commercial banks fluctuated from 21.240 VND/USD to 22.106 VND/USD. However, China's renminbi continued to depreciate strongly. On August 19, 2015, the State Bank of Vietnam decided to increase the exchange rate by 1% to 21.890 VND/USD and widen the band from +/-2% to +/-3%. Due to unpredictable fluctuations in the exchange rate during the year, the State Bank of Vietnam needed to change the exchange rate management mechanism. On December 2015, the State Bank of Vietnam issued Decision No. 2730/QD-NHNN, announcing the central exchange rate of VND against the USD. In addition, the forex market added derivatives and forward contracts

between the State Bank of Vietnam and credit institutions. Regarding the new exchange rate policy, it will allow the exchange rate to fluctuate more flexibly based on the movements of foreign currency supply and demand in the domestic market and the world market.

Since 2015, the new exchange rate policy of the State Bank of Vietnam and the development of the domestic economy have brought Vietnam to a better position in the foreign exchange market. The trade balance continuously recorded a surplus, reaching a level of nearly 20 billion USD in 2020. Besides, FDI inflows also increased year by year; the reserves built up to nearly 100 billion USD. In 2019, the US-China trade war escalated, causing the renminbi to depreciate by an average of nearly 5% against the dollar. In that context, the State Bank of Vietnam raised the central exchange rate by about 1.5%. Accordingly, the USD price at commercial banks at the end of 2019 was almost unchanged compared to the same period in 2018, hovering around 23.250 VND/USD.

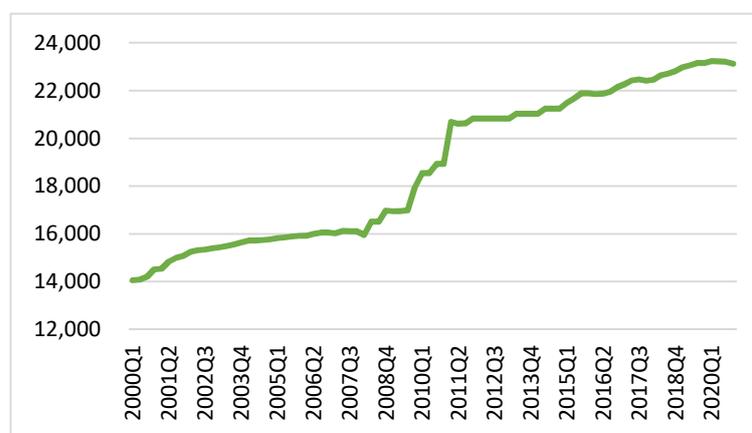


Figure 1: Nominal Exchange Rates VND/USD (Quarterly), 2000-2020

Source: IMF exchange rate data.

4. Data source and REER calculation

The nominal effective exchange rate (NEER) is the weighted average of nominal exchange rates of national currency exchange for a basket of multiple foreign currencies. The NEER does not reflect the price changes in the observed country relative to price changes in the

trading partners. Thus, it does not reflect changes in the purchasing power of the currency, nor to the extent of the competitiveness of goods produced in this country. To identify the extent by which the purchasing power of a currency changed during a specific period, REER is measured. REER is adjusted to changes in price levels corresponding to a relative change in

prices in countries - partners in trading. REER is measured as the weighted average of real exchange rates of the national currency to the currency of its main trading nations. The most popular formula for REER and NEER calculations is a formula for deriving a weighted average of the two exchange rate changes for a certain time to the base year. The weight of countries in total foreign trade is defined to calculate effective exchange rate indices. The weight reflects the importance of the trading partners. REER is measured based on the weight of bilateral trade. The formula for measuring the weight is below:

$$W_{it} = \frac{M_{it} + X_{it}}{\sum_{i=1}^n M_{it} + \sum_{i=1}^n X_{it}} \quad (3)$$

Where:

W_{it} : Weight of country i in the total trade volume $\sum_{i=1}^n W_i = 1$

M_{it} : Import of Vietnam from country i

X_{it} : Export of Vietnam to country i

$\sum_{i=1}^n M_{it}$: Export of Vietnam to 25 main trading partners ($n = 25$)

$\sum_{i=1}^n X_{it}$: Import of Vietnam to 25 main trading partners

This paper selects 25 countries that are considered the largest trading partners with Vietnam; such as China, the United States, Australia, Korea, Japan and so on. The bilateral

nominal exchange rate (NBER) is the number of foreign currency exchanged for 1 unit domestic currency. REER is calculated by using the geometric mean (GM) method instead of the average mean (AM), because the GM method is not influenced by the base year chosen. While the AM gives larger weights to currencies that appreciate or depreciate to a significant extent alongside the domestic currency, the GM treats depreciation and appreciation symmetrically. This makes the GM more useful in identifying trends in REER. The formula for measuring RBER and REER is below:

$$RBER_{it} = NBER_{it} \frac{CPI_{it}}{CPI_{jt}} \quad (4)$$

$$REER_t = \prod_{i=1}^n RBER_{it}^{W_{it}} \quad (5)$$

Where:

$RBER_{it}$: Real bilateral exchange rate.

CPI_{it} : Consumer price index of Vietnam.

CPI_{jt} : Consumer price index of trading partners.

Data on CPI, Export and Import of trading partners comes from IMF's International Financial Statistics from 2000Q1 to 2020Q4. This study selected the base year as the first quarter of the year 2000. Thus the REER index is 100 from this point (Figure 1).

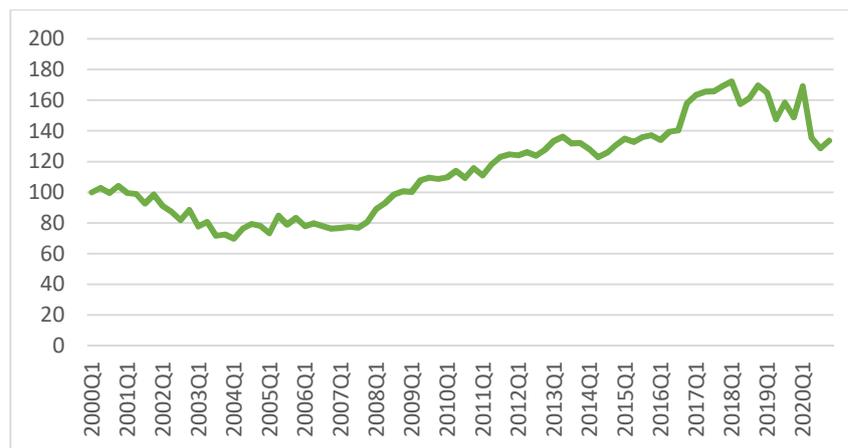


Figure 2: Vietnam: Real Effective Exchange Rates (Quarterly), 2000-2020 (Index 2000 = 100)

Source: Calculation by author using IMF exchange rate data.

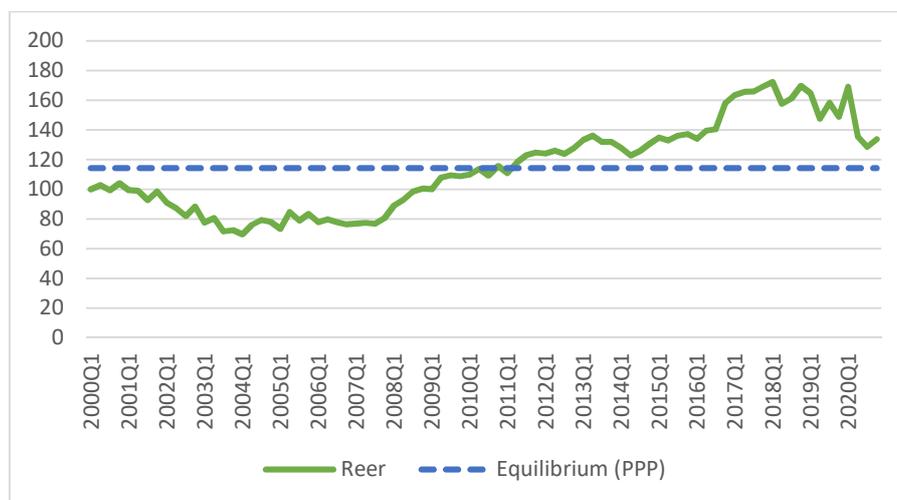


Figure 3: PPP based equilibrium exchange rate
 Source: Calculation by author using IMF exchange rate data.

5. Estimating the misalignment of the real effective exchange rate

In this section, by applying the above methodologies, we have two-time series of equilibrium exchange rates for Vietnam. For the PPP method, the equilibrium is depicted by the dashed line; it is simply the mean of REER calculated with the data for the period 2000Q1 to 2020Q4.

According to the BEER method, this paper will run a regression between REER with fundamental macroeconomic variables including openness of the economy and the M2 ratio and term of trade. The degree of openness and M2 are calculated by taken data from the IMF, WB. The term of trade statistic is from the General Statistics Office of Vietnam. Several series are available only at annual frequency;

interpolated quarterly data are derived by using linearity. All variables are converted into natural logarithms. First, the ADF test is run to verify the stationary of the variables. These variables are stationary of order 1.

Table 1: Stationarity test for the variables

Variables	ADF test
LREER	Integrated at first level of difference
LOPENESS	Integrated at first level of difference
LNM2	Integrated at first level of difference
LNTOT	Integrated at first level of difference

Source: Calculation by author.

Table 2: Johansen test, cointegration rank test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace statistic	0.05 Critical value	Prob.**
None *	0.372933	73.99309	47.85613	0.0000
At most 1 *	0.319017	38.05702	29.79707	0.0045
At most 2	0.087176	8.472215	15.49471	0.4164
At most 3	0.018641	1.448870	3.841466	0.2287

Source: Calculation by author.

Akaike Selection Criterion (AIC) is used to choose the optimal lag. Six lags are taken as the criterion as AIC suggests and the Johansen’s Trace test is used for the cointegrating rank (Johansen, 1995) with the null hypothesis of no cointegration and the alternative hypothesis being the existence of two cointegrating vectors.

The first cointegrating equation is selected to test the long-run relationship between REER and selected fundamental variables. Coefficients of the long run behavioral cointegration model are presented in the VECM model below (Table 3).

These coefficients show the effect of each fundamental variables in the exchange rate model. According to the estimated results of the cointegrating vectors, the long-run equilibrium equation can be written as:

$$LREER = 0.709LM2 + 0.34LOPEN - 15.406LTO + 72.692 \quad (6)$$

Table 3: Vector error correction estimates, at level in the long run

Variables	Vector coefficients
LREER(-1)	1.000000
LM2(-1)	-0.709175 (0.31811) [-2.22933]
LOPEN(-1)	-0.340096 (0.68183) [-0.49880]
LTOT(-1)	15.40627 (2.12196) [7.26038]
C	-72.69203

Source: Calculation by author.

The difference between the actual REER value and the long-run REER after using the Hodrick-Prescott (HP) filter is shown below:

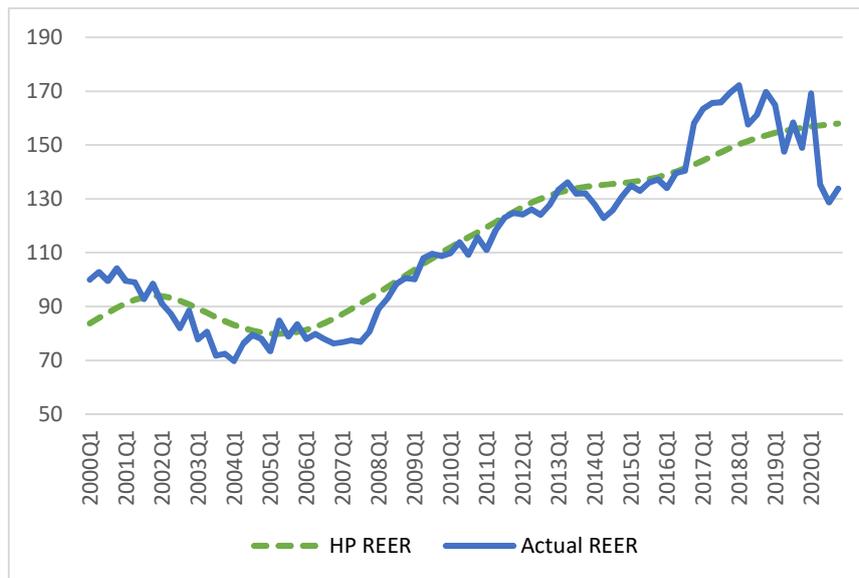


Figure 4: Equilibrium REER and Actual REER

Source: Calculation by author using IMF exchange rate data.

When employing the BEER approach, it is important to identify the misalignments, which are the deviations of the actual exchange rate from the estimates of its equilibrium values. This misalignment measures the actual deviations

from the equilibrium exchange rate of the domestic currency in the short run.

According to Hinkle and Monteil (1999), the misalignment from the equilibrium value after filtering will be calculated as follows:

$$\text{Misalignment} = \frac{\text{REER actual} - \text{HP REER Equilibrium}}{\text{HP REER Equilibrium}} \times 100\% \quad (7)$$

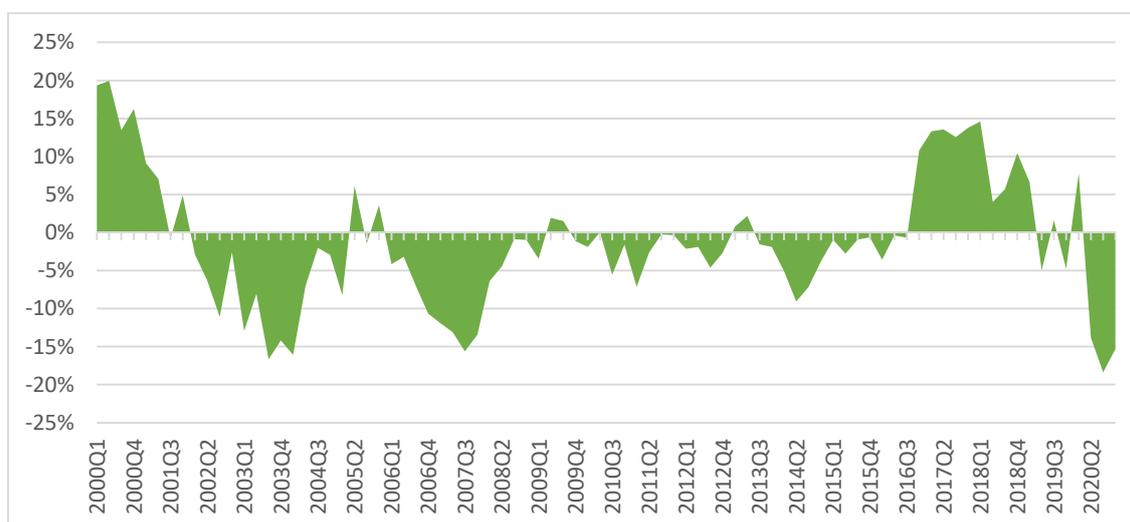


Figure 5: Real exchange rate misalignment BEER model
 Source: Calculated by author using IMF exchange rate data.

6. Conclusion and recommendations

The main objective of this research is to analyze the misalignments of the REER of Vietnam using the PPP approach and the BEER model. The BEER model is derived along the lines of the BEER approach due to MacDonald (2000). This model is then used to analyze the short-term of the Vietnam Dong. The BEER model includes the terms of trade, openness and M2 ratio as potential fundamental determinants of REER. The VECM estimation model suitable for stationary time series is used to estimate the BEER model. Based on the PPP approach, it was found that the Vietnam Dong was, on average, undervalued over the period 2000-2010 and overvalued over the period 2010-2020. Based on the BEER model, the evidence indicates that the Vietnam Dong significantly fluctuated between 2000 and 2010. In recent years, the new crawling peg policy arrangement adopted has minimized the exchange rate misalignment. Under the new regime, the value of the currency is to be adjusted continuously rather than in discrete steps. The advantage of a crawling peg is that it

can realign the exchange rate in line with changes in economic fundamentals variables, which helps stabilize the exchange rate of the Vietnam Dong in the relatively short term.

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