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Full Length Research Paper

Malaysia's palm oil exports: Does exchange rate overvaluation and undervaluation matter?

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This paper examines the impact of exchange rate risk on the exports of palm oil in the era of recurring financial crises and global economic instability. The exchange rate risk is captured by misalignments in the real bilateral US/RM exchange rate. This paper is divided into two parts. First, the incidence of exchange rate misalignment is observed using price-based approach (purchasing power parity) and model-based approach [behavioural equilibrium exchange rate (BEER)]. Next, the estimated exchange rate misalignment is used as a variable in the export model to capture the impact of risks. The long run estimates suggest that exchange rate misalignments affect palm oil exports in a negative manner. Then, the estimated misalignments are segregated into events of overvaluation and undervaluation to further comprehend their individual impact. Results suggest that in the long run, overvaluation has a significant negative impact on palm oil exports. The opposite however, could not be construed in the case of undervaluation which indicates asymmetries in the impact of overvaluation and undervaluation of the exchange rate on palm oil exports. Hence, it is imperative that policy-makers avoid both overvaluation and undervaluation and keep the real exchange rate in line with the economic fundamentals.

Keywords: Exchange rate misalignment, overvaluation, undervaluation, palm oil exports.

INTRODUCTION AND LITERATURE REVIEW

Palm oil is one of the most important export commodities which account for 3.3% of gross domestic product (GDP) and contributed RM49.6 billion worth of export revenue in 2009. Being the second largest palm oil exporter, Malaysia strives towards becoming a global hub for the palm oil industry as well as a hub for research and development in related areas. In the recent 10th Malaysia Plan, palm oil activities has been identified as one of the national key economic areas which is expected to drive the economic activities and contribute a significant portion towards economic growth. Among others, one of the aims of this plan is to increase the exports of palm oil. As a global player, the export of palm oil is subjected to a number of risks. This paper seeks to understand the impact of exchange rate risks on palm oil exports. The definition of exchange rate risk is limited to exchange rate misalignment only (Barrell and Pain, 1996; Goldberg, 1993; Sekkat and Varoudakis, 2000; Serven, 2003) to specifically comprehend the mechanics in more detail.

Exchange rate misalignment is defined as the deviation of the real exchange rate from a hypothetical equilibrium exchange rate. Misalignments are categorized as risks since they introduce some degree of uncertainty which is believed to be detrimental to trade (Pfeffermann, 1985).

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Abbreviations: GDP, Gross domestic product; **ARDL,** autoregressive distributed lags; **OLS,** ordinary least squares; **PPP,** purchasing power parity; **BEER,** behavioural equilibrium exchange rate; **CPI,** consumer price indices; **PPI,** producer price indices; **FEER,** fundamental equilibrium exchange rate; **DEER,** desired equilibrium exchange rate; **PEER,** permanent equilibrium exchange rate; **CHEER,** capital-enhanced equilibrium exchange rate; **IFS,** International Financial Statistics.

The absence of a well-managed real exchange rate would result in real appreciation of the exchange rate which would subsequently affect exports performance adversely by increasing uncertainty. In addition, overvaluation reduces profitability making exports less competitive. In the short run, this is detrimental to the agriculture sector since producers respond to the market price and if imports are cheaper, a country may end up importing the commodity or its substitute rather than relying on local production.

The majority of the existing studies on the exchange rate misalignment-exports nexus focus on the estimation of the impact of misalignment on exports at both aggregated and disaggregated levels on different sets of data and countries. Their point of departure lies mainly in the way the exchange rate misalignment is estimated. In general, the exchange rate misalignment is derived from price-based theories (for example, purchasing power parity, uncovered interest parity), model-based theories (*inter alia* the behavioural real exchange rate, fundamental equilibrium real exchange rate, equilibrium real exchange rate) or based on the black market premia. Mohamad (2003), and Pick and Vollrath (1994) used model-based approach. Sekkat and Varoudakis (2000), Sapir and Sekkat (1995), Ghura and Grennes (1993) and Bryne et al. (2008) estimated misalignments based on the purchasing power parity. Doraisami (2004) used the fluctuations between the dollar-yen exchange rate as a proxy for misalignments. Another departure from the conventional approach was presented by Bleaney and Greenaway (2001) where misalignment is estimated based on the residuals from the fixed effects regression of the log of the real effective exchange rate on the log of the terms of trade and a time trend. In general, these studies (with the exception of Elbadawi, 2001) conclude that exchange rate misalignment exerts negative impact on exports. Grobar (1993) suggests that overvaluation of the real exchange rate causes exports to be less profitable. In similar veins, Pick and Vollrath (1994) demonstrate that exchange rate misalignment has a negative impact on agriculture export performance for four out of the ten countries examined. Elbadawi (2001) shows that misalignment represented by undervaluation improves the export performance of selected African countries.

This study adds to the existing literature in the following manner. First, it differs from other published work as specific attention is given to the palm oil industry. In the light of increasing energy prices, palm oil is a potential alternative bio-fuel, hence has high prospects for future exports. Second, previous studies such as Ghura and Greennes (1993) and Barrell and Pain (1996) include exchange rate misalignment in their empirical analyses on an *ad hoc* basis. This study extends the theoretical model of Caballero and Corbo (1989) to include exchange rate misalignment. Hence, exchange rate misalignment fits into the discussion theoretically instead of in an impromptu manner. Third, both price-based and model-based approaches are used to estimate exchange rate misalignment. This is to attenuate the argument that different approach may yield starkly different results as argued in Egert et al. (2006). In addition, the incorporation of both approaches tests the robustness of the estimates. Finally, the incidence of misalignment is partitioned into events of overvaluation and undervaluation. This enables the examination of whether overvaluation depresses exports or vice versa, and whether these effects are asymmetric. The Wald test procedure is conducted to assess whether the magnitude of deterioration in exports brought about by overvaluation is similar to the magnitude of improvement in exports as a result of undervaluation of the real exchange rate. Most often, published studies normally estimate the elasticity of the respective variables of the export model and very few has taken the analyses further to examine whether the behaviour of prices are asymmetric or otherwise. Previous studies have only examined asymmetries in appreciation and deprecation (for example, Fang et al., 2005). No known studies have examined the asymmetric impact of overvaluation and undervaluation.

THEORETICAL FRAMEWORK

This section intends to shed light on the relationship between palm oil exports and exchange rate misalignment. A simple theoretical model is presented as a motivation for testing the empirical model which follows. Based on Caballero and Corbo (1989), a representative firm in the palm oil sector is subjected to the following demand curve:

$$X^d(t) = A_1(t)\left[\frac{P_x(t)}{P_w(t)}\right]^{-\eta} \qquad (1)$$

where X^d represents export demand, P_x and P_w denote the export price and world price indexes, A_1 is an arbitrary function of time and η is the price elasticity of demand. The production function is given by,

$$X^s(t) = A_2(t)L(t)^{\alpha}K(t)^{1-\alpha} \qquad (2)$$

Where X^s represents export supply, *L(t)* and *K(t)* are labour and capital inputs into production, A_2 is an arbitrary function of time, α is the labour share of output and $1-\alpha$ is the capital share of output. The real exchange rate, *ER(t)* and the real wage, *W(t)* are defined as the nominal exchange rate and nominal wages deflated by the consumer price index and are assumed to be exogenous to the firm. Maximizing the operating profits yields,

$$\pi(K,t) \equiv \max_{L(t)} ER(t)P_w(t)A_1(t)^{\frac{1}{\eta}} X(t)^{\mu} W(t)L(t) \quad (3)$$

where $(\mu = \eta - 1)/\eta$ is an inverse index of monopoly power. Assuming constant wages and the only source of uncertainty is through the exchange rate process, the profit function of the firm π(.) reduces to a function of the real exchange rate and capital used in production. The remaining state variables are defined as a deterministic function of time, *B(t)*,

$$\pi[K(t),t] = B(t)K(t)^{\theta_1} ER(t)^{\theta_2} \quad (4)$$

where θ_1 and θ_2 are industry specific parameters defined as $\theta_1 = \frac{\mu(1-\alpha)}{1-\alpha\mu} < 1$ and $\theta_2 = \frac{1}{1-\alpha\mu} > 1$. The exchange rate affects profits through the demand effects in μ and through the production costs summarized by α. Differentiating (4) yields,

$$\frac{\partial\pi(t)/\partial ER(t)}{\pi(t)/ER(t)} = \theta_2 \quad (5)$$

Under strict conditions, Equation (5) suggests that exporter's profit increases in the event of exchange rate depreciation and falls when the exchange rate appreciates given that $\theta_1 < 1$ and $\theta_2 > 1$. Caballero and Corbo (1989) also express exports as a function of prices and capital stock:

$$X(t) = B(t)[\mu P(t)]^{\frac{\alpha}{1-\alpha}} K(t) \quad (6)$$

where *B(t)* is a function of time and $P = P_x ER(t)$. Following, Darby et al. (1999), we express the exchange rate in a Brownian process,

$$dER = \gamma ERdt + \sigma ERdz \quad (7)$$

where γ represents the deviation of the exchange rate from its equilibrium path (misalignment) and σ measures volatility of the exchange rate. We assume that γ and σ only depend on *E* and time *t*. Suppose that f_1 and f_2 are overvaluation and undervaluation which are dependent on *E* and *t,* the processes followed by f_1 and f_2 are given as,

$$\frac{df_1}{f_1} = \mu_1 dt + \sigma_1 dz \quad \text{and} \quad \frac{df_2}{f_2} = \mu_2 dt + \sigma_2 dz \quad (8)$$

where μ_1, μ_2, σ_1 and σ_2 are functions of *E* and *t*. The *dz* in these processes are similar to that of Equation (7).

Since the objective of this study is to examine the impact of exchange rate misalignment on exports, the remaining discussion focuses on exchange rate misalignment only. Conventional wisdom suggests that higher degree of exchange rate in terms of overvaluation would reduce the demand for exports. Hence, for this contention to be true, the necessary condition is that:

$$\frac{\partial ER}{\partial \gamma} > 0 \quad (9)$$

Darby et al. (1999, p.C58-C60) provide full derivation of the necessary condition for this contention to hold.
For the purpose of empirical estimation, the theoretical discussion above is assimilated into the standard export demand-based framework to incorporate the impact of exchange rate misalignment. The main assumption in this model is that Malaysia's palm oil exports are relatively small compared to the world market. The baseline model is defined as,

$$\log X_t = \alpha_0 + \beta_1 \log Y_t + \beta_2 \log P_t + \beta_3 M_t + \beta_4 D_{97} + \beta_5 D_{08} + \mu \quad (10)$$

where *X* is the export volume, *Y* represents the world income, *P* is relative price, *M* denotes the exchange rate misalignment and *D* captures the impact of crises. Coefficients β_1 and β_2 represent the income and price elasticities of exports respectively.

ESTIMATION METHODS

The presence of a long run interrelationship between palm oil exports and misalignment is tested based on the principals of cointegration in a standard demand-based framework. This direct relationship implies that the variables would not drift away and always gravitate towards the equilibrium. One of the more recent methods is based on Pesaran et al. (2001) bounds testing procedure. Since this method is relatively well-known, explanation is short and precise.

The bounds testing procedure is often preferred in dealing with small samples and when the regressors are a combination of *I(0)* and *I(1)* variables, which eliminates the problems inherent in Johansen and Juselius (JJ) multivariate technique. In addition, bounds test is argued to have better statistical properties compared to the Engle-Granger two-step procedure since it does not push the short run dynamics into the residual terms (Pattichis, 1999). Bounds testing requires the dependent variables to be integrated of order one, *I(1)* whilst the regressors could either be *I(0)* or *I(1).* Fosu and Magnus (2006) cautioned that the procedure collapses in the presence of *I(2)* regressors.

Another major advantage of this procedure is that the long run estimates based on the autoregressive distributed lags (ARDL) are less sensitive towards the number of lags compared to the JJ technique.

Based on the theoretical and empirical model earlier discussed, Equation 11 was as follows:

$$\Delta X_t = c_0 + \delta_1 X_{t-1} + \delta_2 Y_{t-1} + \delta_3 P_{t-1} + \delta_4 M_{t-1} + \sum_{i=1}^{p} \phi_i \Delta X_{t-i} + \sum_{j=0}^{q_1} \varpi_j \Delta Y_{t-j} + \sum_{l=0}^{q_2} \theta_l \Delta P_{t-l} + \sum_{m=0}^{q_3} \varphi_m \Delta M_{t-m} + \gamma D_{97} + \psi D_{08} + \varepsilon_t \quad (11)$$

Where X, Y, P, M and δ_t denote exports of palm oil, world income, relative prices, misalignment and the long run multipliers with c_0 representing the drift term. Two dummies are used to capture the 1997-1998 Asian financial crisis, D_{97} and the recent global financial crisis, D_{08}. ε_t is the white noise error terms. Four lags are chosen given that the frequency of the data is quarterly.

Bounds testing are three-step procedure. First, ordinary least squares (OLS) are employed on Equation (11) to test for the existence of long run relationships amongst the variables. This step essentially tests whether the coefficients of the lagged variables are jointly significant based on the *F*-test. The null hypothesis is $H_0: \delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$ against an alternative, $H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$. The *F*-test results are compared to the approximate critical values by Narayan (2005) which gives an upper, *I(1)* and lower, *I(0)* critical values. There are basically three possibilities emerging from this comparison. If the *F*-test surpasses the upper critical value, then cointegration is inferred. Likewise, if the *F*-test is less than the lower critical values, the hypothesis of no cointegration cannot be rejected. The third possibility is that the *F*-test is between the upper and lower critical value, hence cointegration is indeterminate. In such circumstances, a negative and significant error correction model is useful to infer cointegration (Kremers et al., 1992; Banerjee et al., 1998).

$$X_t = c_0 + \sum_{i=1}^{p} \beta_1 X_{t-i} + \sum_{j=0}^{q_1} \beta_2 Y_{t-j} + \sum_{l=0}^{q_2} \beta_3 P_{t-l} + \sum_{m=0}^{q_3} \beta_4 M_{t-m} + \gamma D_{97} + \psi D_{08} + \varepsilon_t \quad (12)$$

The second step involves the estimation of the conditional long run autoregressive distributed lag model (p, q_1, q_2, q_3) as follows, The variables in Equation (12) are as previously defined. Finally, the coefficients of the short run dynamics are estimated using the following equation,

$$\Delta X_t = \mu + \sum_{i=1}^{p} \phi_i \Delta X_{t-i} + \sum_{j=0}^{q_1} \varpi_j \Delta Y_{t-j} + \sum_{l=0}^{q_2} \theta_l \Delta P_{t-l} + \sum_{m=0}^{q_3} \varphi_m \Delta M_{t-m} + \gamma D_{97} + \psi D_{08} + \eta ect_{t-1} + \varepsilon_t \quad (13)$$

Where ϕ, ϖ, φ and θ are the short run dynamic coefficients, ect_{t-1} denote the error correction term and η is the speed of adjustment.

The behaviour overvaluation and undervaluation is further scrutinized through the test for asymmetries. The aim of this test is to determine whether exchange rate misalignment behaves asymmetrically or otherwise. Episodes of overvaluation and undervaluation represented by dummy variables are as follows,

M- Over$_t$ = 1 if $M_t > 0$
0 if otherwise
And

M-Under$_t$ = 1 if $M_t < 0$
0 if otherwise

Where *M-Over*$_t$ captures the period of overvaluation and *M-Under*$_t$ represents undervaluation. Both *M-Over*$_t$ and *M-Under*$_t$ replace *M* in Equation (10) and is written as follows:

$$\log X_t = \alpha_0 + \beta_1 \log Y_t + \beta_2 \log P_t + \lambda_1 M - Over_t + \lambda_2 M - Under_t + \beta_3 D_{97} + \beta_4 D_{08} + \mu \quad (14)$$

The corresponding null hypothesis is $\lambda_1 - \lambda_2 = 0$. Rejection of the null implies asymmetric takes effects between overvaluation and undervaluation.

Estimation of the exchange rate misalignment

Misalignments generally occur due to changes in the exchange rate regime or as a result of inconsistent government policies such as unsustainable monetary, fiscal, trade or even exchange rate policies. Changes in the real exchange rate in response to changes in the terms of trade or other external shocks do not result in misalignment. Similarly, temporary appreciation or depreciation is not expected to affect the overall alignment of the currency. However, exchange rate misalignment is present when the real exchange rate persistently deviates from the long run equilibrium path. Therefore, it is crucial to identify this equilibrium path. There are generally two common approaches in the estimation of the exchange rate misalignment - price-based approach and model-based approach. As demonstrated by Egert et al. (2006), the estimated degree of misalignments is sensitive towards the choice of approaches. Hence, to partly circumvent this problem, we present two types of estimations based on the two common approaches. The first approach is based on the purchasing power parity (PPP) and the second estimation is based on the behavioural equilibrium exchange rate (BEER).

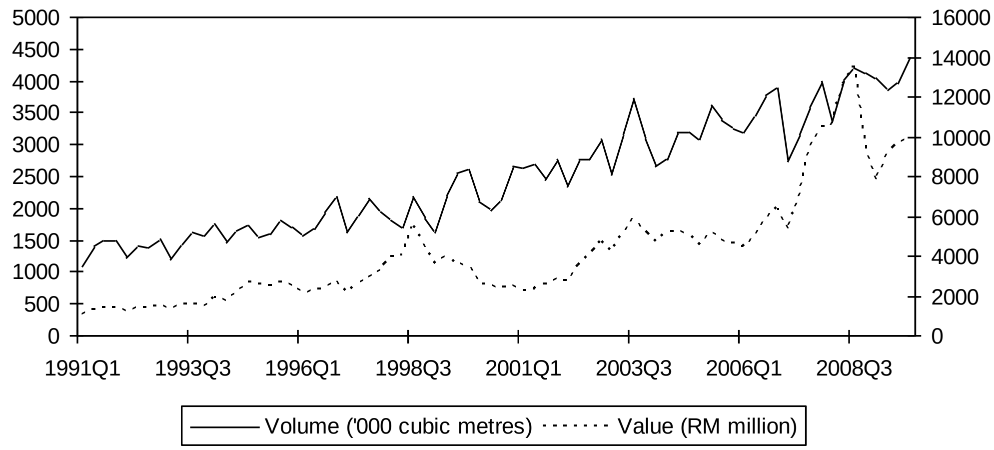

Figure 1. Palm oil export value and volume.
Source: Monthly Statistical Bulletin, Bank Negara Malaysia (various issues).

Price-based approach: purchasing power parity (PPP)

Assuming perfect competition and absence of transportation cost, absolute PPP is written as follows,

$$S = \frac{p^*}{p} \quad (15)$$

Where *S* is the nominal exchange rate in USD/RM, *p** is the price of a good in the US and *p* is the price of an identical local good. In practice, *p* is normally proxied by either the consumer price indices (CPI) or the producer price indices (PPI). When these proxies are used, the weights given to each basket of goods may differ between each country, hence, making direct comparison biased.

To assuage the problem, the above equation is rewritten to incorporate the different weights in price indices as follows,

$$S = \theta \frac{P^*}{P} \quad (16)$$

Where *P* and *P** represent the producer price or consumer price indices for Malaysia and US basket and θ is a designated parameter which relies on the based period of the price indices. To estimate θ, we adopt the technique based on long-run averaging as in Sazanami and Yoshimura (1999). The estimated θ is defined as,

$$\hat{\theta} = \frac{1}{T}\sum_{k=0}^{T-1}(S_{t-k}P^*_{t-k} / P_{t-k}) \quad (17)$$

Where *T* is the number of observations included in the base year period. The selection of based period is very subjective. Chinn (1998) chooses 1975:01-1996:12 which satisfies stationarity conditions and are cointegrated, hence, implying mean reversion towards the long run equilibrium. Furman and Stiglitz (1998) argue that the selection of base period can be *ad hoc* since certain period such as between 1989 to 1991 is relatively free from major macroeconomic shocks. Sazanami and Yoshimura (1999) choose 1978:01-1996:12 to utilize more reliable data on PPP from the Bureau of Labour Statistics system. In line with Chinn (1998), they confirmed mean reversion based on stationarity and cointegration tests. In this study, the base period is between 1984:Q1 to 2009:Q4 which is partly dictated by availability of reliable data and mean reversion is checked using the cointegration test as in Table 1

The estimated $\hat{\theta}$ is then used to calculate the equilibrium exchange rate where,

$$S_{LA} = \hat{\theta}\frac{P^*}{P} \quad (18)$$

Hence, S_{LA} is the equilibrium exchange rate.

Model-based approach: behavioural equilibrium exchange rate (BEER)

It is worth noting that the equilibrium exchange rate is not time-invariant and should be viewed as a variable that varies according to the fundamentals (Edwards, 1989; Williamson, 1994; Elbadawi, 1994; Elbadawi, 1998; MacDonald, 1998). To accommo-date this issue, model-based approach offers a wide range of theories and techniques which spans the gamut of macroeconomic approach [fundamental equilibrium exchange rate (FEER), desired equilibrium exchange rate, (DEER)], external-internal sustainability approach (NATREX) and the equilibrium real exchange rate approach [BEER, permanent equilibrium exchange rate (PEER), capital-enhanced equilibrium exchange rate (CHEER)] which differs in the treatment of dynamics and time frame of the intended study. Model-based approaches are often preferred to price-based approach since they are more reliable for medium to long run periods, capable of dealing with consumer preferences, product differentiation and imperfect competitions (Driver and Westaway, 2005). In this study, we focus on BEER only.

BEER was originally proposed by Clark and MacDonald (1998, 2004) which serves as a theoretical as well as the statistical method to asses the behaviour of the real exchange rate. Unlike its counterparts, BEER requires no specific model, imposes no specific conditions on the structure of the relationship, provides direct estimations of the equilibrium exchange rate and normally uses cointegration to imply long run relationships. Therefore, the real

Table 1. Cointegration test.

	PPI		CPI	
	Trace	**M-Eigenvalue**	**Trace**	**M-Eigenvalue**
r=0	62.3617***	44.1844***	56.7832***	43.2271***
	(47.8561)	(27.5843)	(47.8561)	(27.5843)
r=1	18.1772	13.7414	16.782	13.6155
	(29.7971)	(21.1316)	(29.7971)	(21.1316)
r=2	4.4358	4.4178	3.4817	3.5001
	(15.4947)	(14.2646)	(15.4947)	(14.2646)

The number of optimal lags is 3 based on Bayesian information criterion (SBC). Sample period is from 1984:Q1-2009:Q4. *** indicates significance of the test at 1% level.

exchange rate is expressed as a function of specific fundamental variables. Furthermore, this technique is flexible since it allows an array of ancillary variables to suit specific country features (AlShehabi and Ding, 2008). Benassy-Quere et al. (2010), however, cautioned the use of BEER as it tends to rely on past behaviour of portfolio choices. IMF (1999) and Zhang (2001) partitioned the fundamental variables into four basic components. First, the domestic side factor or better known as the Balassa-Samuelson effect arising from more rapid productivity growth in the traded goods sector than the non-traded goods sector.

Secondly, fiscal policies or government spending where any permanent changes in government spending expenditure in traded and non-traded goods may affect the real exchange rate. Third, the external environment such as the changes in the terms of trade, net capital movement, world inflation rate, world interest rate, interest rate differentials, other external shocks such as oil price shocks, may also affect the real exchange rate. Finally, changes in policies such as financial or trade liberalization, reductions in trade restrictiveness or reduction in export subsidies can lead to appreciation or depreciation of the real exchange rate. This effect is often captured by trade openness. In this study, the real exchange rate is defined as the bilateral US-RM deflated by the consumer price index. Productivity is captured by the consumer price index divided by the produce price index (CPI/PPI) expressed as a ratio of the United States CPI/PPI. Data is retrieved from the International Financial Statistics (IFS) (IMF, 2010a). Government spending expenditure is defined as a ratio to GDP. The external environment is proxied by net foreign assets defined as the assets of the banking and monetary system expressed as a ratio of GDP. The changes in policies are captured by the degree of openness defined as the ratio of exports plus imports to GDP. Finally, the crisis dummy takes the value of 1 between 1997:Q3 - 1999:Q2 and 2008:Q3 - 2009:Q4, and 0 otherwise. Data is gathered from the Monthly Bulletin Statistics, BNM (various issues). Estimation is conducted from 1991:Q1 to 2009Q:4.

The estimated long run equilibrium real exchange rate using the autoregressive distributed lag model is summarized as follows:

$$\underset{(0.8102)}{log(RER_t) = 1.1546} + \underset{(5.2674)}{0.5272}\ PROD_t - \underset{(-4.2330)}{0.2783}\ OPEN_t - \underset{(-1.8222)}{0.6360}\ GOV_t + \underset{(2.8682)}{0.5890}\ NFA_t - \underset{(-3.0972)}{0.2283}\ DUM \quad (19)$$

where *PROD, GOV, NFA* and *OPENNESS* represent productivity, government spending, net foreign assets and the degree of openness, respectively. Interest rate differentials, terms of trade and productivity differentials were taken out of the model as these variables were insignificant and to ensure parsimony in the overall model. The *t*-statistics are in parentheses. The estimated *F*-statistics is 4.6372, is larger than the 1 percent upper bound critical value at 4.620 hence corroborating the existence of cointegration or long run relationships between the real exchange rate and the fundamental variables. The cointegrating relationship is further substantiated by the negative and significant error correction term (-0.6742).

RESULTS AND DISCUSSION

Data for the palm oil exports were gathered from the Monthly Bulletin Statistics, BNM (various issues). Estimation is conducted from 1991:Q1 to 2009Q:4.

Six models were estimated to test the sensitivity of the coefficients in the presence of two different approaches in the estimation of the exchange rate misalignment. Model 1 estimated misalignment based on PPP using the PPI to represent price whilst Model 3 used the CPI as a proxy for price. Model 5 used the estimated misalignment based on BEER. Models 2, 4 and 6 partitioned misalignments into over- and under-valuation based on Models 1, 3 and 5 accordingly.

Cointegration was examined with the null hypothesis of no long run relationship against an equivalent alternative. Table 2 presents the bounds test results for all six models which shows that all the coefficients lie above the upper bound, substantiating the existence of long run relationships amongst the stipulated variables.

Table 3 offers parameter estimates that denoted the long run elasticities via normalizing the cointegrating vectors on palm oil exports. Two crisis dummies were used to capture the impact of the 1997 Asian financial crisis and the recent global financial crisis triggered by the United States sub-prime mortgage crisis. The estimated income elasticities were reasonable, ranging between 0.78 to 1.23, carried the expected positive sign and were

Table 2. Bounds testing for the existence of long run relationship.

Model	Dependent variable and regressor	Lags	Coefficient
Model 1:	X| Y P M-PPI D97 D08	4	6.9728***
Model 2:	X| Y P M-Over M-Under D97 D08	4	6.6325***
Model 3:	X| Y P M-CPI D97 D08	4	6.9728***
Model 4:	X| Y P M-Over M-Under D97 D08	4	5.7634***
Model 5:	X| Y P M-BEER D97 D08	4	9.4997***
Model 6:	X| Y P M-Over M-Under D97 D08	4	5.6580***

The F-statistics are compared with the critical bounds of the F-statistics for zero restriction on the coefficient of the lagged level variables provided in Narayan (2005, p.1988). The upper bound critical value for Models 1, 3 and 5 is 5.092 and for Models 2, 4 and 6 is 4.842 at 1% significant level. *** denotes that the F-statistics is above the 1 percent upper bound critical value. The lag order is selected using the Schwarz Bayesian criteria (SBC).

Table 3. Long run coefficient estimates on Malaysia's palm oil export volume.

Regressor	Dependent variable: Palm oil exports volume					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Y	1.2288***	0.4393	1.2376***	0.1691	0.7828***	0.7893***
	(0.3264)	(0.2619)	(0.3264)	(0.5656)	(0.29044)	(0.2909)
	[3.7653]	[1.6770]	[3.7653]	[0.2991]	[2.6952]	[2.7132]
P	-0.3283***	-0.5461***	-0.3283***	-0.4808***	-0.4140***	-0.4181***
	(0.0900)	(0.0729)	(0.0900)	(0.0979)	(0.0745)	(0.0747)
	[-3.6475]	[-7.4910]	[-3.6475]	[-4.9114]	[-5.5570]	[-5.5998]
M	-0.097354***	-	-0.0813***	-	-0.1919***	-
	(0.0350)		(0.0277)		(0.0714)	
	[-2.7432]		[-2.9347]		[-2.6896]	
M-Over	-	-1.1153**	-	-0.5483	-	-0.2047***
		(0.4580)		(0.3203)		(0.0743)
		[-2.4354]		[-1.7117]		[-2.7543]
M-Under	-	0.2469	-	0.5315	-	0.2071
		(0.5851)		(0.4485)		(0.5893)
		[1.9380]		[1.1850]		[0.3515]
D97	-0.0842**	-0.1161***	-0.0842**	-0.0562	-0.0732***	-0.0754***
	(0.0413)	(0.0320)	(0.0413)	(0.0465)	(0.0237)	(0.0240)
	[-2.0382]	[-3.6295]	[-2.0382]	[-1.2105]	[-3.0898]	[-3.1439]
D08	-0.1656	-0.0069	-0.1656	-0.0092	0.0735	0.0721
	(0.0390)	(0.0270)	(0.0390)	(0.0397)	(0.0405)	(0.0406)
	[-0.4245]	[-0.2542]	[-0.4245]	[-0.2315]	[1.8150]	[1.7780]
C	1.2520	3.1122***	1.2680	3.5764***	2.2447***	2.2398***
	(0.6994)	(0.5851)	(0.7028)	(1.2257)	(0.6286)	(0.6292)
	[1.7900]	[5.3188]	[1.8042]	[2.9179]	[3.5710]	[3.5599]

Notes: *** and ** denote 1% and 5% degree of significance. Data on palm oil exports and relative prices are obtained from the Monthly Bulletin Statistics, Department of Statistics, Malaysia (various issues).

significantly different from zero at 1% level. This indicates that higher world income stimulates palm oil exports. The long run income elasticities were greater than unity in all models but were consistent with recent studies on

Malaysia with similar frequencies (see for example, Wong and Tang, 2008). This indicates that Malaysia has benefited from the spillover effects of high income elasticities from the importing countries (usually developed nations).

In line with the theoretical prediction of the export model, price elasticities were consistently negative and significant in all models. The coefficients were relatively inelastic ranging between -0.33 to -0.55. This is almost expected since palm oil is an agriculture product, and commodity exports tend to be less responsive towards changes in prices. These estimates are comparable to Arize (1990), Doganlar (2002) and Bahmani–Oskooee and Harvey (2006) who studied on exports of Malaysia. The results support the assumption that Malaysia is a price taker.

The coefficients of the exchange rate misalignment in Models 1, 3 and 5 were all negative and significant. A one percentage point increase in misalignment was expected to depress palm oil exports by 0.1 to 0.2% points. The results of this study are consistent with the findings of Pick and Vollrath (1994) where exchange rate misalignment negatively affects Argentina's agriculture commodities namely maize, wheat and meat. Other studies are not comparable since the vast majority are based on total exports (Ghura and Grennes, 1993; Sekkat and Varoudakis, 2000; Mohamad, 2003) and use either annual or monthly frequency, with significantly different time span.

Differences in estimates are inevitable since misalignments change through time and estimates would definitely differ when different time periods are used. Models 2, 4 and 6 separated the impact of misalignment into events of overvaluation and undervaluation. Models 2 and 6 showed that overvaluation had a negative and significant impact on palm oil exports but the same cannot be construed for undervaluation due to lack of statistical evidence. Results showed that overvaluation may deter exports by 0.2 to 1.1% point. The range is quite substantial which implies that the difference in the estimation approach of misalignment may yield sizeable differences in the magnitude of the coefficients. Nevertheless, the sign and significance remain consistent despite the differences in approach. The 1997 Asian financial crisis had a negative and significant impact on palm oil exports ranging between -0.5 to -1.1. The recent 2008 -2009 global financial crisis, however, is not statistically significant in this study. One of the most probable explanation is that in the midst of crisis, exports of durables such as electric and electronics were badly affected (IMF, 2010b) but commodity exports did not endure the same circumstances. This is due to consumers changing their preferences and habits during crisis period in favour of frugality especially in items that are durable. Food and other agriculture commodities which serves as intermediate goods, only account for a small percentage of household expenditure generally remained unchanged.

The coefficients of the error correction terms ect_{i-1} in Table 4 which represent the short run behaviour were significantly negative and within the appropriate band of 0 and 1. These results confirmed the presence of cointegration. As argued by Banerjee et al. (1998) and Kremers et al. (1992), the error correction terms connoted a more efficient measure to test for the presence of long run relationship. The short run coefficients of the regressors, however, were inconsistent with the long run prediction of the theory. The short run coefficients of income were negative in all models which indirectly implied that the exports of palm oil were not durable nor luxury good hence, do not solely rely on the income of the importing countries. Rather, palm oil served as an intermediate good which would be used to produce some other products. The short run coefficients of prices were generally insignificant except in Model 2. Misalignment was negative and significant only in Model 5. Overvaluation was positive and significant in the short run in Models 2, 4 and 6. On the other hand, undervaluation was insignificant in the short run. One of the reasons for the inconsistent signs may be due to the fact that these variables need time to adjust towards the equilibrium. In addition, economic agents may react in an opposite manner in response to any unexpected changes in the variables and gradually, rationalized their actions in the long run.

The standard diagnostic tests were applied to the short run models. The absence of specification error is confirmed by the Ramsey RESET test. The Breusch-Godfrey LM test for serial correction could not reject the null hypothesis of no serial correlation and the Jarque-Bera tests for normality were insignificant in all models. The presence of heteroscedasticity and ARCH effects are ruled out as the null hypothesis of no heteroscedasticity and no ARCH effect could not be rejected.

To provide more insights as to whether the changes in misalignments behave similarly during events of overvaluation and undervaluation, tests for asymmetries were conducted based on Equation (14). The Wald test examines whether the percentage increase (decrease) in palm oil exports during periods of undervaluation (overvaluation) are equal. Specifically, tests were conducted to examine whether a one percentage increase in palm oil exports during undervaluation commensurate a one percent decrease in palm oil exports during overvaluation. Table 5 illustrates the results of the asymmetric tests. Basically, asymmetric effect cannot be rejected in all three cases of misalignments. That is, overvaluation negatively affects palm oil exports and undervaluation is expected to reverse the situation but, at a different magnitude.

CONCLUSION AND POLICY IMPLICATIONS

In this paper, the impact of exchange rate risks represented by exchange rate misalignment on the exports of palm oil is examined. Both price-based approach, PPP,

Table 4. Unrestricted error correction representation for the ARDL model.

Regressor	Model 1		Model 2		Model 3
ect_{t-1}	-0.6318***	ect_{t-1}	-0.6507***	ect_{t-1}	-0.6318***
	(0.1244)		(0.1060)		(0.1244)
	[-5.0779]		[-6.1413]		[-5.0780]
ΔY	-1.2390***	ΔY	-1.2423***	ΔY	-1.5000***
	(0.3574)		(0.2676)		(0.2980)
	[-3.4667]		[-4.6433]		[-5.0329]
ΔY_{t-1}	-0.6022	ΔY_{t-1}	-0.8264***	ΔY_{t-1}	-1.2400***
	(0.3279)		(0.2773)		(0.3574)
	[-1.8367]		[-2.9798]		[-3.4667]
ΔP	-0.0530	ΔP	0.4826***	ΔY_{t-2}	-0.6022
	(0.1285)		(0.1374)		(0.3279)
	[-0.4127]		[3.5195]		[-1.8367]
ΔM	-0.3265	ΔP_{t-1}	0.3039**	ΔP	-0.0530
	(0.2243)		(0.1181)		(0.1285)
	[-1.4554]		[2.5730]		[-0.4127]
D97	0.0073	ΔP_{t-2}	0.3569***	ΔM	-0.2728
	(0.0281)		(0.1120)		(0.1874)
	[0.2607]		[3.1867]		[-1.4554]
D08	-0.0262	$\Delta M\text{-}Over$	1.1693***	*D97*	0.0073
	(0.0232)		(0.3279)		(0.0281)
	[-1.1301]		[3.5664]		[0.2607]
C	0.0092	$\Delta M\text{-}Over_{t-1}$	0.5583	*D08*	-0.0262
	(0.0064)		(0.3413)		(0.0232)
	[1.4350]		[1.6358]		[-1.1301]
		$\Delta M\text{-}Under$	-0.3965	*C*	0.0092
			(0.2286)		(0.0064)
			[-1.7342]		[1.4374]
		D97	0.0074		
			(0.0250)		
			[0.2963]		
		D08	-0.0095		
			(0.0200)		
			[-0.4728]		
		C	0.0037		
			(0.0069)		
			[0.5418]		

*** and ** denote 1 and 5% significant level. Standard errors and t-statistics are in parentheses and square brackets respectively.

and model-based approach, BEER, are employed to estimate the degree of exchange rate misalignment. Next, the estimated exchange rate misalignment is used as a variable in the augmented export demand model to

Table 4. Contd.

Regressor	Model 4		Model 5		Model 6
ect_{t-1}	-0.5910***	ect_{t-1}	-0.7671***	ect_{t-1}	-0.7754***
	(0.1044)		(0.1279)		(0.1269)
	[-5.6590]		[-5.9952]		[-6.1105]
ΔY	0.8881***	ΔY	-1.3022***	ΔY	-1.4187***
	(0.1729)		(0.2826)		(0.2845)
	[5.1360]		[-4.6086]		[-4.9863]
ΔP	-0.0365	ΔY_{t-1}	-1.0716***	ΔY_{t-1}	-1.0653***
	(0.1178)		(0.3394)		(0.3374)
	[-0.3095]		[-3.1572]		[-3.1578]
$\Delta M\text{-}Over$	0.7731***	ΔY_{t-2}	-0.4367	ΔY_{t-2}	-0.3690
	(0.2148)		(0.3050)		(0.3039)
	[3.6000]		[-1.4315]		[-1.2141]
$\Delta M\text{-}Over_{t-1}$	-0.0161	ΔP	0.0448	ΔP	0.0677
	(0.2013)		(0.1061)		(0.1049)
	[-0.0797]		[0.4221]		[0.6457]
$\Delta M\text{-}Under$	-0.8278***	ΔM	-0.1093**	$\Delta M\text{-}Over$	-0.1312**
	(0.2761)		(0.0487)		(0.0499)
			[-2.2457]		[-2.6299]
$D97$	0.0142	$D97$	-0.0044	$\Delta M\text{-}Under$	0.5114
	(0.0256)		(0.0175)		(0.3315)
	[0.5547]		[-0.2530]		[1.5508]
$D08$	0.0049	$D08$	-0.0069	$D97$	-0.0056
	(0.0188)		(0.0204)		(0.0174)
	[0.2628]		[-0.3401]		[-0.3202]
C	0.0020	C	0.0070	$D08$	-0.0108
	(0.0054)		(0.0063)		(0.0208)
	[0.3770]		[1.1199]		[-0.5172]
		C		C	0.0062
					(0.0063)
					[0.9773]

*** and ** denote 1 and 5% significant level. Standard errors and t-statistics are in parentheses and square brackets respectively.

examine the impact of exchange rate misalignment on palm oil exports. Results indicate that exchange rate misalignment negatively affects palm oil exports in the long run. To further understand the mechanics of the impact of misalignments, the impact of misalignments are segregated into events of undervaluation and overvaluation. Results suggest that overvaluation adversely affect palm oil exports but the same could not be generalized in the case of undervaluation, implying the existence of asymmetric effects of overvaluation and undervaluation. To substantiate this contention, an asymmetric test based on the Wald-test is conducted and results indicate that the effects of overvaluation and undervaluation are asymmetric. This literally means that the magnitude of overvaluation and undervaluation are not the same which complements the long run results on the effects of over-and undervaluation on palm oil exports.

Table 4. Contd.

Diagnostic tests/ Model	1	2	3	4	5	6
$\bar{R}^2$	0.4283	0.5348	0.4283	0.5440	0.5546	0.5506
AR	2.1484 (0.1254)	0.0759 (0.7839)	2.1484 (0.1254)	1.8670 (0.1446)	1.6523 (0.1314)	2.1751 (0.1225)
ARCH	2.1376 (0.1483)	0.0348 (0.8526)	2.1376 (0.1483)	0.4767 (0.4922)	1.6322 (0.2057)	2.3145 (0.1327)
RESET	1.3475 (0.2502)	1.2172 (0.3035)	1.3476 (0.2502)	1.6797 (0.1665)	0.5529 (0.4600)	0.6058 (0.4394)
Normality	1.2636 (0.5316)	0.9232 (0.6303)	1.2636 (0.5316)	1.5264 (0.4661)	0.3240 (0.8504)	0.4528 (0.7974)
Heteroscedasticity	1.1995 (0.3139)	0.9068 (0.5395)	1.1995 (0.3139)	1.6892 (0.1182)	1.5434 (0.2145)	1.5273 (0.1584)

Notes: p-values in parentheses.

Table 5. Test for asymmetry based on Wald Test.

Null hypotheses: $H_o = \lambda_1 - \lambda_2 = 0$	*F*-statistics	*p*-values
Model 2	F(1,53)=14.3394	0.0004***
Model 4	F(1,53) = 3.3228	0.0213**
Model 6	F(1,53) = 14.0050	0.0004***

Rejection of the null hypotheses denotes overvaluation and undervaluation are not similar in terms of direction and magnitude. *** and ** denote significance at 1% and 5% significant level.

Several policy implications can be implied from the results. First, misalignments in terms of overvaluation have adverse effects on palm oil exports in the long run. Therefore, it is suggestive that overvaluation be avoided. Second, as a result of pegging to the US dollars, the ringgit has been relatively undervalued after the 1997 financial crisis. However, no significant long run relationship between undervaluation and exports of palm oil could be established. These results imply that de-valuation policies should be avoided as they may not confer the intended results. Third, prolonged overvalue-tion may trigger financial crisis as it did in mid-1997 which signals that the economy was not in line with its fun-damentals. Undervaluation especially after the institution of pegging to the US dollars, on the other hand, may not necessarily help enhance the exports of palm oil. There-fore, the exchange rates should reflect its fundamentals which necessitate the exchange rate management be geared at minimizing the events of overvaluation and undervaluation. The results no longer support the argu-ment that developing countries need the real exchange rate based competitiveness in order to succeed in exports of manufactures (see for example Elbadawi, 2001).

Instead, a good exchange rate management entails compatibility in fiscal, monetary, trade and other supportive non-price policies.

Apart from the exchange rate management, the authorities should also change its approach from exports of raw (intermediate processed) palm oil to exports of high value added palm oil-based exports. In addition, current policies should be geared towards comer-cializing palm-oil based products garnered from the R and D process.

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