Measuring the impact of import liberalization on market prices for selected livestock products in Malaysia

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Abstract

Malaysia has moved towards import liberalization for selected agricultural primary products since 2016. Ruminant livestock products are among the country's major concerns due to their relatively lower rate of self-sufficiency. Since the livestock sub-sector has encouraged value added agricultural based industry, liberalizing import quotas for livestock could expand both of the domestic and export markets as well as for economic growth. For many years, beef and lamb/mutton indicated increasing consumption trends while stagnating and even declining in domestic production. As a result, these products from local producers were short in supply in the market. This situation would negatively affect market equilibrium thus, saddling consumers with incredibly high market prices. This study aimed to analyze the factors affecting market prices of beef, lamb, and mutton in Malaysia. Monthly data which included import quota (import price) and market price, and exchange rate from 2016-2017 were analyzed using quantitative analysis. A Mann-Kendall trend test was initially employed to measure the trend and magnitude of the market prices. The results showed that market prices significantly ($p<0.05$) increased for beef and lamb/mutton with magnitudes of RM 0.20/kg and RM 0.04/kg, respectively. A multivariate regression analysis revealed that exchange rates and import prices significantly ($p<0.1$) influenced market prices of beef and lamb/mutton, respectively. As Malaysia relies highly on imported meat products to meet the shortfall in domestic production, a market diversification for imported livestock products could be a policy strategy to protect both the industry players and consumers. Perhaps, a tremendous increasing trend of global demand in the last two decades has surged the world prices of meat products, thus reflected in the livestock industry in Malaysia.

Introduction

The livestock sub sector has played an important role in the Malaysian economy as the Compound Annual Growth Rate (CAGR) for both gross output and value added were recorded at 15.1% and 17.2%, respectively during 2010-2015 period with the largest contribution of the output stemming from the poultry industry (Department of Statistics, Malaysia, 2016). Despite having achieved full and even more than 100% of self-sufficiency level (SSL) for poultry meat and pork (Ariff et al., 2015), Malaysia livestock sub-sector is struggling with ruminant industry as a large gap between local supply and demand continues to prolong due to a relatively low self-sufficiency level and thus is highly dependent on imports. In 2017, the SSL for beef was recorded at 23.4% while lamb and mutton indicated a lower SSL rate of 11.4 %.

In recent years, beef and lamb/mutton indicated increasing consumption while domestic production remained the same. In fact, domestic production declined, resulting in shortages in the local markets. To overcome this shortfall in domestic supply, Malaysia has become largely dependent on imported meat

(Mohamed et al., 2013). According to Ministry of Agriculture and Agro-based Industry, Malaysia (MOA), the gap between local production and consumption for beef and lamb/mutton in 2016 amounted to 160.2 (in thousand MT) and 35.4 (in thousand MT), respectively. This deficit is expected to further increase in 2020. Hence, Malaysia continues to depend on imported meats from the existing exporters, comprising of Australia, New Zealand, India, Brazil and Thailand (Sahar and Chamhuri, 2016).

As shortage in supply remains the major issue, the government has decided to liberalize import quotas for beef and lamb/mutton beginning in 2016. One of the major rationales of this policy decision is to address inadequacy of local supply which affects consumer prices as well as food security through increasing consumer welfare (MOA, 2017).

Therefore, this study emphasized the impact of import liberalization on market prices for beef, and lamb/mutton. The specific objectives were (1) to identify the trend of economic indicators during the import liberalization period, (2) to analyze the relationship among these economic indicators and (3) to identify factors affecting market prices of beef and lamb/mutton.

Materials and Methods

Data Source

Monthly data from various sources (Department of Veterinary Services Malaysia (DVS), Federal Agricultural Marketing Authority, Malaysia (FAMA) and International Monetary Fund (IMF)) which included import quotas and values, market and import prices during liberalization period, from January 2016 to December 2017, were utilized. This study hypothesized that market prices (i.e., consumer prices) in local currency per kilogram, imports (quantity and value in local currency), import prices and exchange rates are associated with each other. Import prices were referred as the Cost, Insurance and Freight (C.I.F) while the exchange rates were used in the conversion rates in US Dollar (USD) to local currency, Malaysian Ringgit (RM), which were retrieved from the International Monetary Fund (IMF) database. All price variables were determined and explained in real value term. The data were analyzed using R programming language (version 3.4.0) using market price as the dependent variable.

Mann-Kendall Trend Test

The Mann-Kendall (MK) trend test (Mann, 1945; Kendall, 1975) is an applicable technique for identifying and interpreting the trend pattern of exchange rate, market price, and import price for beef and lamb/mutton time series data. This approach is a nonparametric method and does not require any hypotheses of normal distribution, and it is proven that the presence of outliers will not affect the results (Ijaz Ahmad et al., 2015).

The MK test was evaluated based on the correlation between the observed ranks and order of time as expressed below:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^{n} sign(x_j - x_i) \quad (1)$$

$$sign(x_{j-}x_{i)} = \begin{cases} 1\ ;\ x_i < x_j \\ 0\ ;\ x_i = x_j \\ -1\ ;\ x_i > x_j \end{cases} \quad (2)$$

$$V(S) = \frac{n(n-1)(2n+5)}{18} \quad (3)$$

$$Z = \begin{cases} \dfrac{(S-1)}{\sqrt{V(S)}} & ;S > 0 \\ 0 & ;S = 0 \\ \dfrac{(S+1)}{\sqrt{V(S)}} & ;\ S < 0 \end{cases} \quad (4)$$

where $\{x_t : t = 1,2,\dots,n\}$ is a time series for *n* sample size.

Positive values of Z indicate increasing trends while negative values indicate decreasing trends. Test hypothesis for this Mann-Kendall test is described as follows:

H_0: there is no trend
H_a: there exists a monotonic trend

At the significance level of $\alpha = 0.1$ if $|Z| > Z_{1-(\frac{\alpha}{2})}$, then H_0 is rejected and a significant trend exists in the time series.

The direction and magnitude of the trend in time series data were determined by using Sen's slope (Sen, 1968). Sen's slope b, is calculated by

$$b_i = \frac{x_j - x_i}{j - i}, i = 1,2,\dots,N, \quad j < i \quad (5)$$

The Sen's estimator of the slope is the median of these *N* values of b_i. The sign of b reflects the direction of trend data while the value represents the magnitude of the data.

Correlation Analysis

Correlation analysis was used to measure the strength of association between two variables and the direction of a linear relationship. In this study, the correlation analysis was done to identify the relationship between the market price and import price, market price and exchange rate, and import price and exchange rate of beef and lamb/mutton. Pearson *r* correlation was calculated to measure the degree of linear relationship between variables.

Multivariate Regression Analysis

A multivariate regression analysis is a methodology used to identify the relationships between dependent variables (response variables) and independent variables (predictor variables) so that a response or outcome can be predicted from the others (Kutner et al., 2008). Prior to the analysis, regression diagnostics were done to assess the validity of the models. It is important to run the diagnostic test of the model for the data before inferences based on that model are undertaken (Kutner et al., 2008). Two models, quadratic and log-linear models were developed to identify factors affecting market prices of beef and lamb/mutton during import liberalization in Malaysia.

Quadratic Regression

A quadratic model was used to analyze the factors affecting market prices of beef during the implementation of import liberalization in Malaysia. The predicted model is shown as follows:

$$y = \beta_0 + \beta_1 x_2 + \beta_2 x_2^2 + e \quad (6)$$

The variables are described as:
y = market price of beef
x_2= exchange rate
β_0 = intercept
β_1, β_2 = partial regression coefficients
e = residuals

A linear regression model will fit to the data if the quadratic term is determined to have no statistically significant relationship with the data. However, if there is a significant quadratic expression in the data based on F-statistics and quadratic patterns showed in

scatterplots of residuals vs fitted values, the quadratic might be the best model to fit the data (Liu et al., 2005).

Log-Linear Regression

Log linear model is similar to linear regression, however the interpretation is different due to both are log-transformed variables (i.e., response and predictor). Thus, the interpretation is described in percentage change in *Y* when *X* increases. In fact, the partial regression coefficients can be referred as direct elasticity which can easily be evaluated (Akay et al., 2006).

The results of a diagnostic test suggest that a log linear model is suitable as there is no influential outlier and multicollinearity and the errors of the data are distributed normally. There is also no violation regarding homoscedasticity issues.

The model is expressed in equation (7),

$$\ln(y) = \beta_0 + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + e \qquad (7)$$

where:
y= market price of lamb/mutton
x_1= import value
x_2= exchange rate
β_0 = intercept
β_1, β_2 = partial regression coefficients
e = residuals

Results and Discussion

Factors affecting market prices of beef

Figure 1 displays the data of market price, CIF import price, and exchange rate from January 2016 to November 2017, which showed increasing patterns. From the tests conducted, all variables showed positive values and indicated increasing magnitudes which were consistent with the trend patterns. However, only the market price was statistically significant with the magnitude of RM 0.203 per kg of beef while the other variables (imports and exchange rates) were not significant (Table 1).

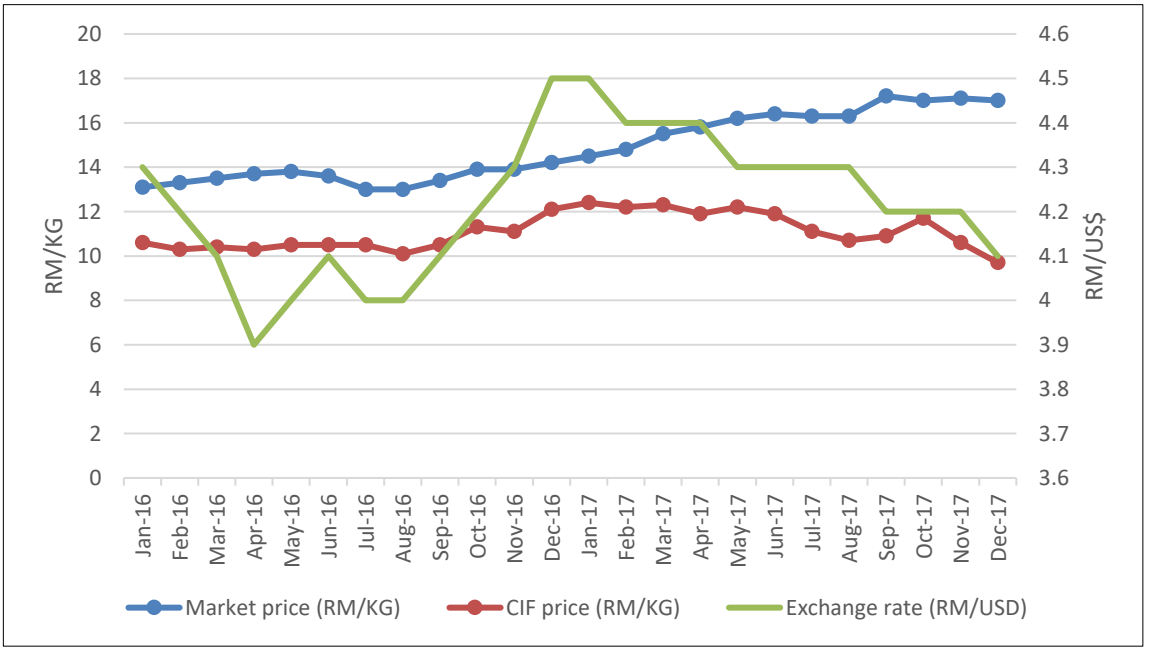


Figure 1: Monthly market price, import price of beef and exchange rate value.

Table 1: Results of trend test of beef

Variable	Magnitude	P-value
Import (CIF) price (RM/kg)	0.032	0.102
Market price (RM/kg)	0.203	0.000**
Exchange rate (RM/US$)	0.005	0.277

*Level of significance ($\alpha = 0.1$),**Level of significance ($\alpha = 0.05$)

According to Food and Agriculture Organization (FAO), an increase in domestic market prices of beef reflected from the upward trends in global meat price as Malaysia was largely dependent on Australia and New Zealand (FAO, 2017).

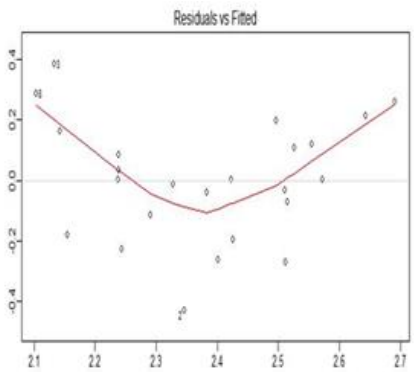
Table 2: Results of Correlation Analysis between import price, exchange rate and market price

Variable	Corr. coef.	P-value
Import price vs. Market price	0.284	0.179
Import price vs. Exchange rate	0.821**	0.000
Market price vs. Exchange rate	0.304	0.148

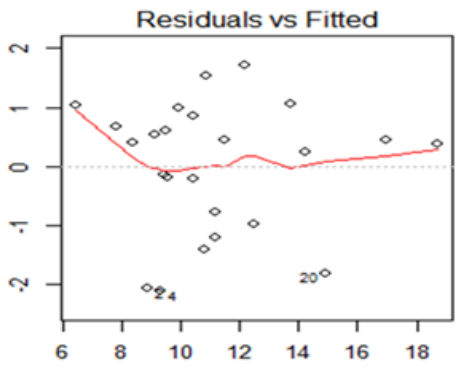
*Level of significance ($\alpha = 0.1$),**Level of significance ($\alpha = 0.05$)

The results of the correlation analysis indicated a strong positive relationship between import price and exchange rate with a coefficient value of 0.821. The rest of the correlation coefficients indicated weak positive correlation of import price and market price, and market price and exchange rate which could be interpreted that the independent variables were not good predictors of market price.

The quadratic model was chosen according to regression diagnostic tests that suggested there was a curvilinear effect between the market price of beef and exchange rates (Figure 2). Figure 2 (a) displays the plot of residuals against fitted values for a linear model. Apparently, the plot suggested that a linear model was not a valid model to be applied. Using a quadratic model, the distribution of residuals was improved (Figure 2(b)). In addition, the results of diagnostic tests for normality, homoscedasticity, multicollinearity, and outliers appeared to be consistent with regression specifications. Thus, the quadratic model appeared to perform well in analyzing market price of beef data.



2(a)



2(b)

Figure 2: Scatter plots of residuals vs. fitted values of quadratic model for market price of beef

Table 3: The parameters and statistics of exchange rate in influencing the market price of beef

Model	β	Std. Error	p-value	R^2	p-value
Constant	-335.55	177.58	0.073	0.236	0.0594*
x_2	163.53	84.35	0.066*		
x_2^2	-19.05	10.01	0.071*		

*Level of significance ($\alpha = 0.1$)

Table 3 indicates the results of regression analysis using quadratic model for market price of beef. A multiple determination coefficient (R^2) indicated a value of 0.236 implying that the variation in the x_2 and x_2^2 variables included in the model could only explain 23.6% of the total variation. Although the R^2 was considerably small, this parameter did not mean that the estimated regression line was not a good fit as the relationship between the response variable (market price) and exchange rate was significant. The *F* test was used to determine the significance of the function which also could explain the goodness-of-fit of the model. The result of *F* value at 10% significance level was 3.240 (p-value = 0.0594). Thus, the result was acceptable to explain the effect of predictor variable on the response variable.

Both partial regression coefficients indicated that exchange rate was a significant factor in influencing the market price of beef. The quadratic model relating the relationship of exchange rate and market price could be explained by differentiation method, meaning that the market price would increase at low currency values, however when the value of the currency was at specific point (x_2= 4.29), market price started to decrease (Table 3).

Factors affecting market price of lamb/mutton

A similar trend test was also employed for lamb/mutton data in detecting a significant trend for monthly market price and import price for lamb/mutton as well as exchange rate.

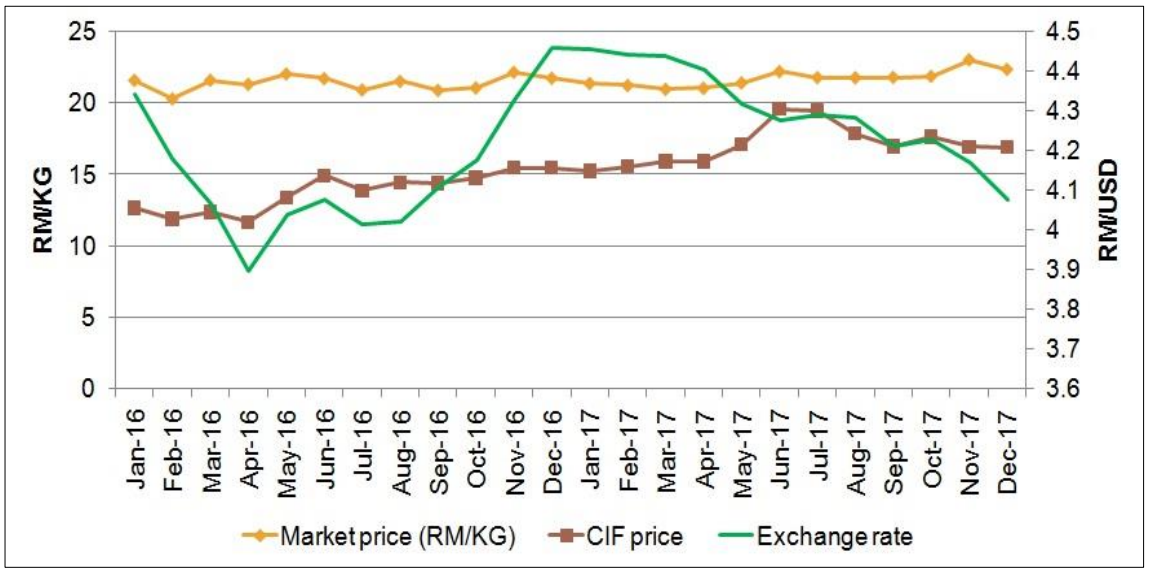


Figure 3: Monthly market price, import price of lamb/mutton and exchange rate value

Table 4: Result of trend test for lamb/mutton

Variable	Magnitude	P-value
Import price (RM/kg)	0.253	0.000**
Market price (RM/kg)	0.040	0.012**
Exchange rate (RM/USD)	0.005	0.277

*Level of significance ($\alpha = 0.1$),**Level of significance ($\alpha = 0.05$)

The results of trend test exhibited increasing trend for all variables. Import price and market price significantly increased with the increasing magnitude of RM 0.253 and RM 0.040 per kg, respectively (Figure 3 and Table 4).

The correlation analysis of market price and import price of lamb/mutton indicated a significant correlation (correlation coefficient = 0.488), implying a positive relationship between import price and market price (Table 5). In addition, the import price and exchange rate indicated a correlation coefficient at 0.421 showing implicit significant positive correlation.

Table 5: Results of Correlation Analysis between import price, exchange rate and market price

Variable	Pearson correlation	P-value
Import price vs. Market price	0.488**	0.000
Import price vs. Exchange rate	0.421**	0.040
Market price vs. Exchange rate	-0.053	0.805

*Level of significance ($\alpha = 0.1$),**Level of significance ($\alpha = 0.05$)

Table 6: The parameters and statistics of exchange rate in influencing the market price of lamb/mutton

Model	β	Std. Error	p-value	R^2	p-value
Constant	3.076	0.181	0.000**	0.326	0.016**
x_1	0.120	0.038	0.005**		
x_2	-0.232	0.140	0.113		

*Level of significance ($\alpha = 0.1$),**Level of significance ($\alpha = 0.05$)

The results of regression analysis performed for market price of lamb/mutton are presented in Table 6. The *F* value of 5.08 at 5% level of significance implied that the log linear model was acceptable to describe the effect of predictor variables on the response variable. The multiple determination coefficient of the model of R^2= 0.326 suggested that 32.6% variation of the market price of lamb could be explained by the variables, import value and exchange rate. The import value significantly affected market price of lamb/mutton. A 1% increase in import value of lamb/mutton, there would result in an increase of 0.12% in market price when other variables remained constant.

The factors of exchange rate and import value had influenced the trend of Malaysian market price of the imported goods of beef and lamb/mutton, respectively. The effect of these two variables could be divided into two different stages. At the first stage, the effect of exchange rate movements towards Malaysian ringgit would influence the cost of imported

goods landed. The second stage was that changes in the prices of imported goods had on overall effect in consumer prices where the effect would be practically direct or indirect. For example, the direct effect is when the consumers buy imported beef or lamb/mutton. Meanwhile the indirect effect is where the prices of domestically produced goods could be affected by the change in the cost of imported input (Chung et al., 2011).

The exchange rate is an important economic variable that influences the sale and purchase of agricultural commodities which are internationally traded. In theory, higher exchange rates positively influence the cost of importing hence, increases the market price (Norazaman et al., 2018). However, other factors which cannot be neglected will also influence the increase of market price of agricultural products. For example, Davidson et al. (2011), revealed in food commodity, that market price movement is accounted in a small degree by world raw commodity market prices where the large amount of changes in market price is influenced by changes in manufacturing costs of food.

As Malaysia relies highly on imported meat products from a limited number of major livestock producers to meet the shortfall in domestic production, a supply diversification could be a policy strategy to protect both local producers and consumers' interest. Perhaps, the tremendous increasing trend of global demand in the last two decades has surged the world prices of meat products, thus reflected in the dynamics of the livestock industry in Malaysia.

Conclusion

In the case of imported beef, mutton and lamb in Malaysia, this study found that the changes in market price of meat industry were influenced by the changes in exchange rate and import price for beef and lamb/mutton, respectively. While trend analysis of market prices for beef showed an upward trend, and there was no relationship between market price and import price, this study revealed that exchange rate was the major factor affecting market price for beef which suggests that market price is not significantly pressured by import price. For lamb/mutton, import prices were identified as significant in affecting market price which indicated an increasing trend. Import prices for lamb/mutton increased as a result of supply shortage in Australia due to climate change affecting the livestock industry (MLA, 2017). However, the empirical analysis in this study is believed to experience a few limitations. For example, both of the regression models contributed a moderate influence described by the predictor variables on the response variables as this reflected that other factors might also influence the changes in market price. Other than that, the time period of import liberalization was only 2 years giving 24 monthly datapoints, thus would somehow affect the result of regression model in this study. Further research is needed to explore other factors that could contribute to change in market price for imported meat products.

Acknowledgement

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