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Food Imports and Exchange Rate: The Application of Dynamic Cointegration Framework

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ABSTRACT

This paper studies how exchange rate policy influences households' consumption styles represented by food imports. We provide an empirical analysis based on the Malaysian annual data from 1980-2012. An autoregressive distributed lag model (ARDL) was utilized in interpreting long-run elasticities of food import demand as a cointegrating relation, and short-run dynamics was interpreted using ECM based on cointegrating regression of the ARDL technique. The robustness of ARDL results are verified using Dynamic OLS (DOLS) estimation technique. Our results, while providing evidence that food import demand in the country is fairly inelastic to both income growth and relative prices of food imports, also raise some important policy issues, particularly on the competitiveness of the country's agricultural and food exports.

Keywords: Food import demand, consumption pattern, ARDL, DOLS, ECM.

1. Introduction

Malaysia's current food production and exports are relatively less impressive. This issue is well recognized by policy makers particularly in the agricultural sector, who focus on how fast to close the gap between the current food imports and exports, guarantee food sufficiency and, what ideal measure(s) should be adopted to ensure competiveness of agricultural sector and food exports.

It is not uncommon that Malaysia has recorded a consistent rise in economic growth in recent years, which in turn, has raised the country's households' income levels (Haron et al., 2005) It is also evident that this growth in households' income has created a situation, where consumers demand are changing away from local food towards more of western style (Ger, 2012, Haron et al., 2005). This scenario may, however, have important implication on domestic food self-sufficiency and competitiveness of the country's agricultural and food exports. In addition, it has been observed that, recently more priority has been given to the production of cash crop because of its importance in boosting the country's exports, as a result the state of food self-sufficiency in the country has been declining (Malaysia, 2001).

The higher demand for foreign food is particularly disturbing, because an increase in food imports implies fall in the competiveness of food exports. Overreliance on food imports has often led to imbalances in Malaysia's food trade; for instance, throughout the sample period of the present study (1980-2012), the country has been experiencing food trade deficits (see Figure 1). If the current trend of food imports does not change, it may likely threaten the sustainability of country's food security (see, for example, Giovannucci et al. (2012)).

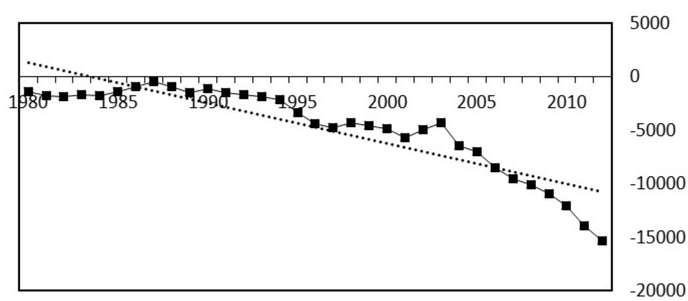

Figure 1: Malaysia's food trade deficits, 1980-2012. Source: calculated from data obtained from the Bank Negara Malaysia, RM million.

The basic trade theory suggests that exchange rate changes, alters country's trade balance, including agricultural trade (Baek and Koo, 2009, Jibrilla and Mohammed, 2015). In particular devaluation can be seen as a way to bridging such gap between food imports and its exports by discouraging local demand of foreign food and driving up food exports through an increase in the relative prices of agricultural commodities (Baek and Koo, 2009). However, given the recent change in households' demand from local food towards more of western style (Ger, 2012, Haron et al., 2005), food import demand may be relatively unresponsive to changes in its relative price. Thus, analysing the nexus between price elasticities and food imports is pertinent, especially to stimulate agricultural reform that can guarantee food security and the overall competiveness of agricultural commodities in the international market.

The importance of the present study is derived from the central role of exchange rate changes in shaping the relative price of domestic demand for import (Bahmani-Oskooee, 1986). The importance is also intensified by the recent appreciation of the U.S. dollar against Malaysian Ringgit, concerns about the potential negative effect that 'persistent' real appreciation of Ringgit may have on food imports, and concerns about the its long-term effect on the competiveness of food exports and food security in the country.

Little is known about how food import price relative to domestic food price is affecting the demand for food imports, particularly in Malaysia. This paper attempts to understand the determinants of import demand based on a particular sector in Malaysia by explicitly modelling food import demand function. Most previous studies on import demand in Malaysia focus only on the aggregate import demand, using traditional import demand model—for example, Semudram (1982), Tang and Mohammad (000a,b), Tang and Nair (2002), among others—yet the sources of dynamics and its components may vary considerably across sectors. Very few studies, if any, models food import demand for Malaysia.

2. Models, Empirical Strategy And Data

2.1 Models

The standard demand model is often used to evaluate the determinants of a country's import (Gafar, 1988). This study adopts a similar approach to examine food import demand function for Malaysia as follows

$$FMD_t = f[RGDP_t, (WFP_t/DFP_t)] \tag{1}$$

where FDM is the real demand for food imports; $RGDP$ denotes real domestic income; and (WFP/DFP) denotes relative food price (hereafter RP), defined as world food price index as a ratio of the domestic food price index. Expressing equation (1) in logarithmic form gives the following food import demand model for Malaysia:

$$\ln FMD_t = \alpha_0 + \alpha_1 \ln RGDP_t + \alpha_2 \ln RP_t + \varepsilon_t \tag{2}$$

where $\ln FDM$ signifies the natural log of real food imports, $\ln RGDP$ denotes the natural log of Malaysia's real gross domestic income and, $\ln RP$ indicates the natural log of the relative price (food import price as a proportion of domestic food price) at period t. ε_t, is the error term assumed to be purely random. Equation (2) forms the baseline model to investigate food demand in Malaysia. The concept of expressing prices in relative terms entails three things. One, domestic and imported goods are imperfect substitutes. Two, it represents the effects of exchange rate changes on the imported food. Three, it checks any potential collinearity between domestic food price and domestic income (seeBahmani-Oskooee (1986), Narayan and Narayan (2005)).

From equation (2), following the demand theory, if Malaysian consumers treat food imports as normal good or if there is less substitutes for imported foods, it follows that an increase in the national income can lead more demand for food imports (see, for example, Magee (1975), in Narayan and Narayan (2005)) . As such, the coefficient on the real GDP could be positive. However, if the local production can provide a relative substitute for imported food, it is possible to have a negative relationship between real income and demand for food imports (see, for e.g. Narayan and Narayan (2005)). Therefore, the sign on the income coefficient is a priori ambiguous.

According to the international trade theory, changes in the exchange rate influences the relative prices of imported goods (see e.g. Alexander (1952)). For example, if the Malaysian currency depreciates, there is a tendency, in particular for the cost of imported food to be highly relative to domestic productions. This is because, the traditional demand theory predicts that, an increase in import prices will likely reduce demand for imported goods as they become more expensive relative to domestic outputs (see, for example, Bahmani-Oskooee (1986)). However, given the changing pattern of consumption among Malaysian towards more of western style, which we refer to as 'habitual demand', demand for food imports is likely to be relatively insensitive to changes in the import prices. Thus, the expected effect of the relative price term to the real volume of food import is indeterminate.

2.2 Empirical Strategy

To examine the cointegrating properties of our study variables, we model equation (2) as a conditional autoregressive distributed lag model (ARDL) proposed by Pesaran and Pesaran (1997) and, Pesaran et al. (2001). One prominent advantage of this method is that, it does not require pre-testing the integration order of the variables in the food import demand equation. This, eliminates the problem of low power associated with conventional unit root tests such as, ADF and PP tests (Wang and Tomek, 2007). Thus, the approach is applicable regardless of whether the regressors in the demand equation are purely $I(0)$, purely $I(1)$ or are mutually cointegrated. In what follows, equation (2) is estimated based on the following unrestricted error correction regressions, in which each of the variables in the food demand equation is taken as dependent variable (Narayan and Narayan (2005), Pesaran and Pesaran (1997), Pesaran et al. (2001))

$$\begin{aligned}\Delta \ln FMD_t = \delta_{0FDM} + \theta_{1FDM} \ln FMD_{t-1} + \theta_{2FDM} \ln RGDP_{t-1} \\ + \theta_{3FDM} \ln RP_{t-1} + \sum_{i=1}^{p} \varpi_{iFDM} \Delta \ln FDM_{t-i} \\ + \sum_{i=0}^{p} \lambda_{iFDM} \Delta \ln RGDP_{t-i} + \sum_{i=0}^{p} \gamma_{iFDM} \ln RP_{t-i} + \varepsilon_{1t} \qquad (3)\end{aligned}$$

Where Δ denotes the first difference operator, all the remaining variables are as defined in equation (2). In these models (3), the lag orders in the ARDL model are chosen based on Akaike Information Criteria (AIC) and the selected model can be estimated using ordinary least squares technique (OLS). The bounds test for examining the presence of a long run relationship among the variables of interest can be conducted using the F-test statistics, which tests the joint significance of the coefficients of the lagged level variables. So, the null hypothesis in equation (3) is ($H_0 : \theta_{1FMD} = \theta_{2FMD} = \theta_{3FMD}$) denoted by $F_{FMD}(FMD/RGDP, RP)$ against the alternative hypothesis ($H_0 : \theta_{1FMD} \neq \theta_{2FMD} \neq \theta_{3FMD}$).

The F test that can be used to examine these hypotheses has a nonstandard distribution with two sets of critical values for certain significance levels in Pesaran et al. (2001). The first set of critical values assumes that all the variables are $I(0)$ and the second set assumes that all variables are $I(1)$. These critical values, depend on the sample size; the number of explanatory variables; whether the series are $I(0)$ or $I(1)$; and whether the ARDL model contains an intercept and/or a trend (see, e.g. Narayan (2005)). If the estimated F-statistics falls outside the upper bounds of $I(1)$, then a conclusion can be made that cointegration exist among the variables. If the computed F-statistics falls below the lower bound of $I(0)$, then the null of no cointegration cannot be rejected. If the calculated F-statistics falls in between the two bounds, then the test becomes inconclusive.

The robustness of the ARDL results can also be carried out by re-estimating the elasticities of the food import demand equation using dynamic OLS (DOLS) technique. DOLS estimator proposed by Stock and Watson (1993) extends the traditional (static) OLS regression by employing lags, leads and contemporaneous values of the explanatory variable in first difference. One important advantage of using DOLS is that, it produces asymptotically efficient estimates for cointegrated variables even in a small sample (Narayan and Narayan, 2005, Stock and Watson, 1993). Let the OLS model take the form

$$y_t = \alpha_0 + x_t^{'}\beta + \varepsilon_t \tag{4}$$

where β is a $(K \times 1)$ vector of the slopes of the regressors, $x_t^{'}$ is a $(K \times 1)$ vector of the autoregressive process of the first order difference of the explanatory variables: $x_t = x_{t-1} + \varepsilon_t$ and, ε_t is the usual error term. In what follows, the DOLS estimator of (4) can be expressed as

$$y_t = \alpha_0 + x_t^{'}\beta + \sum_{i=-l_1}^{i=l_2} \phi_i \Delta x_{t+i} + \upsilon_t \tag{5}$$

where ϕ_i is the coefficient of a lag and lead of the first differenced regressors. Suppose y_t is found to be $I(1)$ and at least one of the explanatory variables is $I(1)$ or $I(0)$, the DOLS estimates are obtained by regression of equation (5).

2.3 Data Source(s)

The Malaysian data relating to the time series of the income, food imports index and food (consumer) price index were taken from Bank Negara Malaysia statistical bulletin (various issues) over the 1980-2012 period. As we are interested in analyzing how changes in the Malaysian monetary policy that occurred in the last 33 years influenced the relationship between relative food price and food imports. The start and end periods of our sample are dictated by data availability, as no data are thus far obtainable for more recent periods.

3. Empirical Results

Although the ARDL technique does not require pre-testing the order of integration of the variables, it is useful to know the stationarity properties of our variables. The results of the unit tests using ADF, PP and KPSS techniques are reported in Table 1.

Table 1: Results of the ADF and KPSS unit root tests (1980-2012)

Variables	**ADF**	**PP**	**KPSS**
$\ln FMD$	-1.816	-1.877	$.238^{**}$
$\Delta \ln FMD$	4.565^{***}	-4.942^{***}	$.276$
$\ln RGDP$	-1.953	-1.921	$.247^{**}$
$\Delta \ln RGDP$	-6.088^{***}	-6.082^{***}	$.175$
$\ln RP$	-1.173	-1.115	$.286^{**}$
$\Delta \ln RP$	-4.996^{***}	-4.991^{***}	$.508$

Notes: ADF and PP are the augmented Dickey-Fuller (1979) test and Phillips-Perron (1988) test, respectively. KPSS is Kwiatkowski-Phillips-Schmidt-Shin (1992) test. Lag length for ADF was chosen by Akaike information criterion (AIC). Bandwidth for PP and KPSS using Bartlett Kernel. **(***) denote statistical significance levels for the rejection of the null hypothesis at the 5% and 1% , respectively.

The results show that all the variables are $I(1)$. Having established that the variables are $I(1)$, we proceed to test for univariate cointegration test using the ARDL technique. The computed F-statistics (12.307) for model (3) appears to be higher than the critical value (7.873) of the upper bound at the 1% significance level (Table 2). Thus, the null hypothesis of no cointegration for the food import demand model should be rejected.

Table 2: ADRL bound test results Test for cointegration relationship

Critical value of the F statistic for the bounds test results with intercept and no time trend						
k	1%		5%		10%	
	$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
2	6.183	7.873	4.267	5.473	3.437	4.470
Computed F-statistics $F_{FMD}(FMD/RGDP, RP)$ 12.307						

Notes: critical values are from Narayan (2005)

As a robustness check, the analysis will further re-examine the long-run relationship between food imports and its determinants using the Johansen (1988) —multivariate cointegration test approach. Table 3 shows that, the Johansen cointegration test results, reject the null hypothesis of no cointegration at better than 5% significance level, thus confirming the bounds test results.

Having established cointegration relation between food import volume and its regressors for the period under review, the study proceeded to examine both long-run and short-run elasticities of Malaysian food import demand. The results from the long-run and short-run models estimated using the ARDL technique are presented in Table 4 & 5. The long-run elasticities of the food import demand model is also re-estimated using DOLS to check the robustness of the ARDL results (also presented in Table 2, column 2).

Table 3: Johansen cointegration tests

Hypothesized no. of CE(s)	$r = 0$	$r \leq 1$	$r \leq 2$
Trace statistic (λtrace)	51.407**	23.025	8.782
Maximum eigenvalue	$r = 0$	$r \leq 1$	$r \leq 2$
statistic(λmax)	28.382**	14.243	7.928

** indicates rejection of the null hypothesis of no cointegration at 5% significance level. The Lag length for Johansen cointegration tests are chosen based on Akaike Information criterion (AIC).

Table 4 shows that, both growth in the national income and an increase in the relative price of food appear to be positively associated with the demand for food import in Malaysia. It is noteworthy that, the observed positive associations seem similar across both techniques applied. This suggests that our results are reasonably robust. The estimated coefficients show that every 1% growth in the national income is associated with as much as .84% increase in the demand for imported food, suggesting that income growth has an inelastic impact on food import demand in Malaysia. Moreover, the estimated long-run elasticities from the two estimators indicate that a 1% rise in the foreign food price relative to domestic price lead to approximately .95% to .97% increase in the demand for food imports.

Table 4: Long-run elasticities of Malaysian food import demand

ARDL		DOLS	
Constant	-4.8683*** (.54420)	Constant	-5.191392*** (.420931)
$\ln RGDP$	.81295*** (.048120)	$\ln RGDP$	.838592*** (.037714)
$\ln RP$	.96756*** (.16581)	$\ln RP$	.945418*** (.130533)

Notes: *** indicates rejection of hypothesis at the 1% significance level. The lags used to estimate the ARDL model as well as the lags and leads used to estimate the DOLS model are chosen based on Akaike Information criterion (AIC, 1973).

The estimated coefficient on the relative prices, which is less than unity tends to demonstrate that food import demand in the country is fairly inelastic to the relative price changes. These results are not too surprising given the recent sustained growth of domestic economy and income levels as well as changing consumption pattern of Malaysian, particularly for food towards western lifestyle.

To further ascertain the robustness of our estimated ARDL model, we perform residual diagnostics of univariate normality, serial correlation and hetroskedasticity tests. As can be observed in Panel B of Table 5, all the test results are in conformity with the standard assumptions. In addition, the specification test using Ramsey RESET and, the stability test of recursive residuals using CUSUM and CUSUM Squares (see Figure 2) indicate that the estimated ARDL model is free from misspecification, and all the coefficient estimates are relatively stable respectively at the 5% significance level.

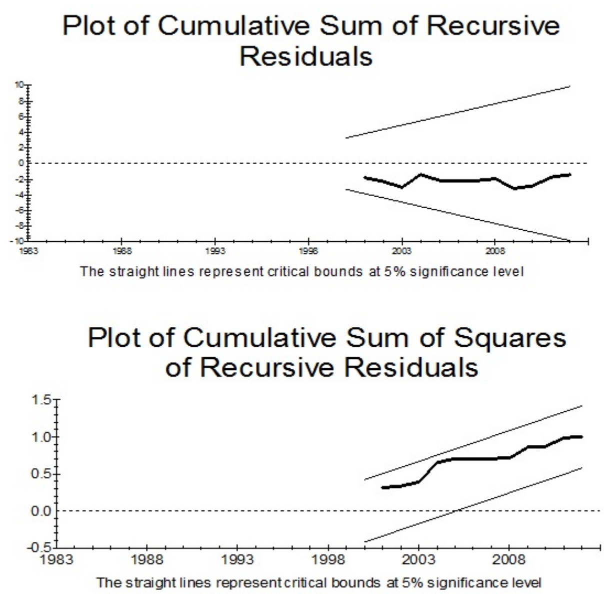

Figure 2: CUSUM and CUSUM of Squares test for the Malaysian food imports demand model

Table 5: Panel A: Short-run elasticities of Malaysian food import demand

Dependent variable: $\Delta \ln FMD$		**Standard error**
Panel A: Short-run elasticities		
Constant	-3.7924***	.12161
$\Delta \ln RGDP$	.50182**	.18783
$\Delta \ln RP$	.92650***	.22008
ECMt-1	- .77900***	.24199
Panel B: Diagnostics Statistics		*P-Values*
$\bar{R}^2$	.52871	
σ	.061496	
$\chi^2_{Norm}(2)$	.97318	(.615)
$\chi^2_{LM}(1)$	1.2016	(.273)
$\chi^2_{WT}(1)$	.0018878	(.965)
$\chi^2_{RESET}(1)$	.17093	(.679)

Notes: ** and *** indicate rejection of hypothesis at the 5% and 1% significance levels, respectively. χ^2_{Norm} is the Jarque-Bera test for normality, χ^2_{LM} is the Serial Correlation LM Test, χ^2_{WT} is the white hetroskedasticity test, χ^2_{RESET} is the Ramsey's RESET specification test. The lags used to estimate the ARDL model are chosen based on Akaike Information criterion (AIC, 1973).

The estimated short-run coefficients on the real income and relative prices are also positively and significantly related to food import demand. Again, the coefficient on the income is less than unity, suggesting the necessity of food import in the country. Moreover, the short-run coefficient of the relative prices, which is positive and less than one may suggest that the variety of imported food has little or no relatively close domestic substitutes.

The error correction term, ECM_{t-1}, for the food import demand model, which measures the speed of adjustment back to its long-run equilibrium level from any deviation, is negative and statistically significant at the 1% level. Demand for food import adjust at the speed of about 78%, or it will take Malaysia roughly 1 year and 3 months to reach the long-run equilibrium when there is any shock in the real food imports.

It is important to note, however, that our results need to be interpreted with caution given the relatively short-sample size used in this study. Notwithstanding the potential limitations of small sample, it has been shown that both the ARDL and DOLS frameworks applied in the present study can produce robust and consistent long-run estimates even in a small sample (see Narayan and Narayan (2005), Pesaran and Y. Shin (1999)).

This research contributes to the literature in the following ways. It explores the implications of an increase in relative prices of food in an economy that heavily rely on food imports to meet its local demand. The central proposition that the elasticity of food imports to changes in the relative price of food may be inelastic is reasonably supported by the empirical findings presented in the current study. Note that the estimated long-run coefficients in all the two models (presented in Table 2) show that in reality, food imports in Malaysia are unresponsive to changes in relative prices. These results cast some doubt on the ability of monetary policy via exchanges changes alone to improve domestic food production and to competitive food exports in the country.

At the very least, our findings appear to serve as a reminder that the recent appreciation of the U.S. dollar against Malaysian Ringgits do indicate that the competiveness of food exports may not significantly rely on the factors that affect relative prices of food, such as, for instance exchange rate policy, at least as far as can be detected in the data used for the present analysis.

4. Conclusions and Policy Implications

Based on Gafar (1988)'s "import demand model of the traditional demand theory, this study hypothesized that in the absence of domestically produced substitutes of imported food changes in national income and relative price may not significantly alter household demand for imported food, especially if such demand is significantly influence by 'consumers' habit'. Our long-run results show evidence that both domestic income and relative prices have positive impact on the real volume of food imports in Malaysia. Similar effect is also evident in the short-run.

The policy implications of these finding is that (i) with the fairly inelastic food import demand to relative price, changes in import price may likely keep Malaysian import bill for food unchanged[1] and (ii) the evidence of positive long run impact of growth in national income on the demand for imported food tends to suggest that, higher growth will influence higher demand for imported food. If the growth in food imports is more than that of exports, as has been the case in Malaysia in recent years, then the country's food security is likely to be threaten.

[1]That would, however, depend on the stability of price level as higher inflation relative to food import price can raise food import bill (see, for example, Narayan and Narayan (2005)).

Finally, while, for example, currency devaluation or the real appreciation of domestic currency is desirable for Malaysia to promote positive exports, particularly for food, such devaluation should be accompanied by agricultural reform policies that are pro-local farmer's empowerment. In this light, the extension of food production base and productivity improvement, particularly in areas where Malaysia has abundance agricultural resources, is required. It should be noted that food production in Malaysia has been relegating because (i) the country's agricultural policy has recently been encouraging production of cash crops over food crops. Therefore, more effort to develop new ideas that can assist in effectively applying modern technology in the food industry to strengthen the competitiveness of the country's agricultural and food exports is desirable.

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