ESTIMATING ASYMMETRIC PRICE TRANSMISSION IN THE INDONESIAN BEEF MARKET

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ABSTRACT

Rising beef prices and its volatility faced by Indonesian households have contributed to uncertainties of allocating households' resources and purchasing powers. In spite of low per capita consumption, the price fluctuations have posed challenges to the meat self- sufficiency target enacted by the government. Import dependence of beef and live cattle have also risked domestic price stability due to their links with international price fluctuations. This study specifically investigated the domestic price responses to the changes of the international prices. This study also employed a threshold cointegration model using beef prices data at the international and consumer level from 2008 to 2016. The findings depicted that a threshold occurred in the beef markets, reinforcing the non-linear price asymmetries in the markets. Additionally, the two regime models also revealed that the domestic and international beef price deviations in the long-run equilibrium exceeds 0.03 prior to the adjustment of the domestic beef price in reaching its equilibrium. Two important policy implications are suggested, concerning the reduction of transport costs in beef distribution and increasing market efficiency by involving more market players.

Key words: volatility, linear, non-linear, threshold, asymmetric price, beef market**.**

INTRODUCTION

There has been an increasing awareness of Indonesian people to the importance of protein for their health. As their awareness increasing, the households' income rise has led people to increase their demand on protein (Bennett's law) including beef which is the second source of protein consumed by people in Indonesia (Sekretariat Ditjen PKH 2017). However, the increasing demand of beef could not be followed by the increasing supply from local production (Harmini et al. 2011). As a result, there is an excess demand which leads to an increasing and a fluctuating price of beef at the domestic (retail/consumer) level (Fig. 1). One of the efforts made by the Indonesian government to fulfill the increasing demand and to stabilize the price of beef is by importing beef. Unfortunately, the policy seems to be ineffective as the price has never stabilized. In addition, as the prices at the consumer level tend to rise constantly, the prices at the international level have fluctuated during the periods of study (Fig. 1). This has provided an indication that the changes in international prices have been not perfectly transmitted to the domestic market. As it can be identified in Fig. 2, either the magnitude or the speed of its changes is not the same between international and domestic (retail) markets. For a perfectly competitive market, a price increase in a market will be transmitted to other markets in the same speed

or magnitude as the price decrease or price transmission tends to be symmetric (Chen and Saghaian 2016). However, the figure provides insights that the price transmission seems to be asymmetric. Several factors contributing to the asymmetric price adjustment including: the imperfect competitive market characterized by price leadership or market powers, adjustment cost, and government intervention such as price supports and marketing quotas (Goodwin and Holt 1999). On the other hand, significant attention has been given on this issue due to its potential negative impacts on consumers. There is an indication that the retailers decide to automatically increase the prices due to the rise in the wholesale prices, but do not adjust when the wholesale prices decline (Manera and Frey 2005).

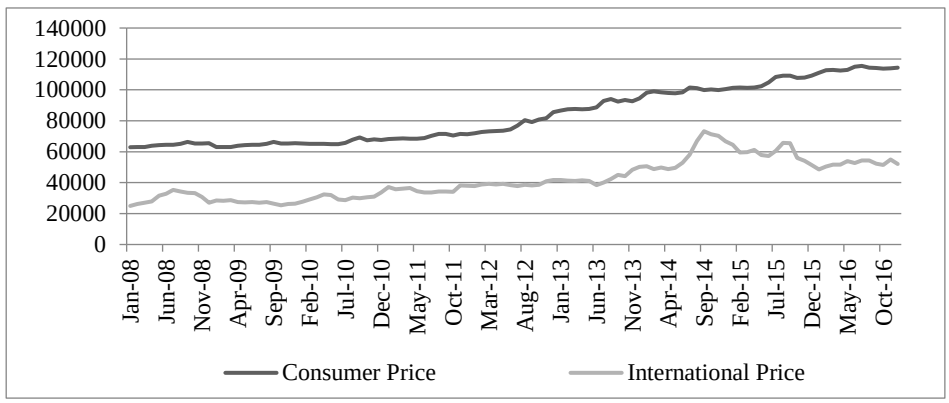

Fig. 1. Beef price development at domestic and international markets

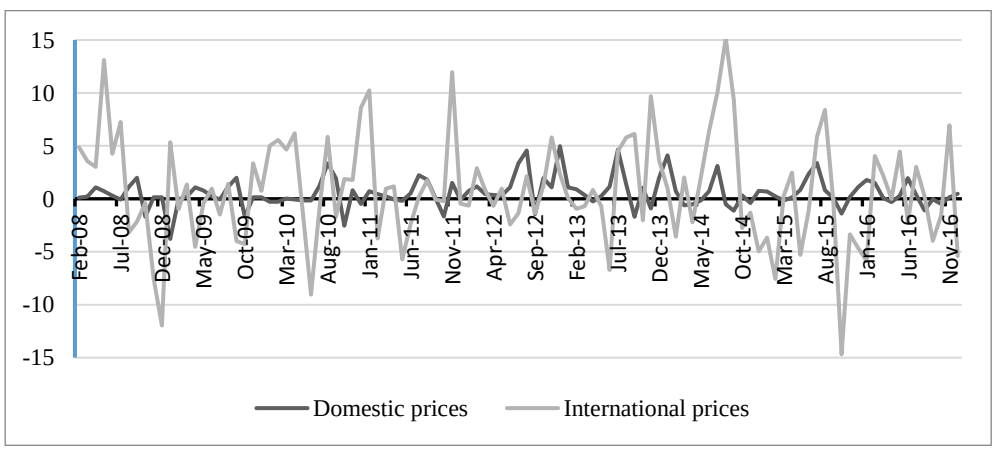

Fig. 2. Quarterly growth of beef prices at domestic and international markets (%)

The linkages between markets or price transmission for meat and livestock products have been examined extensively (Kinnucan and Forker 1987; Goodwin and Holt 1999; Luoma et al. 2004; Pozo et al. 2013; Zainuddin et al. 2015; Komalawati 2018). Initially, studies on price transmission usually assume the linear error correction where the long run equilibrium illustrated a straight line as the slope is constant over time. This also indicates an instant adjustment towards the equilibrium will occur regardless of the size of the deviation to the equilibrium. Therefore, this adjustment mechanism also does not take into account the possible transaction costs within the chains (Meyer and von-Cramon Taubadel 2004; Luoma et al. 2004). It has been widely acknowledged that the price changes are often do not adjust instantly to its equilibrium in the long run. Therefore, to accommodate non-linearity in

price transmission, a new approach was developed from the study of Balke and Fomby (1997) which is well known as "threshold cointegration". In this model, cointegration is still maintained and between the estimated thresholds r_1 and r_2 there may be a range of unit root adjustment (Luoma et al. 2004). When the deviation is larger than the threshold value, the deviation will result in price changes. It is also worth to note that the non-linear dynamic relationships resulted from the adjustment costs involved in the thresholds. Therefore, it is apparent that the threshold effects occur only when larger shocks constitute a dissimilar response than that of relatively smaller shocks (Goodwin and Holt 1999).

The indication of the non-linearity in data of price could be seen in the study of Luoma et al. (2004) where price transmission in the pork market was analyzed. Initially, pork price series were not co-integrated and there was a structural change in the formation of the consumer price. Additionally, the study also found that there is no asymmetric price transmission between price levels. However, after further analysis by considering the longer time interval, a continuous structural change beef market was determined. The continuous structural change could be seen from the proportion of the producer price to the consumer price that was continuously decreasing. The non-linear adjustment of prices between consumer and producer prices in the Greek milk sector was analyzed using a threshold error correction/autoregressive model (Rezitis and Rezitis 2011). By using a two-regime threshold cointegration model, the research rejected the null hypothesis of linear cointegration.

However, modeling non-linearities does not explicitly help to improve the forecast performance. The transmission mechanism between producer and consumer prices of milk and dairy products in Austria was assessed using monthly data of milk, dairy and cheese products, as well as butter in the consumer and producer level as well as Threshold Vector Error Correction Model (TVECM) (Fernandez-Amador et al. 2010). An inaction band was found around the long-run relationship and the price dynamics differ between periods of increasing and decreasing trend of change in causal prices. The results show that there is asymmetric price transmission in milk and dairy markets in Austria. These asymmetries can be modeled as triggered by the magnitude of the deviation from equilibrium, as well as the trend in prices in a reference period. Impulse response analysis gives further support to the bias of the market when establishing prices beyond the inaction band around the long-run equilibrium.

Price transmissions among farm, wholesale and retail of U.S. beef markets was examined using two types of retail level price data. The first one was collected by the Bureau of Labor Statistics (BLS) and the other was collected at the point of sale using electronic scanners and is analyzed using TVECM (Pozo et al. 2013). Although these two retail price series differ in the way these were constructed, there is no evidence of asymmetry in the response of retail prices to shocks in upstream prices. Since retailer adjustments to farm and wholesale price changes are symmetric, the U.S. beef market is not as inefficient as found in previous studies. That is, information is transmitted more efficiently along vertically coordinated beef markets. By using non-linear ARDL model, there were an asymmetry either in speed or magnitude between farm and wholesale markets and between wholesale and retail markets (Fousekis et al. 2016). These two studies reveal the inability of modeling non-linearities to actually correct (Fernandez-Amador et al. 2010). Different results could be obtained from the modeling non-linearities because of differences in data used.

The studies on price transmission of beef in Indonesia both by Zainuddin et al. (2015) and Komalawati (2018) have assumed the linear error correction in the long run. This study sought to evaluate the possibility of asymmetric price transmission of beef from the international to retail markets in Indonesia. This study attempts to investigate the possibility of non-linear adjustment in the asymmetric price transmission of beef by utilizing the Threshold Vector Error Correction Model (TVECM) that was introduced by Hansen and Seo (2002). The results of this study are expected to provide relevant recommendations for decision makers in the formulation of an invaluable policy for improving the market mechanism.

METHODOLOGY

Data. The data used are monthly time series data from January 2008 to December 2016. The international price data is obtained from the World Bank, while the domestic price data is collected from the Indonesian Ministry of Trade. Both prices are in Rupiah (IDR) per kilogram and deflated with the monthly consumer price index (CPI) deflator.

Analysis method. The data was analyzed using TVECM and processed using software R.3.3.3. Before analysing the data, there are several requirements that have to be fulfilled:

Stationarity Test. The first requirement, the data used have to be stationary. To test the stationarity, Augmented Dickey-Fuller (ADF) or Phillips and Peron (PP) test are used. It is repeatedly used at the same level until a stationary data is obtained. The ADF test uses the following equation:

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \sum_{t=1}^{p} \beta_i \Delta P_{t-i} + \varepsilon_t \quad (1)$$

P_t is variable of beef meet prices (international price and domestic price) in t period (IDR/kg), while P_{t-1} and P_{t-i} are beef prices from the previous period (Rp/kg) and i previous period (IDR/kg). ΔP_t is the difference between price on the previous period and current period (P_t - P_{t-1}p is the number of lag, α_0 is intercept, γ and β are the coefficient of parameter, and ε_t is *error term*. The hypotheses used in this model are as follow: (a) $H_0 : \gamma = 0$ (H_t is stationary); and (b) $H_1 : \gamma < 0$ (H_t is not stationary).

Determination of Optimal Lag. One of the problems that occur in stationary test is in determining the optimal lag. If the lag used in the stationary test is too small, then the residual from the regression cannot display the white noise process, so the model cannot accurately estimate the actual error. In determining the optimal lag in the model, several information criteria can be used such as Akaike Information Criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn Criterion (HQ), and others.

Cointegration Test. The test of cointegration is conducted to show the long-term relationship between the variable price of beef at international and domestic levels. The cointegration test used in this study is based on the methods of Johansen, and Johansen and Juselius, known as the maximum likelihood (Vavra and Goodwin 2005). Based on the Johansen method, the cointegration test begins with the traditional VAR model to determine the optimal amount of lag, based on the likelihood ratio test. The optimal lag is used to estimate VECM and determine the rank of the parameter matrix. The cointegration equation of the VECM model is as follows:

$$\Delta P_t = \Pi P_{t-1} + \Gamma_1 \Delta P_{t-1} + \ldots + \Gamma_{k-1} \Delta P_{t-k+1} + \varepsilon_t \quad (2)$$

ΔP_t is the lag between price on the previous period and current period (P_t - P_{t-1}), ΔP_{t-1} is the lag between price from two periods before and price on the previous period, and ΔP_{t-k+1} is the difference between price from k+1 periods before and price from k periods. k is the number of lag or periods, Γ_1 = price dynamics in the short-run, while Π indicates the co-integration relationships between two variables.

According to the Johansen method, VECM is estimated using the maximum likelihood Lmax (r) which is a function of cointegration rank r. To test the existence of long-term relationships between variables, there are two testing methods, namely trace test and maximum eigenvalue test. If the value of the trace statistic (TS) and the maximum eigenvalue (ME) exceeds the t-statistic value, then the null hypothesis is rejected. In other words, there is a long-term relationship between the variables analyzed.

The equation for TS and ME are the following:

$$\lambda_{trace} = -T \sum ln(1 - \hat{\gamma}_i) \quad (3)$$

$$\lambda_{max}(r, r+1) = -T \sum ln(1 - \hat{\gamma}_{r+1}) \quad (4)$$

$\hat{\gamma}_i$ is the estimated root value (eigenvalues) obtained from the matrix estimation Π.
T is the number of observations, and
r is the ordo which indicates the number of cointegration vectors.

Threshold Vector Error Correction Model (TVECM). Analysis of market integration in accordance with price data alone has been criticized because transaction costs are ignored. TVECM can explain the effect of transaction costs in price transmission without directly depending on information about those costs. Threshold cointegration was proposed as a viable technique for incorporating non-linearity and cointegration. In particular, this model allows for non-linear adjustments to long-run equilibrium (Balke and Fomby 1997). This model is used to explore and adjust the speed of price transmission and the cointegration approach is used to determine whether there is integration in the long term or not. Threshold cointegration incorporates nonlinearity and cointegration by allowing nonlinear adjustments over the long run. TVECM is a model used to determine a condition that is bounded threshold, so as to create two or more different conditions. The extension of this model enhances the cointegration analysis capability to represent real-world economic phenomena by loosening the assumption that the speed at which a cointegrated series moves toward a long-term equilibrium relationship is not constant over time. TVECM is also used to estimate asymmetric price transmission. The threshold model is a more accurate dynamic economic balance model for testing dynamic price relationships between different markets (Balke and Fomby 1997).

The present paper analyzes asymmetric transmission between domestic and international beef meet prices by using Hansen and Seo's threshold cointegration approach. Hansen and Seo (2002) estimate two TVECM regimes with one cointegrating vector and threshold parameters based on error correction term. A TVECM equation can be written as:

$$\Delta P_t = \begin{cases} \alpha^1 \omega_{t-1}(\beta) + \sum_{t=1}^{k-1} r_t^1 \ \Delta P_{t-1} + u_t^1 & if\ \omega_{t-1}(\beta) \leq \gamma \\ \alpha^2 \omega_{t-1}(\beta) + \sum_{t=1}^{k-1} r_t^2 \ \Delta P_{t-1} + u_t^2 & if\ \omega_{t-1}(\beta) > \gamma \end{cases} \quad (5)$$

Equation (5) can be described as follows:

$$\Delta PD_t = \theta_{11} + \alpha^1 \omega_{t-1}(\beta) + \lambda^1{}_{111}\, \Delta PD_{t-1} + \lambda^1{}_{121}\, \Delta PI_{t-1} + \lambda^1{}_{112}\, \Delta PD_{t-2} + \lambda^1{}_{122}\, \Delta PI_{t-2} + u_t^1 \ \Delta PI_t = \theta_{12} + \alpha^1 \omega_{t-1}(\beta) + \lambda^1{}_{211}\, \Delta PD_{t-1} + \lambda^1{}_{221}\, \Delta PI_{t-1} + \lambda^1{}_{212}\, \Delta PD_{t-2} + \lambda^1{}_{222}\, \Delta PI_{t-2} + u_t^1 \} \ if\ \omega_{t-1}(\beta) \leq |\gamma| \quad (6)$$

$$\Delta PD_t = \theta_{11} + \alpha^1 \omega_{t-1}(\beta) + \lambda^1{}_{111}\, \Delta PD_{t-1} + \lambda^1{}_{121}\, \Delta PI_{t-1} + \lambda^1{}_{112}\, \Delta PD_{t-2} + \lambda^1{}_{122}\, \Delta PI_{t-2} + u_t^1 \ \Delta PI_t = \theta_{12} + \alpha^1 \omega_{t-1}(\beta) + \lambda^1{}_{211}\, \Delta PD_{t-1} + \lambda^1{}_{221}\, \Delta PI_{t-1} + \lambda^1{}_{212}\, \Delta PD_{t-2} + \lambda^1{}_{222}\, \Delta PI_{t-2} + u_t^1 \} \ if\ \omega_{t-1}(\beta) > |\gamma| \quad (7)$$

Where ΔPD_t is the differences of domestic beef price between previous period and current period. ΔPI_t is the lag of international beef price between previous period and current period. ω_{t-1} (β) is the residuals of beef prices at the domestic and international levels representing the threshold variable (ECT), and γ is threshold parameter that separates two regimes.

RESULTS AND DISCUSSION

The empirical analysis, as previously mentioned above, utilizes two series of monthly beef prices observed from January 2008 to December 2016, giving a total of 108 observations. The international prices for beef were collected from the World Bank, and the retail prices were collected from the unpublished database of Ministry of Trade. The standard unit-root tests using Augmented

Dickey-Fuller (ADF) and Phillips and Peron (PP) tests confirmed that both series of prices are stationary at first difference (Table 1). Thus, those series of prices are integrated at order one (1).

Table 1. Unit root test of international and domestic beef prices

Variables	ADF		PP	
	Level	First Difference	Level	First Difference
International beef price (PI)	-1.484 [0.538]	-7.676 [0.000]*	-1.474 [0.543]	-7.649 [0.000]*
Domestic beef price (PD)	0.460 [0.985]	-8.793 [0.000]*	0.375 [0.981]	-8.783 [0.000]*

Having tested the presence of unit root and stationarity, the second stage was to investigate the optimal lag selection. From the economic point of view, the effect of any external shock will take time to come to the equilibrium level. Therefore, the current data is usually associated with the past information of the concerned variable as in the association of present price to the past price. By specifying the optimal lag length, the model will not be misspecified or there will be no under – and overspecification of lag length when testing the cointegration (Ajibola et al. 2015).

Several criterias are applicable when determining the optimal lag length: *Likehood Ratio* (LR), *Final Prediction Error* (FPE), *Akaike Information Criterion* (AIC), *Shwarz Information Criterion* (SC), dan *Hannan-Quin Criterion* (HQ), and others. In this study, the optimal lag length is selected based on the smallest value of AIC. The smallest value of AIC is in the first lag (Table 2). Therefore, the lag length used in the model is the one lag. The selection of the optimal lag length is important to avoid the problems of autocorrelation and heteroscedasticity in vector error correction model (VECM).

Table 2. The selection of optimal lag length.

No.	LR	FPE	AIC	SC	HQ
0	NA	4.85e-07	-8.862409	-8.809982*	-8.841197*
1	10.00962	4.74e-07*	-8.885867*	-8.728587	-8.822232
2	4.908348	4.88e-07	-8.857276	-8.595142	-8.751216
3	2.465568	5.15e-07	-8.803267	-8.436281	-8.654784
4	3.962719	5.35e-07	-8.766489	-8.294649	-8.575582
5	7.723059	5.32e-07	-8.773443	-8.196750	-8.540112
6	7.487797	5.29e-07	-8.779703	-8.098156	-8.503948
7	2.387396	5.58e-07	-8.727316	-7.940916	-8.409137
8	10.82734*	5.32e-07	-8.778549	-7.887295	-8.417946

Note : *indicates lag order selected by the criterion

Johansen Cointegration tests was then carried out by comparing between trace statistics and critical value and maximum eigenvalue at five percent significance. If the trace statistic or maximum eigenvalue is greater than the critical value, there is a long-term relationship or cointegration between the prices. The Johansen cointegration tests indicated the existence of a single cointegrating relationships among the two prices (Table 3). Therefore, the international and domestic beef markets are co-integrated in the long-run.

Table 3. Cointegration test of international and domestic beef prices

Hypotheses	Trace Statistic	Critical Value 5%	Max-Eigen Statistic	Critical Value 5%
None	85.705	15.495	49.770	14.265
At most 1	35.934	3.841	35.934	3.841

Zainuddin et.al. (2015) who analyzed the integration of beef prices between international and domestic markets also found similar results. However, the results assumed the constant and linear co-integration of markets. In the real word, however, the direction of a response to the economic shocks may deviate from the long run equilibrium asymmetrically. For instance, the retail beef market receives government interventions such as market operation to stabilize the price when it is hiking and volatile or import quota to protect domestic cattle farmers to support beef meat self-sufficiency. The market responds possibly in the opposite direction. Referring to the concept of asymmetric price transmission, several factors contribute to this phenomenon. The model proposed by von-Crammon Taubadel (1998) does not answer the presence of for instance structural break or policy shift, implying no linear cointegrating vector. Therefore, this study aims to investigate the presence of threshold cointegration due to structural break and regime changes (Liu 2008), and adjustment costs (Mamatzakis and Remoundos 2010).

The method proposed by Hansen and Seo (2002) was applied to ensure the presence of threshold or to reject the use of linear equation when modelling the relation between international and domestic beef price. The fixed regressor bootstrap is calculated with 1,000 simulation replications (Stigler 2010). Following the value of fixed regressor bootstrap under supLM test, the decision follows the t-values larger than that critical values at several level of significance. The results obviously proved that t-value was 20.599 larger than of 19.986 (critical value) for the probability value of 0.036 (Table 4). Hence the null hyphotheses of non-linear relation was rejected, leading to accept the presence of threshold value (Fig. 3). There is therefore, a threshold cointegration between domestic and world beef prices. The estimated cointegration vector shows that in the long run, a 1% price increase in the international prices leads to 1.06% increase in domestic prices, revealing an almost one-to-one price transmission (Table 5). The relationship between international beef prices and domestic beef prices is supported by the study of Zainuddin et. al. (2015), although a relatively higher value of cointegration vector (3.55) was determined. The relationships between domestic and international beef prices could be explained by the fact that Indonesia is a small country in the world beef market and Indonesia is as a net importing country for beef commodity. Therefore, beef prices in the domestic market are most likely to be influenced by world beef prices.

Table 4. SupLM test for analysis of the presence of threshold between international and domestic beef price

Fixed Regressors Bootstrap			
Test statistic	20.599		
Critical values	0.90%	18.341	0.036
	0.95%	19.986	
	0.99%	24.334	

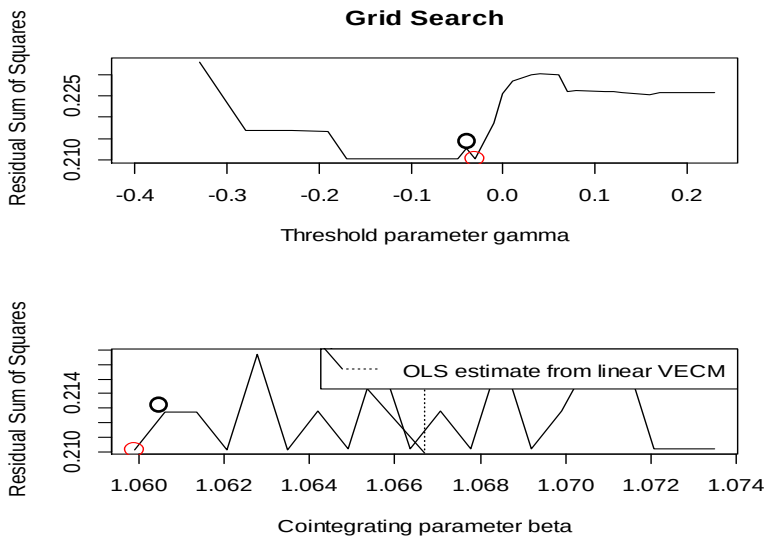

Fig. 3. Two-dimensional grid search for a TVECM

Table 5 presents the estimated valued of the Threshold Vector Error Correction Model (TVECM) following Hansen and Seo (2002). The threshold parameter could be seen from the gamma value of -0.03. Since it has only a single threshold, two regimes could be identified. Regime one occurs when (t-1) (β) ≤ 0.03 or when the price of beef is lower than the threshold. According to Table 5, regime one consists of 15.1 percent observation which means that regime one occurs for 1.8 months, while regime two occurs when (t-1) (β)> 0.03 or when the price of beef is higher than the threshold. Regime two consists of 84.9 percent observations which means regime two occurs for 10.2 months. The TVECM results in Table 5 show both domestic and world prices adjust insignificantly toward the long-run equilibrium in the first regime and significantly in the second regime. This means when the prices below the threshold and fall to the first regime, there is no adjustment take in place either for domestic or world prices toward the long-term equilibrium. On the contrary, when larger shocks (shocks above some threshold) occur and the prices in regime two, both the domestic and world prices give a response toward the long-term equilibrium.

The value of ECT in Table 5 shows a higher ECT value of world beef prices than domestic prices. The world beef prices move to the long-run equilibrium at a much faster speed (coefficient of adjustment speed 0.138) compared to the domestic beef prices (coefficient of adjustment speed -0.029). Different adjustment processes occured toward the long-run equilibrium indicate the effect of threshold (Chen and Saghaian, 2016). Threshold effects occur when larger shocks give a different response than do the smaller shocks (shocks below the threshold) (Goodwin and Holt 1999). Goodwin and Holt (1999) also mention about other dynamic response that could occur and non-linear in nature as a result of other various combinations of adjustments from alternative regimes defined by the thresholds. These different response of adjustments, as mentioned earlier, could happen as a result of adjustment cost or government policies and others.

These results are similar to Rezitis and Rezitis (2011) where cointegrating relationship only occurs when the equilibrium price at the consumer level declined more than 24.12% or the marketing margins increased to more than 62.74%. Consumer prices have to increase faster than producer prices to restore the long-run equilibrium between consumer-producer milk prices. Increasing the consumer prices denotes the retail price responds faster than producer prices. The phenomenon is comprehensible due to the supply response lags and its characteristics of inelastic short run supply.

Table 5. The estimated parameter of Threshold Vector Error Correction Model (TVECM)

Regressors	**Threshold VECM**			
Percentage of Observations	**Regime One 15.1%**		**Regime Two 84.9%**	
	$\Delta lnPD_t$	**$\Delta lnPI_t$**	**$\Delta lnPD_t$**	**$\Delta lnPI_t$**
$\omega_{t-1}(\beta)$	0.060 (0.180)	0.146 (0.304)	-0.029 (0.096)*	0.138 (0.012)**
$\Delta lnPD_{t-1}$	-0.136 (0.708)	2.214 (0.056)*	0.110 (0.292)	0.042 (0.898)
$\Delta lnPI_{t-1}$	-0.027 (0.635)	0.633 (0.007)***	0.003 (0.922)	0.211 (0.043)**
Intercept	0.018 0.087)***	0.002 (0.948)	0.008 (0.001)***	-0.010 (0.206)
Cointegration	(1, - 1.060)			
Threshold Estimate (γ)	-0.03			
SupLM	Test statistic value: 20.599 Fixed Regressor p-value: 0.036**			

Notes: Robust standard error in paranthesis for estimated coefficients. Single, double and triple asterisks (*, **, ***) indicate statistical significant at the 10%, 5%, and 1%. The number of bootstrap replications for SupLM test is 1.000, and the critical values for 1% and 5% significance levels are 21.642 and 18.470, respectively

Our results on the price adjustment of the beef prices are similar to those reported by von Cramon-Taubadel (1998) and Abdulai (2002) in the regime of the stretched margin case, although our estimate for adjustment speed is much smaller. Moreover, our findings also differ with those of Goodwin and Holt (1999) and Goodwin and Harper (2000) where three regime models were applied. Their parameter estimates are closer to the results of von-Cramon Taubadel (1998) and Abdulai (2002) than to our results. Different responses of world beef prices and domestic beef prices toward the long-term equilibrium are an indication of asymmetric price transmission between the world and domestic beef prices. The prices at the world market move faster at the second regime because the world beef market is a competitive market. Since beef producent countries have to maintain their competition in the world market, they will adjust faster when their prices higher than the equilibrium. Theoretically, if the domestic market is a competitive market, when the world market adjust faster to the equilibrium, the domestic market will substantially adjust their prices to equilibrium in the same speed. However, the results of the study show a different response for domestic beef market.

Indonesia is a net importing beef. This means the availability of beef mostly supplied by international market. Therefore, it could be assumed that the domestic beef market could be seen as a retail market, while the world market is the producer markets. The retail market will adjust faster to the increasing prices in the producer market, but it will respond slightly longer for decreasing prices in the producer market. The consumer prices usually increase faster than producer prices since they have to restore the long-run equilibrium between consumer-producer prices (Rezitis and Rezitis 2011). In the short-run, the asymmetric adjustment happens as a result of adjustment cost or additional cost acquired because of taxes, cost for handling import registration, changes in the catalogue cost, and others (Yustiningsih 2012). When price transmission is caused by adjustment cost, even without the existence of market power, prices will adjust to its long-term equilibrium eventually (Ruslan 2016).

In the long term, there are at least two possible reasons for asymmetric price transmission. First, the asymmetric price transmission happens because of market abuse by some middlemen (Goodwin and Holt 1999) as well as the existence of asymmetric information (Meyer and von Cramon-Taubadel 2004). The Indonesian beef market is characterized by many traders either importer

companies or local traders and it is supposed to be a competitive market. However, in reality, there are some importing companies that have more market shares for imported beef that leads to the beef market becoming less competitive (Komalawati 2018). On the other hand, the government uses survey data of cattle in calculating demand of beef, while cattle farmers in Indonesia still use cattle as their savings. Thus, data on beef cattle could be inaccurate to predict demand on beef. Inaccurate data on beef demand causes the availability of beef in the market to be always inconsistent with the real needs of beef. This is also supported by the government's attitude that is not transparent in providing information on the mechanism for determining importers and sharing import quotas (Izzaty 2013). The distribution of import quotas is not implemented through an open auction mechanism. Thus, the government seems to provide an opportunity for certain importers to have market power in the domestic markets.

In a market with less competitive behavior, the ability of middlemen or market players to access the price information is a major factor to increase their market power, take more profits or be "rent seekers" and have a greater impact on the market (Stiglitz 2017). In the case of beef market in Indonesia, influential beef importers are estimated to have greater access to price information in the world market compared to those in domestic markets, and thus have more market power. These companies with its market power are suspected to have the ability to influence the roles or policies applied in the market by manipulating demand data and prices, and violating the rules (Jiuhardi 2016). By allowing middlemen to make use of the market power, it is reasonable if the domestic prices will not respond immediately to any decreases or fluctuations of beef prices in the world market. The domestic sellers will maintain prices above the competivite level as long as their sales remain above a threshold level.

CONCLUSION

This study examined the non-linear adjustment in the asymmetric price transmission of beef in Indonesia by utilizing TVECM. The results indicate a non-linear adjustment and an asymmetric price transmission between domestic and world beef market. Beef prices in the domestic market do no respond faster to any changes in the world market. When the beef prices above the threshold, the world beef prices will adjust faster compared to domestic beef prices. The asymmetry price transmission in Indonesian beef market occurs because of asymmetric information and the ability of some importing companies to influence the roles and policies related to beef. Therefore, it is recommended for the government to have a strong commitment in creating a regulation that supports a transparent information on beef in domestic markets. By having a transparent information, every stakeholder in the beef market will have an equal opportunity to take advantage from the information, and thus, the beef market will be more competitive.

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