Determining the Equilibrium Exchange Rate for Jamaica:
A fundamentalist approach for deferring time horizons

DRAFT

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Abstract

This paper investigates the determination of equilibrium exchange rate in Jamaica over the short-run (SR), medium-run (MR), and long-run (LR) and their potential impact on competitiveness. For this study, the mean reverting properties of the real exchange rate (RER) is employed as the metric of equilibrium exchange rate. Three distinct fundamentalist based approaches are used to evaluate the dynamic process of mean reversion in the RER among the range of theoretically based impacting variables, utilizing cointegration and decomposition techniques. Key factors contributing to disequilibrium in the RER were identified within each time frame. Also, the study yielded some policy recommendations to maintain long term stability of the exchange rate and prevent the infrequent but disruptive adjustments in the domestic foreign exchange market. The paper relies heavily on the survey of equilibrium exchange rate models conducted by Driver and Westaway (2004), supplemented by a range of prominent empirical investigations on pre-selected models.

[1] The views expressed in this paper are those of the author and does not necessarily represent those of BOJ or BOJ policy.

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1 INTRODUCTION

Why Equilibrium Exchange Rates?

The level and variability of exchange rate is widely held as a gauge for international competitiveness and macroeconomic stability. A country's level and trend in international competitiveness may establish whether it is or will be a net importer or exporter, borrower or lender, debt stricken, crisis bound or fundamentally sound. In establishing a sound macroeconomic environment, a stable exchange rate is needed to build confidence; promote long-term planning and investment among foreign and domestic stakeholders of a country. The Bank of Jamaica (BOJ) is charged with the responsibility of maintaining stability within the foreign currency market toward this end. It becomes crucial for the bank to identify an equilibrium level of exchange rate to be targeted in carrying out its mandate. This paper seeks to achieve that goal by identifying the current position of exchange rate relative to the fundamentally determined equilibrium level. The paper seeks to identify periods of, existing and potential, exchange rate misalignment signaled by changes in economic fundamentals over varying time spans.

Contextual Overview

Jamaica, a small developing country is a net importer of traded goods and services. The country relies heavily on foreign currency inflows from Tourism, Remittances, Foreign Direct Investments, and Bauxite exports. Increased competition and elimination of preferential privileges among longstanding traditional exports such as banana, and sugar has stimulated concerns of reduced competitiveness for the nation during the past decade.

Jamaica remains vulnerable to external shocks that affect major export markets and cost of imported raw materials. A key factor contributing to the cost of production is imported oil that severely impeded Jamaica's economic activity in the international oil shocks of the 1970's and recently, mid to late 2000's. In the same time periods, earning from tourism, bauxite exports and access to foreign financing were contracted resulting in a balance of payments crisis for the territory. Both periods necessitated reliance on the international monetary fund for financial assistance. In the early 1990's the country liberalized its foreign exchange market resulting in significant depreciation of the local currency. By the mid to late 1990's, the country experienced a financial crisis leading to significant public debt accumulation[2].

[2] The Jamaican financial crisis of the mid to late 1990's was attributed to significant build up of non-performing loans attributed to poor financial regulation and imprudent business practices. The GOJ opted for a bailout in guiding the economy back to recovery.

Jamaica has long strived to become competitive as evidenced by competitive strategies such as import substitutions, Export promotion, and Liberalization. Nonetheless, the likelihood of balance of payment crises will increase when negative external shocks result in the deterioration of a country's terms of trade. In the case of Jamaica, these included weather related shocks, significant supply shortage of capital and raw materials such as oil on the international market. A significant accumulation of debt, similar to Jamaica's financial crisis in the mid-to-late 1990's imposes a risk premium on invested capital, thus reducing the level of competitiveness.

Investigative Contribution

Precursory studies related to exchange rate in Jamaica demonstrate that equilibrium conversion on the basis of uncovered interest parity (UIP) is evidently weak (see McFarlane 2003). In this paper, it was incited that prolonged deviation from equilibrium was attributed to a time varying risk premium ascribed to fiscal dominance in relative asset supplies. In estimating Jamaica's real equilibrium exchange rate, Williams (2008) demonstrated that the two normative approaches that were employed gave conflicting results suggesting a state of over-valued currency in one, and a state of equilibrium in the other. A third method, being a more positive approach, however suggested a state of equilibrium[3].

The issue surrounding appropriate measure of competitiveness was confronted by Hendry (2001). It was indicated that the real effective exchange rate (REER) may not adequately capture the level of competitiveness in Jamaica. He pointed out that depreciation, contrary to typical belief, does not necessarily lead to an improvement in external competitiveness. The validity of the REER as a measure of competitiveness was also evaluated by Henry and Longmore (2003) in determining its impact on elements of Jamaica's current account. The results show little correspondence of the REER to current account components and demonstrated that selected exports had insignificant responses to alterations in the REER. Henry (2001) recommended the use of alternative measures of competitiveness in conjunction with the REER. These include Unit Labour Cost, Profitability among Tradables, Ratio of Tradables to Non-tradables, and the ratio of Trade Balance to Total Trade.

[3] Williams (2008) utilized three methods which were the Macroeconomic Balance (MB) approach, the External Sustainability (ES) approach, which are both normative in nature. The last method recognized as the Equilibrium Exchange Rate (ERER) approach is the more positive direct estimation method.

Contrary to previous studies, this paper seeks to ascertain the equilibrium state of the RER over three distinctive time horizons. Inter-temporal contrasts are conducted to determine the current position and likely direction of the RER relative to the SR, MR, and LR measures of equilibrium. Acknowledging the misguided perception of RER as a one sided indicator of competitiveness, the paper adopts methods that explicitly captures both the exchange depreciating and exchange appreciating increases in competitiveness[4]. This paper also employs alternative measures of competitiveness as recommended by Henry (2001) in evaluating misalignment and the steady-state conversion of Jamaica's fundamentally determined equilibrium exchange rate over the three time horizons.

Outline of Paper

Section 2 of this paper follows with a conceptual framework within which equilibrium exchange rates are evaluated. Section 3 follows with a literature review outlining the crucial elements of equilibrium exchange rate models grouped within three distinctive time horizons (SR, MR, & LR). Section 4 gives a description of the data and key fundamental variables and competitiveness indicators observed in the investigation. Section 5 provides a trend analysis of the key fundamental variables followed by Section 6 which outlines the econometric methods employed in carrying out the various empirical analyses. Section 7 presents the econometric results generated form the range of empirical tests conducted that is immediately followed by Section 8 that evaluate key indicators of competitiveness in relation to periods of disequilibrium. Section 9 concludes with a survey of the interpreted findings within the paper followed by a bibliography and appendix with key tables and graphs.

2 CONCEPTUAL FRAMEWORK

Exchange Rates Defined

Mishkin (2004) defines exchange rate as "the price of one currency in terms of another". This is also regarded as the nominal exchange rate. A real exchange rate can be expressed as the nominal exchange rate adjusted for any price differences between two or more countries. Depending on the prices being observed for the two countries (trade prices, consumer prices, wholesale prices, producer prices, GDP deflators, labour costs etc), the measurement of real exchange rate can take on very different values and direction of change and interpretation. The

[4] There are instances when competitiveness can be enhanced from rising productivity. In such cases the exchange rate appreciates from an increase in the demand for domestic currency. This contradicts the common perception that in order to become more competitive, the exchange rate has to depreciate.

real exchange rate (RER) can be expressed in the manner shown in equation 1. A representation of the real effective exchange rate (REER) is derived from a composite weighting of the RER for a range of key trading partners. This is expressed in equation 2 below:

$$RER = S_{ijt}(P_{it} / P^{*}_{jt}) \quad \textbf{(1)}$$

$$REER = \prod_{j=1}^{n}\left[S_{ijt} P_{it} / P^{*}_{jt}\right]^{\omega ij} \quad \textbf{(2)}$$

Where *RER* and *REER* is the real exchange rate and real effective exchange rate respectively; S_t is the nominal exchange rate between country *i* and *j*; P_{it} is the price level for the domestic country *i* and P^{*}_{jt} is the price level for the foreign country *j*.[5] The real exchange rate is expressed as a geometric mean where ω_{ij} is the weight of the foreign country *j* in the total trade of country *i*.

Exchange Rates Parity Conditions

There are two fundamental bases on which theorists believe exchange rate adjustments are made. These include the Purchasing Power Parity (PPP) and the Uncovered Interest Parity (UIP). Formally stated, Purchasing Power Parity (PPP) is based on the Law of One Price which implies that, in two countries that produce a similar good with minimal transportation costs and barriers to trade, the exchange rate should be such that the cost of a non-differentiable good remains the same throughout the world irrespective of the country in which it is produced (Mishkin 2004). PPP extends this law of one price to require that any adjustments in the price or cost of producing the particular good will result in an appropriate adjustment in the exchange rate to ensure that the law of one price holds.

Uncovered Interest Parity (UIP) is based on the Theory of Asset Demand assuming currency transfers between territories are free of capital mobility restrictions rendering deposits in foreign currency to be a perfect substitute for deposits in domestic currency. On this basis the decision about whether to hold foreign or domestic currency deposits will depend solely on the rate of interest offered on either domestic or foreign currency deposit accounts. Both domestic and foreign investors will shift deposits to the territory that offers a higher rate of interest on their respective currency deposits. The uncovered interest parity condition therefore requires that the

[5] Real effective exchange rate (REER) is contrasted to the bilateral exchange rate which is the exchange rate between the domestic country and a single foreign country. Like the REER, it is normally expressed as the quantity of foreign currency it takes to acquire one unit of the domestic currency. Hence an appreciation is represented as an increase in the exchange rate while depreciation is reflected as a reduction.

exchange rate be adjusted to correct any prevailing interest rate deviations (arbitrage) between the observed territories.

Equilibrium Exchange Rate

The conditions of PPP and UIP are essentially equilibrium conditions that identify the ideal level of exchange rate between a domestic economy and its trading counterpart. The PPP condition holds when the exchange rate is such that the price of a local good is indifferent to the price of an identical foreign good. The UIP condition holds when the exchange rate is such that the interest return on domestic currency is indifferent to the interest return on foreign currency deposits. The key difference between the two is that PPP is essentially a long-run (LR) condition due to stickiness of prices over time, while UIP is a short-run (SR) equilibrium condition due to the lower level of friction in capital market interest rates determination.

From a theoretical perspective, SR models emphasize equilibrium exchange rate based on rational market behaviour in light of all available information[6]. MR models emphasize the attainment of a sustainable internal and external trade balance; while the LR models emphasize the structural role that fiscal debt stock and stock flow adjustments will play in determining the equilibrium exchange rate.

It is important to identify an equilibrium exchange rate for two main reasons. They are: (1) the effective monitoring and targeting (monetary policy) of a desired real exchange rate for stability in the foreign currency market; and (2) preserving the level of competitiveness of key export sectors (industries) based on relative import costs and export price with a focus on enhanced productivity and a sustainable balance of payment position. This paper seeks to address both areas of concern in the analysis stemming from the determination of Jamaica's equilibrium exchange rate.

In an extensive survey investigating the concepts of equilibrium exchange rates, Driver and Westaway (2004) expressed the structural form commonly used to explore equilibrium relationships between an exchange rate and the wide cross-section of fundamental and transitional variables. The structure is expressed in equation 3 below.

[6] There are also statistical methods that seek to decompose permanent components from trends in exchange rates. Such models rely on the condition of convergence for proof of equilibrium and are less applicable when a specific equilibrium level is sought after.

$$e_t = \beta' Z_t + \theta' T_t + \varepsilon_t \quad \textbf{(3)}$$

Where e_t represents the specified exchange rate at time period t, Z_t is a vector of MR and LR economic fundamental variables identified by theory, T_t is a vector of transitional variables encompassing lagged dependent, independent and other variables utilized to capture the SR dynamics of the specification. Both β' and θ' are coefficient vectors for the respective fundamental and transitional variables.

3 LITERATURE REVIEW

Short-Run Models

Short-run equilibrium exchange rate is projected from a combination of actual fundamental variables and anticipated transitional variations. The SR equilibrium exchange rate is therefore that estimated rate for which unexpected variations (ε_t) are abstracted out. Driver and Westaway (2004) specify the SR structure of the equilibrium exchange rate as shown below in equation 4.

$$e_t^{SR} = \beta' Z_t + \theta' T_t \quad \textbf{(4)}$$

SR models largely consider capital market dynamics that reflect the actions of asset holders in response to available market information. The theoretical condition that describes this type of response from market participants is the UIP. The range of SR models available for this analysis include the: Flexible Price Monetary Models (FPMM); Sticky Price Monetary Models (SPMM) proposed by Dornbusch (1976); Portfolio Balance model presented by Frankel (1993), MacDonald and Taylor (1992) and Taylor (1995); the Capital Enhanced Equilibrium Exchange Rate (CHEER) model presented by MacDonald (2000); and the Behavioral Equilibrium Exchange Rate (BEER) model presented by Clark and MacDonald (1997 and 1999).

The modeling of equilibrium exchange rate has been widely assessed in economic literature. The FPMM was made popular in the early 1970's post Brenton-Woods shift towards floating exchange rate regimes in the industrialized world: see Rapach and Wohar (2001) and Moura et al (2008). The FPMM proposed that prices are flexible and that PPP holds continually; see Frankel (1976) and MacDonald (1992). The poor performance of the FPMM however, led to the recommendation of alternative strategies for explaining foreign exchange rate movements. Dornbusch (1976) introduced the concept of sticky prices, suggesting that prices take time to

adjust, thereby causing nominal and real exchange rates to overshoot equilibrium levels. Dornbusch (1976) showed that with distorted interest rates, exchange rates eventually revert to the PPP equilibrium level based on the velocity of price adjustments.

There are however, other shortcomings that the FPMM and SPMM did not address. Of key concern is the UIP assumption of no restrictions on the mobility of capital between territories. Evidence in support of: home bias, liquidity difference, solvency risk, tributary differences, and the presence of currency exchange rate risks supports the notion of imperfect substitution of assets across borders; see Moura et al (2008). The PBMM was therefore established to remedy the asset market limitation encountered. The model also incorporated stock-flow effects, such as current account misalignments in explaining equilibrium exchange rates (see MacDonald, 1992).

The CHEER model is based on the premise that, at any given point in time, the PPP condition may be in disequilibrium due to non-zero interest rate differentials[7] in the SR. The CHEER model combines both components of the PPP and UIP conditions in determining equilibrium exchange rates. Whereas the PBMM utilized a risk premium to capture the effects of imperfect capital mobility, the CHEER instead utilizes the price differentials. The BEER model is also premised on the UIP condition which accounts for imperfect capital mobility with a risk premium. In this analysis, Clark and MacDonald (1997 and 1999) used other variables regarded as fundamentals to explain variations in the RER.

Medium-Run Models

An exchange rate is theoretically deemed to be at MR equilibrium when the internal and external economic affairs of a country are brought to a point where there is no natural tendency for change (balance or steady state)[8]. The internal balance relates to a position of full employment of resources while external balance relates to a sustainable current account position that is typically consistent with convergence to a LR steady state of stock flow[9]. At the MR level, all "nominal inertia would have been washed out of the system" as noted by Driver and Westaway (2004). This essentially nullifies unexplained and transitional forces on the equilibrium exchange rate rendering its determination wholly on the basis of estimated medium term economic

[7] It is postulated that when interest rate differentials are non-zero, and are needed to finance the capital account, it could result in disequilibrium in the PPP determined real exchange rate. Driver and Westaway (2004) p.37.

[8] Internal full employment is otherwise regarded as the Non Accelerating Inflation Rate of Unemployment (NAIRU).

[9] The term "stock" in the literature refers to the public debt stock of a country while "stock-flows" refer to the fiscal surplus or deficit that will determine the future accumulation or diminishing of indebtedness.

fundamentals[10]. This measure coincides with the concept of flexible price equilibrium that is independent of interventionist type policies. Inline with the structure presented in equation 5, the MR equilibrium is expressed as follows:

$$e_t^{MR} = \beta' \hat{Z}_t \quad \textbf{(5)}$$

The range of MR models contemplated for this analysis include the: Fundamental Equilibrium Exchange Rate (FEER) model investigated by Wren-Lewis (1989 and 1992); and the Desired Equilibrium Exchange Rate examined by Artis and Taylor (1993). The BEER method is also contemplated for the MR analysis though employing less subjective approaches to establishing internal and external balance.

The internal and external balance conditions for the FEER are premised on the optimal levels of capital flow (K) and current account (CA) balance demonstrated by Clark and MacDonnald (1998). Faruqee, Isard, and Masson (1998) also show that the difference between savings and investment will reflect this balance. It is demonstrated that any deviation from the estimated CA and the actual CA after considering seasonal trends and specification errors, will unveil that FEER that is required to maintain some optimal level of the income and savings condition. The term Desired Equilibrium Exchange Rate (DEER) is another name for the FEER that highlights the normative characteristic of the model, see Bayoumi et al (1994) and Artis and Taylor (1993).

The FEER / DEER methodology is characterized as normative[11] in a sense that the indicators of internal and external balance are calculated to derive ideal/optimal/desired levels. The optimal calculations are then superimposed in the determination of an equilibrium exchange rate. A representation of the FEER was conducted for Jamaica by Williams (2008) using two established methods of calculating equilibrium norms[12]. The results yielded inconsistent results where one method, the external sustainability approach (ES), alluded to a state of equilibrium and the other, macroeconomic balance approach (MB), a significant overvaluation. A BEER model was also estimated which suggested that Jamaica was in a state of MR equilibrium, consistent with the External Sustainability approach.

[10] Driver and Westaway (2004) suggest that the premise on which equilibrium exchange rate is wholly dependent on fundamental variables is only valid if there are no significant hysteresis effects and that adjustments take place within the reasonably short run.

[11] The normative method of the FEER is considered by some a limitation since the ideal levels are superimposed by the investigator by a calculated means. The normative nature of FEER is alluded to by the founder Williamson (1994) and other seminal papers such as Clark & MacDonald (1998), p.6, and Driver & Westaway (2004) p.46.

[12] These two methods included the Partial Macroeconomic Balance (MB) approach suggesting disequilibrium while the External Sustainability (ES) approach suggested a stable exchange rate.

In an assessment of extensions to the Macroeconomic Balance Approach, Isard, Faruqee and Debelle (1998) demonstrated that both a partial adjustment model and error correction model generated satisfactory explanations of the CA behavior in relation to various explanatory affecting the savings and investment balance. Clark and MacDonald (1998), however, points out that, unlike the BEER approach, the FEER has no theoretical basis on which a convergence to equilibrium is explained. Rather the FEER is simply a method of calculating an equilibrium exchange rate given optimal levels of the CA and Savings & Investment balance. Any adjustment to the exchange rate is then assumed depending on the relative position of the actual exchange rate to the calculated equilibrium rate.

This paper is focused on the less-normative methods of estimating the equilibrium path of the REER. In light of this, the BEER is used to estimate the behavioral impact of MR and LR and Transitional variables on the REER. Among the list of LR variables are joint relationships that will establish equilibrium by imposing parameter restrictions. Cointegration and Error Correction techniques are employed to arrive at the results.

Long-Run Models

LR equilibrium exchange rate is considered to be the level consistent with equilibrium stock-flows. At this stage, there are no endogenous tendencies for change, such that all MR related bubble, and cyclical effects nullified (see Driver & Westaway 2004). The LR equilibrium expression is presented in equation 6, where the bar represents the LR state of variables.

$$\bar{e}_t^{LR} = \beta' \bar{Z}_t \qquad \textbf{(6)}$$

In the literature, two predominant methods are utilized in observing LR equilibrium exchange rates. They include (1) the purely statistical approach where focus is placed on the decomposition of a permanent component of the exchange rate trend; and (2) the fundamentals approach, which seeks to explain equilibrium exchange rate based on a desirable (steady state) level of capital or stock-flow expected to be attained in the long-haul.

The models explored for conducting the LR analysis include the Natural Real Exchange Rate (NATREX) approach presented by Stein (1994), Stein and Allen (1995), and Stein and Paladino (1998); the Permanent Equilibrium Exchange Rate (PEER) model, and the Structural Vector Autoregression (SVAR) model utilized by Clarida and Gali (1994).

The NATREX approach is an offshoot of the FEER which incorporates the impact of fundamental variables on the equilibrium exchange rate. The method also incorporates the portfolio balance condition that domestic and international real interest rates are aligned. The NATREX can be used for either MR or LR analysis. After estimation, the equilibrium level is derived from setting residuals equivalent zero. Where as NATREX takes on the normative methods employed by the FEER and removes random transitory effects, the PEER instead utilizes the more positive BEER model from which the equilibrium REER is derived from a permanent decomposition of the estimated results.

The SVAR model is useful in identifying key shocks that have and are likely to affect the real exchange rate. The method however, cannot provide a reliable equilibrium exchange rate level due to starting point limitations. Emphasis is therefore placed on the fundamentals based approach, and in particular the BEER method following which the permanent component is decomposed to reveal an equilibrium REER path. This method of estimating the PEER is adopted from Fernandez et al (2001).

Model Selection

The selection of models is based on conformity to the criteria of being fundamentally determined. Additionally, data accessibility will confine research to those models for which adequate data representation can be attained. For the purpose of this paper, the BEER method was employed for both SR and MR analysis and also combined with the PEER method to determine a LR permanent component. The FEER methods were rejected on the basis of inconsistent results presented on the case of Jamaica (see Williams 2008), and the less than positive approach employed in the investigation. The methods employed by Clark & MacDonald (1998), and Melecky & Komarek (2005) is adopted for the SR and MR BEER determination.

The method employed by Fernandez et al (2001), utilized the BEER estimation technique to explain the RER following which the transitory and permanent components were decomposed. The Permanent component is considered the LR PEER that will unveil periods of over and undervaluation when compared to the original RER.

4 DATA DESCRIPTION

Monthly data is used for the period April 1995 to July 2009. The Nominal Exchange Rate (NER) is used to model the SR CHEER Model while the Real Exchange Rate is (RER) used as the dependent variable for the BEER and PEER models The RER is adjusted expressed as the NER adjusted by the ratio of foreign and domestic consumer prices. RER are expressed in foreign dollars per unit of domestic dollars. Resultantly, any increase in the RER represents an appreciation. The NER however is represented as domestic dollars per foreign dollar. In this case an increase is synonymous to depreciation.

Domestic Price (PRID) - Domestic prices are used to capture the impact of inflation on exchange rates. The transmission may either be by a substitution or income effect. As it pertains to the former, when domestic prices increase, local consumers are expected to shift demand away from the more expensive domestic goods to the relatively cheaper foreign goods. In such circumstances, the demand for domestic currency decline resulting in depreciation. The income effect reflects a greater demand for the domestic currency to maintain the same level of consumption. As such, domestic inflation would result in an appreciation. The domestic price (PRID) is the log of Jamaica's Consumer Price Index (CPI).

Foreign Price (PRIF) - Foreign prices, like domestic prices also affects the exchange rate by transmission of the substitution and or income effect. By substitution, an increase in foreign prices, will trigger an increase in the demand of relatively cheaper domestic goods away from the more expensive foreign goods. In this case, more domestic currency is demanded relative to the foreign currency resulting in an appreciation of the domestic currency. The income effect reflects a greater demand for the foreign currency to maintain the same level of consumption. As such, foreign inflation would result in a depreciation of the domestic currency. In this paper, the log of US Consumer Price Index is used for the foreign price (PRIF).

Domestic and Foreign Interest Rates (INTD & INTF) - Interest rates are expected to have a direct impact on currency holdings. Higher domestic interest rates, all things being equal, are expected to result in both domestic and foreign investors shifting holdings away from foreign currency deposits to domestic currency depost. When foreign interest rates increase, the opposite effect of a rising domestic interest rate becomes true. The domestic interest rate used for this paper is

Jamaica's 6 month annualized Treasury bill rate in decimals. The foreign interest rate taken as the US 6-month annualized Libor rate is used for the purpose of this paper.

Interest Rate Differential (RIRD) [negative] – Trends in the interest rate differential is expected to capture the uncovered interest parity (UIP) condition which suggests that portfolio investors will shift capital to a territory with relatively higher interest rates. The UIP condition requires that the exchange rate adjusts to prevent any arbitrage emerging from interest rate differentials between territories. Therefore, an increase in the Jamaican interest rates (INTD) relative to that of the US interest rate (INTF) would attract investors away from USD to JMD denominated holdings (deposits). Naturally the demand for JMD would increase causing a domestic (JMD) appreciation. However, the theory of UIP requires that the exchange rate will adjust to nullify any arbitrage and thereby prevent significant shifts in portfolio balances of either domestic or foreign denominated currencies. The real interest rate differential (RIRD) is derived from the INTD net of Jamaica's 12 month headline inflation rate minus the INTF net of the US 12-month inflation rate.

Net Foreign Asset (NFA) [positive] – The impact of the LNFA on the exchange rate is considered from two perspectives. From a portfolio balance perspective, a current account deficit or worsening thereof will require financing from international investors who will demand higher yields which can only be achieved by exchange rate depreciation if interest rates are taken as given. Therefore deterioration (decline) in the LNFA by way of increased foreign currency liability should lead to depreciation (decline) in the RER and vice versa in light of the portfolio balance effect. The alternative reasoning is that debt attained to finance CA deficits will attract interest payments. It is only by way of an improved trade balance that premiums can be afforded. This will require a depreciation of the domestic currency in order to increase competitiveness, improve the trade balance, and hence, ability to service such loans. The LNFA is calculated as the total foreign assets held by Jamaica's Central Bank, Commercial Bank & Central Government in millions of USD minus total foreign liability held by the same institutions. The values are then expressed in logs after normalizing by way of adding 1 million to each value considering all values are negative where Jamaica is a net borrower.

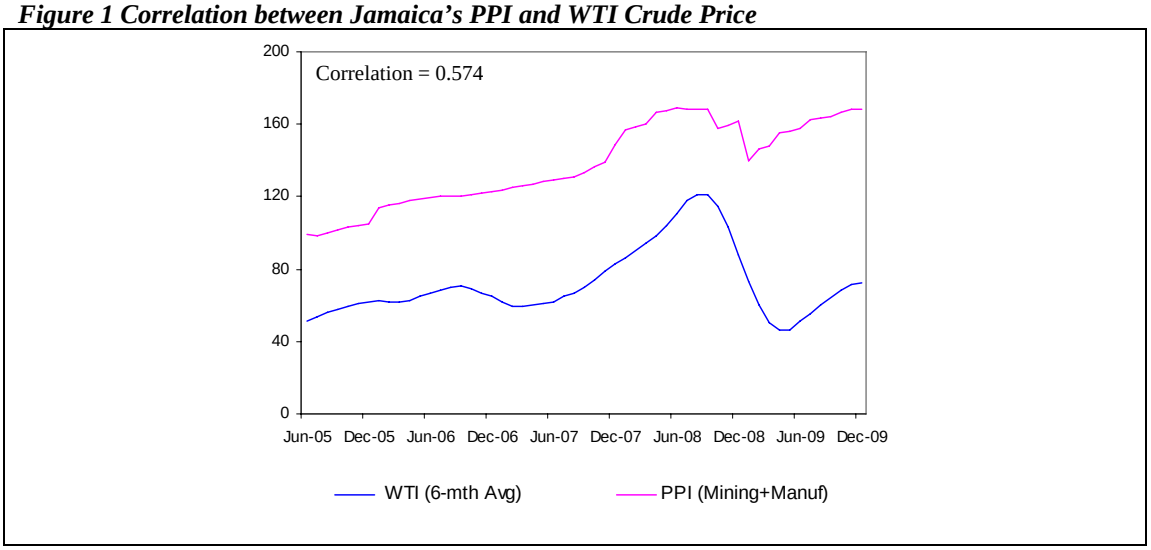
Net Government Debt Differential (LNGDD) [positive] – This risk premium is included in SR models to take account of limitations associated with presence of imperfect mobility of capital across borders. When domestic debt increases relative to foreign denominated debt, the domestic risk premium will increase. Since investors require higher compensation for this added risk, if

interest rates are given, then the domestic currency will depreciate. For the purpose of this paper LNGDD is expressed as the log of total GOJ and BOJ domestic debt in millions of USD minus the log of total foreign debt liabilities held by the same institutions in millions of JMD.

Productivity (Balassa Samuelson) [positive] PROD

Higher productivity generates increased wealth and higher capacity for domestic spending. Should the level of productivity among tradable goods increase, wages and employment are then expected to increase. If there is a high degree of labour mobility across tradable and non-tradable sectors, wage prices will also be bided up in the non-tradable sector. When domestic wages increase, prices are bided up generating a higher demand for domestic currency. This higher currency demand triggers an appreciation. It is this positive relationship between productivity and domestic currency appreciation that has been coined the Balassa Samuelson effect[13]. Typically

Figure 1 Correlation between Jamaica's PPI and WTI Crude Price



productivity is indexed by the ratio of GDP to total labour employed. However due to data limitations an alternative but popular[14] proxy is utilized to measure productivity in the tradable sector. The Productivity index (PROD) is calculated as the log difference between Jamaica's consumer and producer indexes, minus the log difference between the US consumer and producer price indexes. Jamaica's Producer Price Index is proxied by the West Texas Intermediate (WTI)

[13] The Balassa-Samuelson Effect demonstrates that when examining a country's competitiveness, anything that causes the productivity in the tradables sector to increase more than proportionate to productivity growth in the non-tradable sector, will bring about an appreciation of the real exchange rate vis-à-vis its trading partner.

[14] Fernandez, and Schnatz (2001).pp12.

crude oil price due to the limited time-span available for the PPI[15]. The PPI reflects the simple average of both the Mining and Manufacturing Producer Price Indexes for Jamaica. The correlation between Jamaica's monthly PPI and the 6-month average of the WTI is 0.57 (See Figure 4.1).

Terms of Trade [positive] TOT is an indicator of the degree of competitiveness between trading partners. A country that depends heavily on oil, for instance, might experience deterioration in its TOT if oil prices should increase whereas; an oil exporting trading partner would experience an improvement in its TOT. The theoretical underpinnings suggest that a change in the TOT has both income and substitution effects on the exchange rate, see Melecky & Komarek (2005). Consider a case where the price of exported goods increased causing an improvement in the domestic TOT. The substitution effect suggests that domestic producers will drive production among tradables and away from non-tradables. The resulting wage increases that follow, spurs demand across both tradables and non-tradables. The higher prices and boost in the current account that follows will stimulate an appreciation of the domestic currency. The Income effect emerges when a rebalancing adjustment of the exchange rate takes effect to restore internal equilibrium between both tradables and non-tradables. The TOT variable is expressed as the ratio of BOJ's export index to the import index. The variable is then logged for consistency.

The following variables recommended by Henry ( ) were used in the analysis as a measure of competitiveness. Due to data limitations, the analysis of competitiveness within Jamaica is restricted to quarterly trends for the time period March 1998 to December 2009. The variables include Unit Labour Cost (ULC), Ratio of Tradables to Non Tradables (TNT), and Trade Balance to Total Trade (TBT). Details are provided below:

Real Effective Exchange Rate (REER) - The REER as defined in equation 2 is actively used as a measure of competitiveness by the Bank of Jamaica. Jamaica's REER is the geometric mean of bilateral exchange rates weighed against the largest 10 trading partners (see equation 1). The REER is expressed as the cost of one local dollar in terms of the weighted foreign currencies thereby representing an appreciation when increased and depreciation when reduced. The REER is typically used as a measure of competitiveness whereby an increase (appreciation) in general terms signifies a decrease in competitiveness and the inverse, an increase in competitiveness.

[15] Jamaica's Producer Price Index (PPI) has its first data point in January 2005 and is available on a monthly frequency.

Unit Labour Cost (ULC) [] – Unit labour cost captures how much a country spends to produce a unit of output. A lower ULC represents increased cost of production while higher values represent a greater level of production per dollar spend. As such a country is deemed more competitive when the ULC increases and less competitive when there is a decline. For our purpose, the ULC for Jamaica is calculated as Total real value added at basic prices divided by total wages paid to the employed labour force. A relative ULC is derived from the ratio of Jamaica's ULC divided by the OECD calculated ULC for the US.

Ratio of Tradables to Non Tradables (TNT) [] - The ratio of Tradables to Non-tradables is an indicator of productivity. When Tradables increase relative to Non-tradables, it suggests relatively more wealth is being directed towards the production of goods for trade. As such it implies greater profitability among tradables relative to non-tradables. A higher ratio is therefore consistent with increased competitiveness. Greater productivity leads to increased employment and a greater demand for the domestic currency. This results in the well-known Balassa Samuelson effect of a domestic appreciation where there is increased productivity attributed to increased competitiveness.

Trade Balance to Total Trade (TBT) [] - The ratio of trade balance to total trade (TBT) captures the shifting bias of trade to either imports or exports. TBT is calculated as the twelve month balance of total imports minus total exports, all divided into by the sum of total import and export. An increase in TBT therefore captures an increasing bias towards the importation of goods while a decrease suggests an increasing bias to exports. The former reflects a deterioration in the terms of trade while the latter an improvement.

5 DATA TREND ANALYSIS

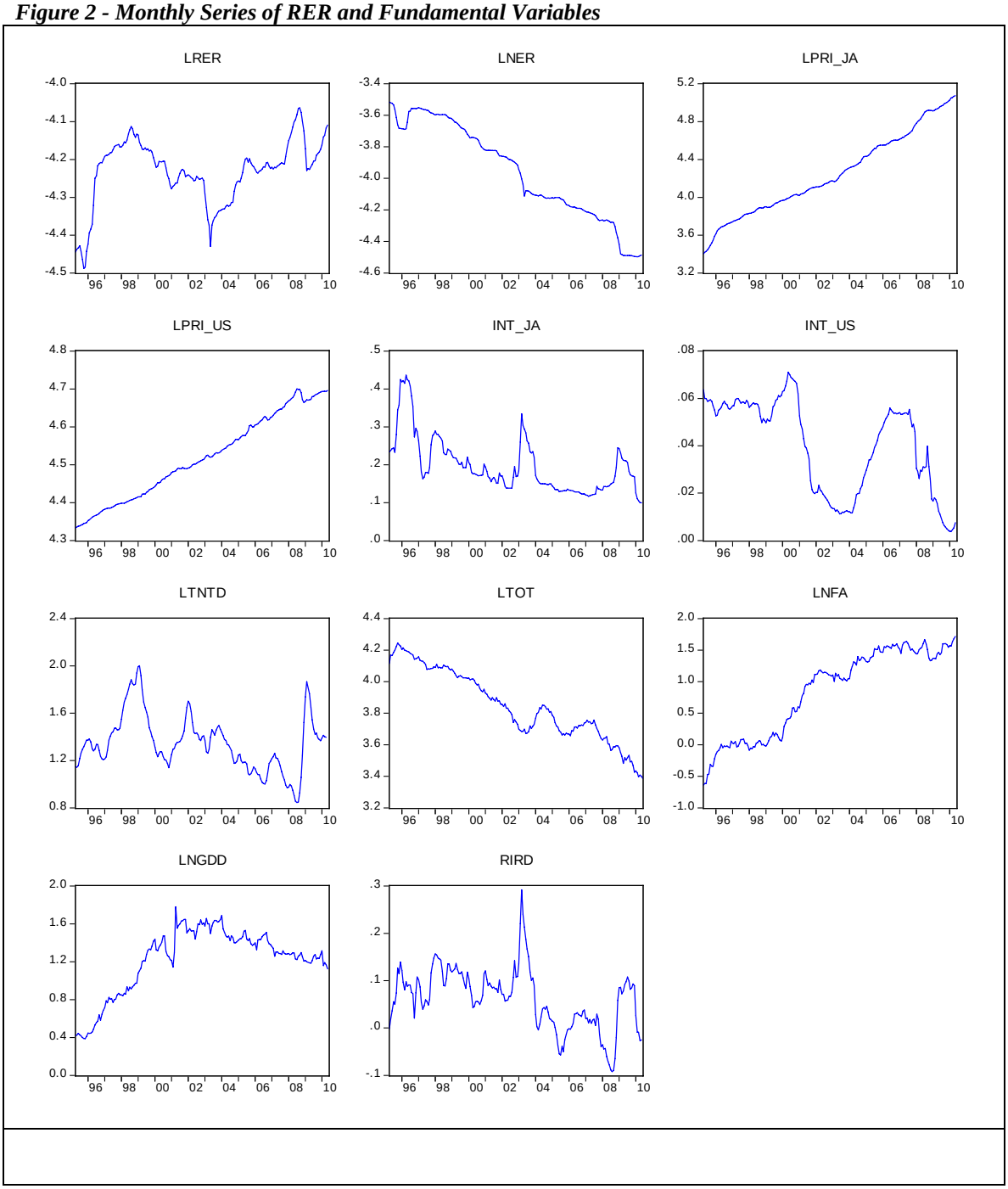
Trends of the variables reviewed in the previous section are shown in figure 2. All trends are expressed in logs except for the real interest rate differential (RIRD) and the two dummy variables (DUM1 & DUM2). The first dummy is used to capture unexplained positive shocks to the real exchange rate (LRER) while the second captures unexplained negative shocks. Between Oct-1995 and Aug-1996 real exchange rates appreciated consistently and significantly from the lowest point in the period under review. Following this, the LRER gradually increased to a peak for the late 1990's on Aug-1998. Following this, a gradual downward trend spanned the period

Aug-1998 to Dec-2002 (4.3 yrs) characterized by moderate oscillations. Between Dec-2002 and May-2003 the LRER experienced a steep falloff venturing close to the lowest level experienced in Oct-1995. Following this, the real exchange rate reverted to a strong upward trend over the period May-2003 to Jul-2005 (2.3 years). The real exchange rate then remained relatively stable over the period Jul-2005 to Oct-2007 (1.5 years). Immediately following this relative stability, the real exchange rate appreciated with a significant and consistent slope over the 12-month period of Oct-2007 to Oct-2008. After the period of relative stability the LRER continued to appreciate consistently peaking within 12 months in October 2008 while hovering within that range for the remainder of 2008. However, in the first two months of 2009, there was a drastic depreciation of the real exchange rate to levels consistent with the one year stability observed during mid 2005 to late 2007.

The trends in Tradable to Non-tradable Difference (LTNTD) bears close resemblance to the LRER. The steep and gradual appreciation during the mid to late 1990's characterized by corresponding movements in the LTNTD. When the LRER reverted to a gradual downward tend in latter half of 1998, the LTNTD overshoot this trajectory and only reverted to a downward trend (12 months later) in late 1999. Following this, the LTNTD gradually declined as did the LRER for the next 2 ½ years beginning in Nov-1999. The LTNTD, however, severed ties with the LRER in mid 2002 when a steep increase in the LTNTD was eventually fallowed by the drastic falloff of the LRER in the first 5 months of 2003. As the LRER begun a strong recovery by appreciating, the LTNTD (5 months later) started gradually declining against the gradual appreciation of the LRER for a period of 3 years ending July 2006. Following this, the LTNTD and LRER was once more synchronized with the exception of the 2 month LRER correction observed at the start of 2009 which appeared as a gradual adjustment in the LTNTD since.

The Terms of Trade (LTOT) depicted a general upward trend for the major part of the data set. Nonetheless, the trend reflected slight oscillations and some cyclical shifts over the range. The LTOT demonstrated no coincidental movement with the LRER in the 1995 to 1996 period when the LRER appreciated drastically. Nonetheless, following this period, variations in the LTOT appeared to move in direct opposition to the LRER for the 6 year period to 2002 end. Following the strong depreciation of the LRER in the first 5 months of 2003, the LTOT and the LRER have since moved in harmony with the LTOT leading the LRER by approximately 5 months. This was evidenced in the strong appreciation in the 12 months to Oct-2008 and the sharp corrective depreciation that followed.

Figure 2 - Monthly Series of RER and Fundamental Variables



The log difference between Domestic and Foreign Debt, termed Net Government Debt (LNGDD) also bears features similar variations with the LRER. This is particularly true during the significant real appreciation experienced between 1995 and 1996 along with the gradual appreciation that followed into mid1998. The LNGDD also demonstrated stark similarities in the

appreciation observed in the 12-month period to Oct. 2008 and the sharp fall off in the first two months of 2009. Like the LTNTD, the LNGDD also overshoot the gradual appreciation in the LRER by approximately 12-months up to late 1999. Over the period 2000 to 2003, the LNGDD declined gradually inline with the LRER in like manner to the LTNTD. The sharp real depreciation of the LRER that spanned the first 5 months of 2003 was not featured in the LNGDD but the corrective appreciation that followed was however reflected in the LNGDD.

The net of total foreign asset to total foreign liability in Jamaica, termed Net Foreign Asset (NFA), displayed key correlations when compared to the LRER. In the 7 month period between Nov-1995 and Jun-1996 when the LRER reflected a significant appreciation, the LNFA displayed a consistent but moderate upward trend that had already been in motion the start of the series. When the appreciation of the LRER in late 1996 slowed to a moderate increase, the LNFA switched to a relatively stability that lasted for approximately 3 ½ years to the close of the decade. At the beginning of 2000 when the LRER had already been following a moderate depreciation for approximately 12 months, the LNFA started a moderate increase against the LRER continuing depreciation. By January 2003 when the LRER suffered a sharp depreciation over 5 months, the LNFA followed with a decline. Thereon, the LNFA remained relatively stable until another notable decline that manifested in approximately 5 months prior to the sharp depreciation of the LRER in only 2 months.

The real interest rate differential (RIRD) varies inversely to the LRER during the 3 main periods of significant LRER changes. These included the 12 month period of depreciation followed by appreciation between both Jul-1995 and Jun-1996, and Jan-2003 to Dec-2003, and the appreciation followed by depreciation observed between Oct-2007 to Feb-2009. Throughout the period of investigation the RIRD displayed continuous oscillations also reflecting inverse correlations when compared to less pronounced variations in the LRER. This is consistent with the expected negative relationship between LRER and RIRD as proposed by the theory of UIP.

6 ECONOMETRIC METHOD

Both the CHEER and BEER empirical investigations utilized cointegration techniques that are outlined in steps 1 to 4 below. Step 5 represents the additional step employed having complete the BEER investigation to arrive at results for the PEER.

(1) Conduct unit root tests on the range of variables to ensure valid properties of the selected series estimation
(2) Determine the appropriate equilibrium specification using Transitional variables and the given MR and LR variables.
(3) Conduct Cointegration tests on the MR and LR variables accounting for any additional exogenous variables.
(4) Estimate the Vector Error Correction Model (VECM) and demonstrate credible results based on sign of cointegrating parameter, speed of convergence, and strength of exogeniety among other variables.
(5) Decompose the Transitional and Permanent component for joint BEER and PEER method.

CHEER Methodology

The CHEER model adopted for this paper follows the investigative approach of MacDonald & Marsh (1997). The CHEER enhances the PPP condition with components that are responsive to capital market dynamics. This is represented in equation (4).

$$NER_t = \beta_1 P_t - \beta_2 P_t^* + \beta_3 I_t - \beta_4 I_t^* + \varepsilon_t \quad \textbf{(7)}$$

Where:

NER_t	=	column vector of spot exchange rate between the US and JA[16].
P_t	=	vectors of domestic consumer prices in logs
P_t^*	=	vectors of foreign consumer prices in logs
I_t	=	vectors of annualized 3 month domestic interest rate
I_t^*	=	vectors of annualized 3 month foreign interest rate
β_k	=	coefficients vectors of the CHEER specification for k = 1 to 4.
ε_t	=	the random disturbance component.

All variables are expressed in logs except for domestic and foreign interest rates that are represented in decimals. Stationarity tests are first conducted on the range of variables as a prerequisite for cointegration analysis. The commonly used Aumented Dickey Fuller and Phillips Perron tests were used for this purpose. A range of diagnostic tests are then conducted on varying deterministic components. Tests for no serial correlation and normality in the errors, required for appropriate error correction methodologies are also implemented. The number of cointegrating vectors is then evaluated by way of the Johansen trace and maximum eigen values. Multiple

[16] Measured as USD per JMD, therefore an increase represents an appreciation.

cointegrating vectors would require the Johansen maximum-likelihood procedure in appropriately estimating error correction. Otherwise the standard Engel Granger methodology would suffice.

The sign and significance of the cointegrating coefficient is then evaluated for proof and speed of error correction in the specified model. With proof of error correction, the VECM residual is tested for white noise and significance of constant and trend. The cointegrating coefficient is expected to remove all information from the residuals leaving a white noise and no significant constant or trend. At this stage the estimated component of the cointegrating equation, considered to be the equilibrium, is then decomposed and compared to the actual exchange rate. Any deviations between the two (equilibrium and actual exchange rate) is labeled the exchange rate misalignments as implied by the proposed model (CHEER).

In accordance with MacDonald and Marsh (1997), a number of restrictions are performed on the cointegrating equation (beta matrix) to test for evidence of PPP and the relevance of domestic and foreign interest rate inclusion. Establishing the adequacy or limitations of the model will aid in assessing the term, direction, and leading factors associated with misalignments in the applicable exchange rate.

BEER Methodology

The BEER model employed was based on the methods employed by Clark and MacDonald (1998). The recommend structural form of the BEER model derived from equation (8) is also represented in equation 9.

$$RER_t = \beta_1 Z_{1t} + \beta_2 Z_{2t} + \gamma T_t + \varepsilon_t \quad \textbf{(8)}$$

$$RER_t = BEER_t + \gamma T_t + \varepsilon_t \quad \textbf{(9)}$$

where:

RER_t	=	column vector of Jamaica's US-bilateral real exchange rate
Z_{1t}	=	vectors of LR fundamental variables
Z_{2t}	=	vectors of MR fundamental variables
β_1, β_2	=	coefficients vectors of the equilibrium specification.
T_t	=	vector of transitory factors
γ	=	reduced form coefficient vector.
ε_t	=	the random disturbance component.

Congruent with Clark and MacDonald (1998), this paper classifies the MR related variables within the Z_{1t} matrix and the longer LR variables within the Z_{2t} matrix. The variables utilized in the MR matrix includes the terms of trade (LTOT), net foreign asset (LNFA), and the measure of productivity represented by trade to non-tradable differential (LTNTD). Net government debt differential (LNGDD) was also included to capture risk premium stemming from adjustments to the fiscal stock position over the long haul while the real interest rate differential (RIRD) captures the inter-temporal effects of UIP. The range of dummy variables, constant, trend and components of the ARIMA structure that are proven significant at the 5% level of significance are classified as Transitional variables T_t. The BEER model is represented as shown in equation 10.

$$RER_t = \left[\beta_3 LTOT_t + \beta_4 LNFA_t + \beta_5 LTNTD_t + \beta_1 RIRD_t + \beta_2 LNGDD_t\right] + \gamma T_t + \varepsilon_t \qquad \textbf{(10)}$$

The path of the RER determined by the VEC specification is considered the equilibrium RER from the BEER model for the SR to MR. This is then matched against the original RER to determine periods of over and under valuation. Clark and MacDonald (2000) highlights that real interest rate differentials are likely to reflect business cyclical developments as opposed to systematic trends over longer periods. On this basis, a second BEER is calculated whereby RIRD is classified as a transitional variable.

PEER Methodology

The PEER presented by Fernandez et al (2001) is adopted for this analysis. Whereas the BEER establishes equilibrium using actual fundamental values, the PEER superimposes equilibrium conditions on the fundamentals within the BEER specification. Hence, the PEER may be considered an augmented BEER representation. In accordance with Clark & MacDonald (1998) the PEER can be represented as shown in equation 11, and 12.

$$RER_t = \beta_1 \overline{Z}_{1t} + \beta_2 \overline{Z}_{2t} + \gamma T_t + \varepsilon_t \qquad \textbf{(11)}$$

$$RER_t = PEER_t + \gamma T_t + \varepsilon_t \qquad \textbf{(12)}$$

The bars in equation 11 represents equilibrium levels of fundamentals, and β_1, β_2, and γ are the original vectors of coefficients from equation 8. As demonstrated by Clark & MacDonald (1998), a Hodrick-Prescott (H-P) filter is used to attain LR trends of the fundamentals for the Z bars.. The decomposed permanent component is considered to be the LR PEER. This too is matched against the original RER to determine periods of over and under valuation of the domestic currency over the long haul.

7 ECONOMETRIC RESULTS

Model results for the three distinctive time horizons are presented within this section. These include (1) the SR Capital Enhanced Equilibrium Exchange Rate (CHEER) model, (2) the MR Behavioral Equilibrium Exchange Rate (BEER) model, and (3) the LR Permanent Equilibrium Exchange Rate (PEER) model.

CHEER Model Results

Equation 6 was used to evaluate the CHEER. All variables were stationary in the first difference satisfying the necessary condition for cointegration. Simple regression resulted in approximately 95% of the variation in the RER being explained by the fundamental variables. Including constant trend and dummy variables resulted in over 99% of explained variation. Additionally, the Jarque Bera null of no normality was strongly rejected for the residual.

To formally test the presence of cointegration appropriate lag length tests was first conducted on the range of variables for which the the SC and HQ recommended the nth lag of two (2). The Johansen trace and maximum eigen value tests were then conducted to determine the number of cointegrating vectors. The results show that there was only 1 cointegrating vector at (n-1) lags. With proof of cointegration, the VECM methodology was estimated on a single lag (n-1), accounting for one (1) cointegrating vector and no trend in the cointegrating equation. From the results, all variables except for the interest rate for Jamaica were statistically significant at the 5% critical level. Among the variables, an incorrect signs and significant coefficient was found on the foreign price. Additionally, the domestic interest rate was incorrectly signed but was the only insignificant variable. Nonetheless, the cointegrating coefficient (-0.15) was significant at both the 5% and 1% critical level and appropriately signed (see Table B in appendix). The speed of adjustment is estimated with a half-life of 6 months. Both ADF and PP unit root tests confirms a unit root in levels of the residual with no significant constant and trend. Hence, all information has been captured by the resulting VECM.

The evidence suggests that variations in both Jamaica's price and interest rates do not conform to PPP and UIP respectively. The increase in Jamaica's price level resulted in a depreciation of the domestic currency rendering domestic goods approximately 50% cheaper on the global market (see CHEER1 in Table A of appendix). The Jamaica's interest rate though being statistically insignificant reflected an increase in demand for domestic currency when increased. Both the US

price level and interest rate conforms to the PPP and UIP conditions respectively and are both statistically significant. Higher US prices are not met an approximate one to one depreciation of the exchange rate with the assurance that price increases and decreases in the US are reflected in Jamaica. This is reasonable given that Jamaica depends on the US for supplying a large share of its capital and raw materials. The interest rate impact is also just above one on one where by any increase in the US interest rate is met by an appropriate appreciation of the JMD to ensure that investors to not shift deposit holdings away from JMD denominated to US denominated assets.

The JMD interest rate also reflected a sign contradictory to theoretical expectations. In the CHEER model, JMD appreciated in response to an increase in both the US and Jamaican interest rates. When the interest rate differential was used in place of separate interest rates (see CHEER2 in Table B of Appendix), the UIP condition was nonetheless confirmed. The results suggest that when domestic interest rates increase, the demand for JMD increase demonstrating that some interest rate arbitraging persist without full correction of the exchange rate to eliminate such. This variable was however, statistically insignificant. Change in the US interest rate however, reflects a full adjustment in the exchange rate to prevent any shift in currency away from the JMD to the USD.

Figure 3a & b shows the SR real and nominal equilibrium exchange rate (CHEER) vis-à-vis the respective actual exchange rate for the period being investigated. The results demonstrates that in the period 1995 to mid 1996, the Jamaican dollar was severely undervalued for which a speedy correction was made by the start of 1997. In the 2003 foreign exchange instability the JMD became undervalued on account of market psychology from uncertainty. The resulting disequilibrium gradually dissipated over the next two year. Evidence of SR disequilibrium was observed from late 2007 during a period when oil prices begun climbing to historical highs. Since August 2008, a month after Oil prices began falling, the foreign exchange rate went into a period of expanded overvaluation. A significant depreciation resulted towards the end of 2008 to bring exchange rate back to the equilibrium path.

BEER Model Results

The BEER model was estimated using equation 9. All variables were stationary in the first difference satisfying the necessary condition for cointegration. A simple regression resulted in approximately 35% of the variation in the RER being explained by the fundamental variables. Of the five (5) variables, only three (3) were significant at the 5% critical level. However, including

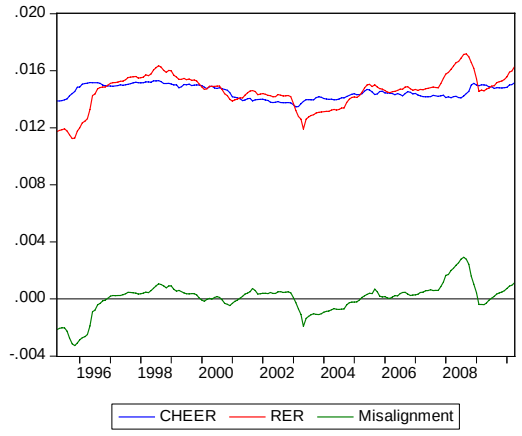
constant and dummy variables resulted in over 82% of explained variation with all variables significant at the 5% and 1% critical level. Additionally, the Jarque Bera null of no normality was strongly rejected for the residual.

Lag length tests was based on the FPE, AIC, SC and HQ filters all recommended the nth lag of two (2). The Johansen trace and maximum eigen value tests were then conducted to determine the number of cointegrating vectors. The results show that there was no more than 1 cointegrating vector at (n-1) lags. With proof of cointegration, the VECM methodology was estimated on a single lag (n-1), accounting for one (1) cointegrating vector and no trend in the cointegrating equation. The results show that, all variables except for Jamaica's Terms of Trade (TOT) and Net Foreign Asset (NFA) had the correct sign. These two variables however, were both insignificant at the 5% and 10% critical level (see Table B in Appendix). The cointegrating coefficient (-0.06) was significant at both the 5% and 1% critical level and appropriately signed (see Table B in appendix). The speed of adjustment is estimated with a half-life of 13 months. The resulting residual proved to be a unit root in levels with no significant constant or trend which supports the notion that all information has been captured. The evidence suggest that there are no significant explanatory power of the theoretically recommended TOT and NFA in explaining variations in the bilateral exchange rate between Jamaica and the USA. Both fundamentals were insignificant and inappropriately signed (see Table B in Appendix).

Among the factors that proved theoretically consistent and significant were the productivity indicator proxied by (TNTD) which supports the Balassa Samuelson effect where an increase in productivity will enhance competitiveness while appreciating the domestic currency. Additionally, the differential between domestic and foreign debt (NGDD) strongly supports the notion that increasing domestic debt will result in a depreciation of the domestic currency vis-à-vis its US counterpart. The real interest rate differential (RIRD) significantly reflects the expected UIP relationship between the domestic and foreign interest rate. The results show that when Jamaica's interest rates are relatively higher than US interest rates, the domestic dollar depreciates to cancel the arbitrage that emerges.

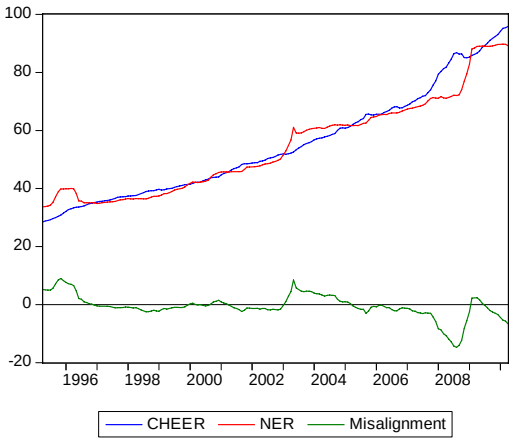
Figure 3 – Monthly Actual and Equilibrium Exchange Rates

CHEER - Real Equilibrium vs Actual Exchange Rate



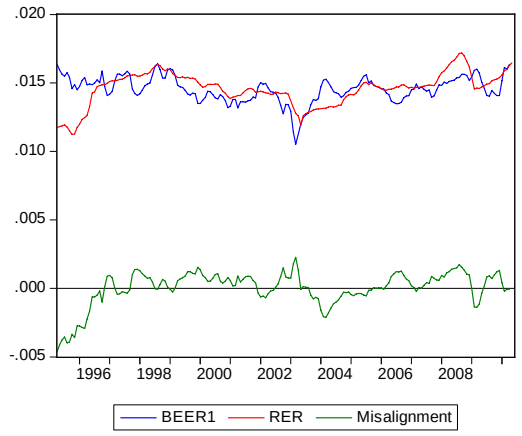
a

CHEER - Nominal Equilibrium vs Actual Exchange Rate



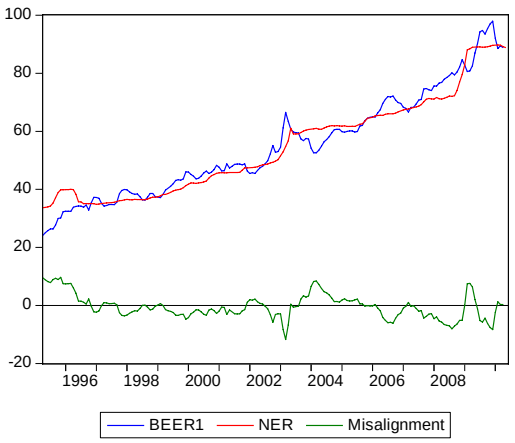
b

BEER1 – Real Equilibrium vs Actual Exchange Rate



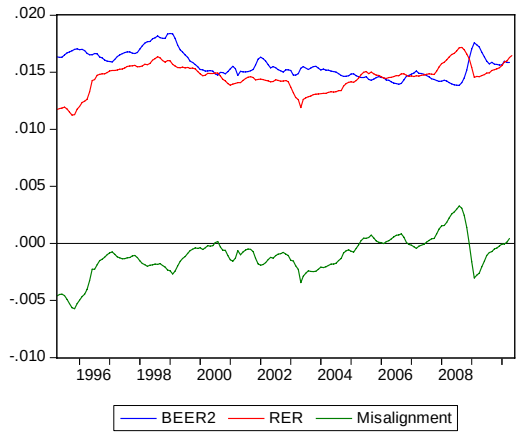
c

BEER1 - Nominal Equilibrium vs Actual Exchange Rate



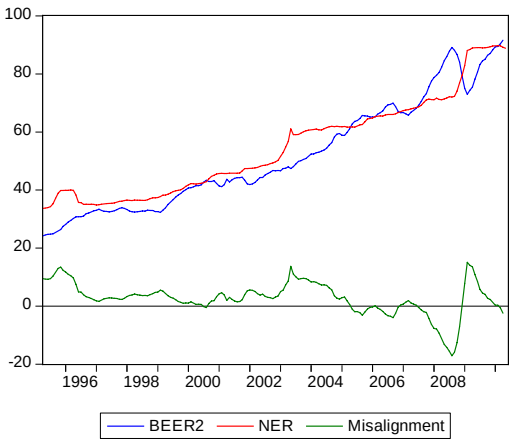
d

BEER2 – Real Equilibrium vs Actual Exchange Rate



e

BEER2 - Nominal Equilibrium vs Actual Exchange Rate



f

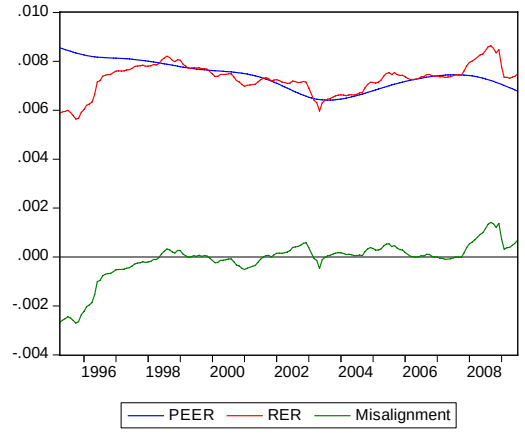
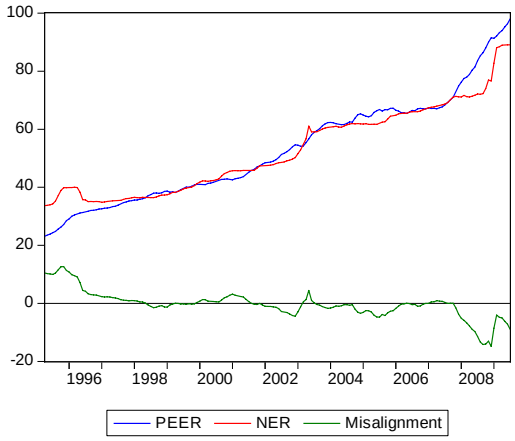
PEER1 - Real Equilibrium vs Actual Exchange Rate	PEER1 - Nominal Equilibrium vs Actual Exchange Rate
 g	 h
PEER2 - Real Equilibrium vs Actual Exchange Rate	PEER2 - Nominal Equilibrium vs Actual Exchange Rate
Clark and MacDonald (1998) characterized total misalignment as $q_t - \beta_1' \overline{Z}_{1t} - \beta_2' \overline{Z}_{2t}$ where q_t is the exchange rate of concern and $\overline{Z}_{1t}$ and $\overline{Z}_{2t}$ are the LR and MR fundamentals respectively. The PEER is the LR equilibrium with Hodrick-Prescott filtered fundamentals Real expressed as USD per JA$1 hence increase equates to an appreciation. Nominal expressed as JMD per US$1 hence increase equates to a depreciation	

Figure 3.c & d graphically compares the BEER (SR) with the actual real exchange rate. With the explanatory power of RIRD, BEER (SR) appears to be much more in sync with the actual RER. The main disequilibrium featured was in relation to the financial crisis in the mid to late 1990's. The other two disturbances that were cited in the CHEER models were cited too in the BEER (SR) but with much less deviation from equilibrium. The BEER (SR) therefore appears to be a much better guide to where the exchange rate should be in the SR. A MR fundamentally consistent equilibrium rate was derived by omitting variations in the RIRD. This was represented by BEER (MR) was proxied by excluding the RIRD (see Figure 3e and 3f). When decomposed, the model demonstrated that for the entire period of 1996 to early 2005, the exchange rate was biased towards being undervalued. Similar to the CHEER, the BEER (MR) revealed that both the financial crisis of the mid to late 1990's and the financial instability of 2003 were periods of excessive depreciation. Nonetheless convergence was present. The 2007 to 2008 period of rising oil prices which culminated in an exacerbated global financial crisis, was a period of significant appreciation in the real measure. Nonetheless, the nominal exchange was kept artificially overvalued during the period following which a significant correction took place within the period October 2008 to February 2009.

PEER Model Results

The PEER model was estimated using equation 11. The parameters are the same as those specified within the BEER model. It was not deemed necessary to calculate two PEER since the cyclical components are believed to be filtered out in the HPF transformation. The PEER revealed that the extended undervaluation relating to the financial crisis of the 1990's and the overvaluation leading up to the 2008 global financial crisis were both distinctive periods of disequilibrium. The model demonstrates, however, that the instability 2003 instability was more inline with fundamentals. The trends demonstrate that prior to the 2003 exchange rate spike; the real exchange rate deviated from LR equilibrium following which a corrected was made with the 2003 spike. The gradual move away from equilibrium prior to 2003 was not a distinctive feature of the SR and MR models. Rather, in both SR and MR models, the spike appeared to be a shift away from equilibrium whereas in the LR model, the spike appeared to be a correction. This suggests that effectively monitoring deviations from LR equilibrium may provide invaluable information about potential instability in the foreign exchange market.

8. COMPETITIVENESS

By determining the equilibrium exchange rate, periods of disequilibrium can be more clearly identified. It is perceived that extended periods of disequilibrium may result in suboptimal levels of competitiveness. The paper therefore seeks to access the effects of disequilibrium on Jamaica's level of competitiveness. The measures of competitiveness adopted for this purpose include the REER, ULC, TNT, and TBT. Changes in these measures of competitiveness are matched against the computed misalignment for the CHEER, BEER1, BEER2 and PEER (see Figure 3 A,B,C and D in the Appendix). The key relationships between disequilibrium and competitiveness over the three (3) distinctive time periods of disequilibrium are presented below.

Financial Sector Crisis (Mid to Late 1990's)

During this period, the CHEER and PEER reflected a marginal overvaluation while BEER2 reflected an undervaluation. The REER suggested a decline in competitiveness at the peak of disequilibrium but reflected improved competitiveness as the misalignment converged to equilibrium (see Figure 3A in appendix). During the Financial Crisis of the late 1990's, the ULC in Jamaica was declining at a significant rate (see figure 3B in appendix). At the same time the US ULC was increasing by similar magnitude. This period was therefore characterized by declining productivity as more was being paid in wages to generate a unit of output. As the

misalignment dissipated, the rate of productivity deterioration showed though worsening considerably again in late 2001. At this point the rate of increase in US labour productivity also slowed considerably in conjunction with the 2001 September 11 terrorist attacks. The ratio of tradables to non-tradables showed relatively little variation in competitiveness in the period.

Foreign Currency Market Instability (2003)

In this period the CHEER and BEER2 reflected a significant spike that indicated a shift towards an undervaluation of the JMD vis-à-vis the USD. The BEER1 model, contrary to the other models, reflected a sharp overvaluation that was immediately followed by a large undervaluation (see Figure 3A in appendix). During this period the REER reflected an increase in competitiveness signaled by a significant depreciation. At this point Jamaica's ULC switched from a consistent deterioration to no change in competitiveness. The TNT indicator of competitiveness reflected no significant change in competitiveness that was demonstrated by relatively stable TNT. The TBT, similar to the REER and ULC during this period, reflected a notable improvement in competitiveness as this was the only period during which there was as substantial bias towards exports. This period of a relatively undervalued domestic currency reflected a general improvement in competitiveness. Nonetheless, as the instability of 2003 corrects towards the various representations of equilibrium, the level of competitiveness continued deteriorate.

Global Economic & Financial Crisis (2008)

During this period all four measures of misalignment reflected a strong and persistent shift away from equilibrium beginning in mid 2007 in favour of an overvalued Jamaican dollar (see figure 3 in appendix). By mid 2008 continuing onwards, a sharp correction was evident in both the SR CHEER and LR PEER models. The BEER1 and BEER2 however, reflected a strong shift to the over side into a period of strong undervaluation. The two phases were strongly correlated to the significant hike in crude oil prices leading up to mid 2008 that experienced a significant correction following this period (phase 2). In the first phase of mounting overvaluation, the REER reflected a consistent deterioration in the level of competitiveness. The second phase where SR and LR exchange rates corrected, but for which MR undervaluation was signaled, the REER sharply switched to a strong improvement in Jamaica's level of competitiveness. In the first phase of an expanding overvaluation of the Jamaican dollar, domestic ULC worsened while US ULC also deteriorated. Both trends suggested a relatively stable to declining levels of competitiveness in Jamaica. In the second phase however, domestic ULC reverted to comparable

levels prior to phase one of the 2008 Global financial crisis. Nonetheless, the ULC of the US continued to descend into the negative bands reflecting a net relative improvement in Jamaica's level of competitiveness. This is consistent with the REER measures of competitiveness during this period.

Similar to the REER and ULC indicators, the TNT ratio captured a falloff in competitiveness in the first phase of expanding overvaluation. The trend, however, persisted into the second phase where an aligned currency by SR and LR models but undervalued by MR models was matched against a period of deteriorating levels of competitiveness or productivity as signaled by the TNT indicator. The TBT reflected continued deterioration in the terms of trade throughout the enter period of the Global financial crisis. This indicated that there remained a bias towards an expanding deterioration in the trade balance which captures persistent levels of declining competitiveness. Therefore TBT is consistent with TNT in both phases but inconsistent with the REER and ULC second phase indication of competitiveness.

9. CONCLUSION

This paper set out to determine the equilibrium exchange rate for Jamaica over three distinctive time horizons (SR, MR, & LR). A fundamentals based approach was embraced in modeling the dynamics of mean reverting tendencies as implied by the theories of PPP and UIP. With the use cointegrating techniques, proof of mean reversion was confirmed in the models presented. Error Correction coefficients were all significant reflecting reasonable speeds of adjustment with a half life ranging from 6 to 13 months for SR to MR models respectively.

The SR model demonstrated that variations to the Jamaican price level are not met with an appropriate adjustment in the exchange rate that will ensure PPP. This was however evidenced in changes in the US price index. Both variables were statistically significant. The model also demonstrated that variation in the Jamaica's interest rate is not met with full adjustment in the exchange rate expected to eliminate any arbitrage between the two currencies, thus violating the UIP condition. This was however statistically insignificant. The US interest rate was however both statistically significant and demonstrated an approximate unitary adjustment in exchange rate to eliminate arbitrage between yields on currency holdings. The strong reliance of Jamaica on imported raw materials and a less efficient local foreign currency market may be the underlying factors contributing to these results.

The MR and LR models reflected expected signs for all variables except TOT and NFA. Both variables however, were statistically insignificant. In summary, the Balassa Samuelson theory was confirmed demonstrating that the exchange rate will appreciate when productivity increases. This was also supported by trends in the TNT productivity measure of competitiveness which showed deterioration in competitiveness as productivity levels declined in the second phase of the global financial crisis. Also the negative correlation between exchange rate and the risk premium imposed by government debt was significant. Hence, increasing the domestic debt relative to foreign debt will lead to a general depreciation of the domestic currency. The interest rate differential was also significant with a negative sign suggesting than increases in the Jamaican interest rate relative to the US interest rate will generate an increase in the demand and hence appreciation of the domestic currency.

The measure of competitiveness displayed conflicting results in the financial sector crisis of the late 1990's due to variations in the equilibrium models. The 2003 financial sector instability and the 2008 Global financial crisis reflected clear signals that an undervalued currency resulted in increased levels of competitiveness. The productivity and trade flow measures of competitiveness (TNT & TBT) however conflicted with the REER and ULC measures of competitiveness in the second stage of the Global financial crisis. In this case, persistent decline in productivity resulted in periods of undervaluation and was accompanied by continued deterioration in the trade balance.

All models except for BEER1 showed visual signs of gradual correction of exchange rates following a deviation from equilibrium. Where as the SR models suggested a sharp shift from equilibrium in the 2003 foreign currency market instability, the LR model featured this as a correction to deviations from the LR norm. This suggests that monitoring the LR model will better aid in spotting potential disruption in the foreign currency markets that may be attributed to fundamental based misalignments.

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11. APPENDIX

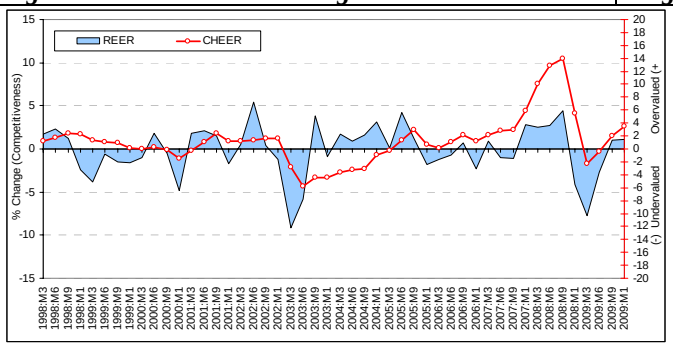
Table A - Unit Root Tests for Monthly Fundamental Variables

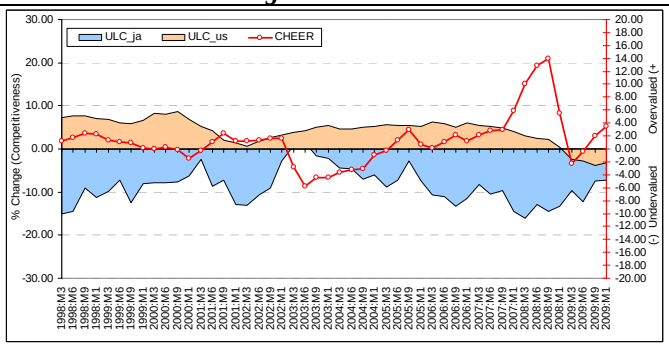
Variables		ADF		PP	
LRER	levels	-2.680	[c]*	-2.605	[c]*
	1st diff	-8.381	***	-8.489	***
LPRI_ja	levels	-2.527	[c,t]	-0.503	[c]
	1st diff	-6.438	[c]***	-6.438	[c]***
LPRI_us	levels	-3.313	[c,t]*	-3.148	[c,t]*
	1st diff	-8.758	[c]***	-6.850	[c]***
INT_ja	levels	-3.170	[c,t]*	-0.818	
	1st diff	-9.508	***	-9.514	***
INT_us	levels	-1.495		-1.394	
	1st diff	-5.280	***	-11.052	***
LNFA	levels	-2.974	[c]**	-2.856	[c]*
	1st diff	-12.864	[c,t]***	-12.864	[c,t]***
RIRD	levels	-4.111	[c,t]***	-2.782	[c]*
	1st diff	-8.989	***	-9.214	***
LNGDD	levels	-3.493	***	-3.784	***
	1st diff	-15.950	[c,t]***	-15.927	[c,t]***
LTNTD	levels	-3.160	[c]**	-3.191	[c]**
	1st diff	-9.183	[c,t]***	-9.398	[c,t]***
LTOT	levels	-2.627	[c,t]	-2.971	[c,t]
	1st diff	-11.764	***	-11.764	***
Significance is indicated as *** at 1%, ** at 5%, and * at 10%					

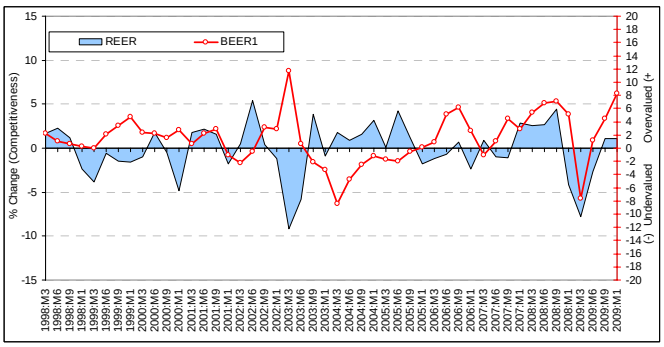
Table B - Estimation Results for BEER, PEER, FEER and CHEER Models

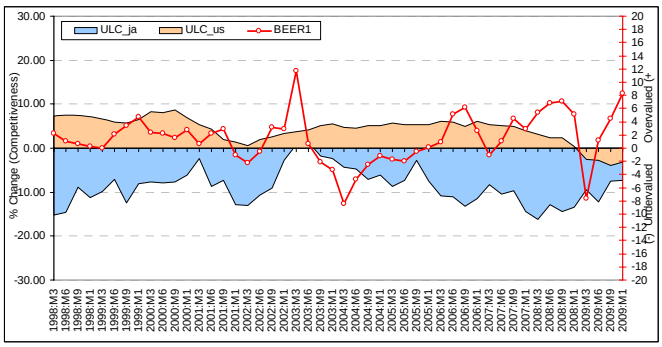
Variable	Sign	SR Model	SR Model	MR Model	MR Model
NAME	**[+/-]**	**CHEER**	**CHEER(2)**	**BEER (1)**	**FEER**
Dependent		LNER	LNER	LRER	
PRI_JA		-0.4845 (-4.077)	-0.2810 (-2.040)	---	
PRI_US		-0.9558 (-2.057)	-1.9620 (-3.787)	---	
INT_JA		0.0441 (0.435)	---	---	
INT_US		1.0122 (2.7687)	---	---	
LTNTD	[+]	---	---	0.2241 (5.584)	
LNGDD	[+/-]	---	---	-0.0989 (-2.455)	
LTOT	[-]	---	---	-0.0325 (-0.296)	
RIRD	[-]	---	-0.4512 (3.787)	-1.1574 (-6.823)	
LNFA	[+]	---	---	-0.030268 (--0.0160)	
CONSTANT		2.3682	2.3682	4.2058	
COINT Coeff	[-]	-0.1501	-0.1501	-0.0576	
		[-4.941]	[-4.941]	(-2.867)	
R-Squared Adj-Rsquared		0.380 0.345	0.380		
DW Statistic Jarque-Bera (Prob)					
LM Test (2)					
ADF (Unit Root)		-13.481 ***	-7.414116 ***	-7.414116 ***	
Significance is indicated as *** at 1%, ** at 5%, and * at 10% ; FEER (1) uses specification from Plaudio Paiva (IMF-Working Paper). [e] refers to expected sign and[r] pertains to the resulting sign from estimation.					

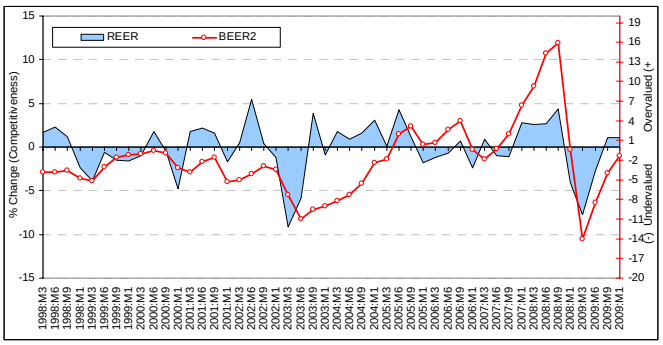
Figure 3A – REER and Misalignment	*Figure 3B – ULC and Misalignment*

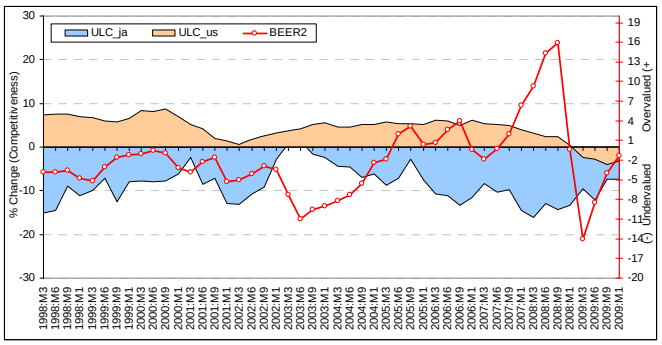


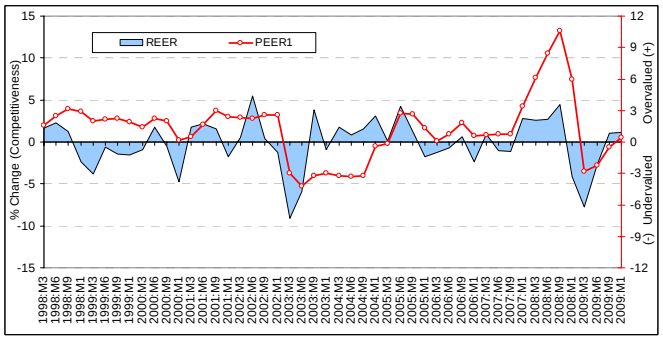












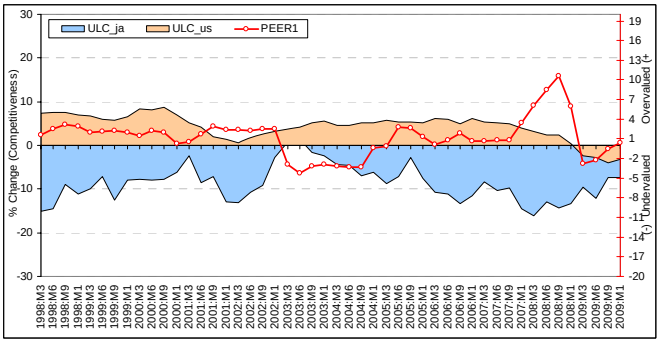
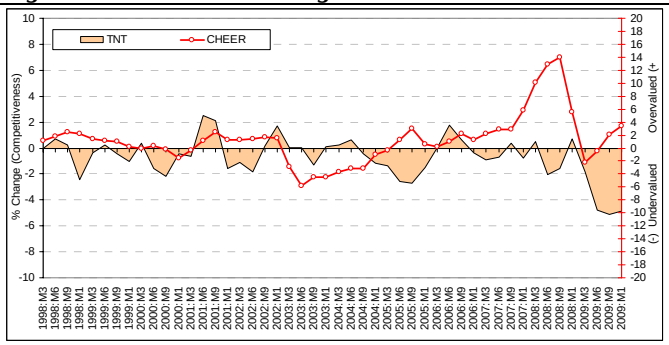
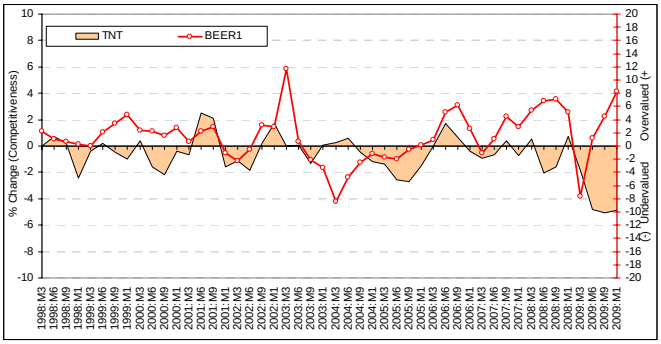
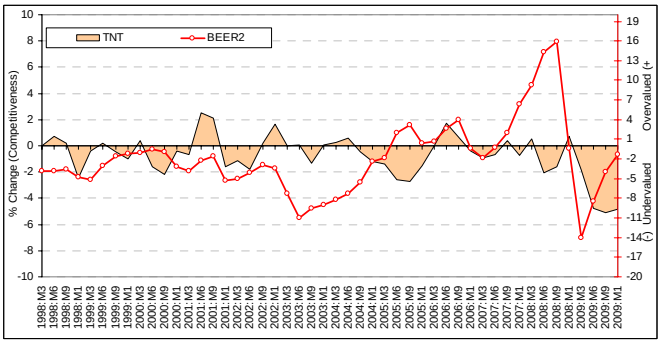


Figure 3C – TNT and Misalignment







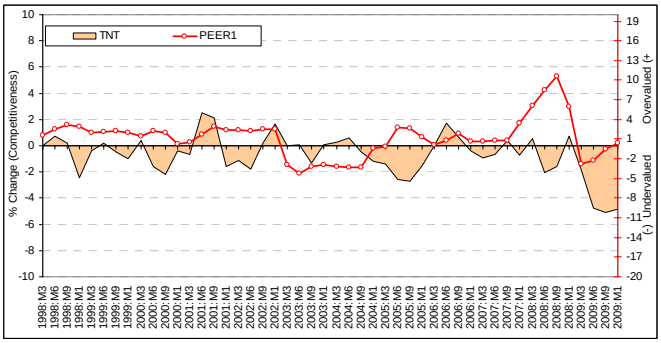


Figure 3D – TBT and Misalignment