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PRICE ASYMMETRY IN INTERNATIONAL- INDONESIAN MARKETS OF SKIMMED MILK POWDER

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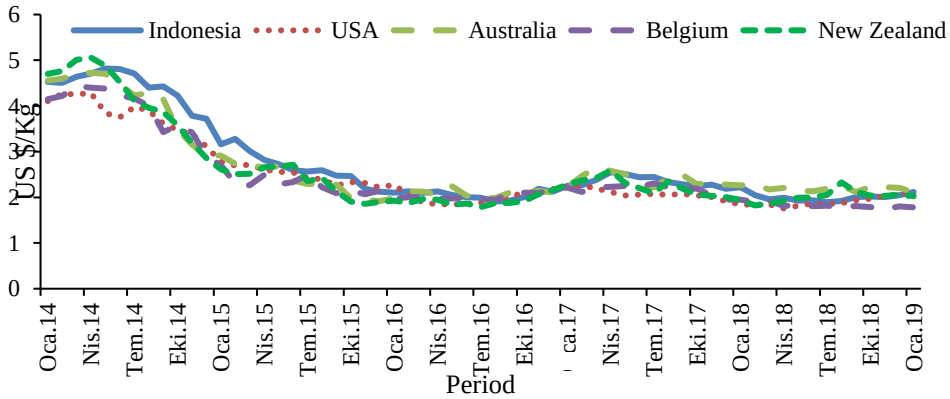
Abstract:

This study examines the price transmission of skimmed milk powder (SMP) from exporting countries (United States, Australia, Belgium, and New Zealand) to the Indonesian market by using the Error Correction Model (ECM) method. Monthly SMP prices in the exporting countries and Indonesia from 2010 to 2019 were utilized in the analysis. The results showed that transmission between exporting countries and Indonesia's SMP prices were asymmetric in the short run in which domestic market price responds faster when exporter market prices increase than when the latter fall. This implies inefficiencies in the import process due to the presence of transaction costs. Meanwhile, there was no asymmetric price transmission identified in the long run.
Keywords: *Asymmetrical prices, ECM, skimmed milk powder prices.*
JEL Codes: *Q11 ; Q17 ; B23*;

1. Introduction

After dramatic price changes in the period 2007-2008 for agricultural products, due to the food crisis, the analysis of horizontal price asymmetry in the agricultural market has attracted new interest from researchers (Listorti & Esposti, 2012). The food crisis was caused by the increase in oil prices, and some trade barriers, which then have caused high volatility in food prices in the world market (European Commission, 2011). This situation also affects dairy prices which after 2007 experienced a high level of volatility (Bonnet et al., 2015). Domestic

food prices have increased substantially in most countries during the world food crisis; exceptions are for some large countries that can protect themselves from world markets. The high volatility of global food prices certainly affected domestic food prices, especially if the country is the main importer of food products. This situation is related to a price transmission issue showing the different responses of domestic prices to the changes in international prices (Meyer & v.Cramon-Taubadel, 2004).



Source: International Trade Centre (2019)

Figure 1. The Development of Skimmed Milk Powder Prices in Indonesia and International Market January 2014- January 2019

Indonesia has been importing milk in large quantities due to increasing demand and insufficient domestic production. The demand was driven by an increase in Indonesian public awareness to consume milk as milk and its derivative products are rich in nutrients and the best source of calcium (Institute of Medicine, 2018). In addition, rising income per capita has also significantly boosted the demand for milk. However, the domestic milk consumption (about 3,764 thousand tons/year) could not be fulfilled by domestic production. For example, domestic production in 2017 that reached 876 thousand tons was only able to fulfill 22.3% of domestic demand, while the remaining (77.7%) has relied on the imports from the milk's top exporters i.e., the United States, Australia, New Zealand, and several Western European countries in form of *skimmed milk powder, anhydrous milk fat* dan *buttermilk powder* (Ministry of Agriculture, 2018).

The high reliance on imported milk implied that the Indonesian milk prices were influenced by the changes in the milk prices from the main exporting countries. Based on Figure 1, there was a price disparity between the price of imported milk in Indonesia and the price of exported milk in the exporting countries. On average, the price in the exporter's market were decreasing around 89% - 115% (from January 2014 to January 2019, while the import prices decreased by 122%. Meanwhile, the lagging adjustment of prices was also identified in the period of observations. From February 2014 to August 2014 there was an increase in SMP prices in the exporting countries, while the prices in Indonesia began to increase from March 2014 to July 2014.

Table 1 shows the coefficient of variation (CV) of SMP in each main exporter and Indonesia. The higher the CV, the greater the level of SMP prices dispersion around the mean. The SMP from New Zealand had the highest variations (30.61%) in terms of price, followed by Indonesia (27.69%), Belgium (27.49 %), Australia (26.57%), and finally the United States

(5.94%). A low CV value indicated that the price of SMP in the United States was the most stable in comparison to other countries.

Table 1. SMP price's coefficient of variation (CV) in Indonesian and International Markets January 2010- January 2019

Countries	Obs	Price		
		Average	Std Dev	CV
Indonesia	109	3.005	0.832	27.69
United States (USA)	109	2.778	0.721	25.94
Australia	109	2.985	0.793	26.57
Belgium	109	2.813	0.773	27.49
New Zealand	109	2.946	0.902	30.61

Source: Authors' calculation.

The data indicated that there was a problem in the transmission of SMP prices from the exporting countries to the Indonesian market. The price transmission analysis, then, turn out to be important because the asymmetric price transmission had a significant possibility to make the trade barriers in the countries biased (Nurunisa et al., 2014). In addition to that, a price asymmetric analysis can also provide information related to marketing chain efficiency and welfare obtained by exporters and importers (Hahn, 1990; Peltzman, 2000; Meyer & Von-Cramon Taubadel, 2004; Bacombe et al., 2007). A slow response to price changes between exporting and importing countries shows the inefficiency and inequality of price transmission in the marketing channels that occur in the SMP trade in the Indonesian and international markets (Miller & Hayenga, 2001). The existence of asymmetric prices shows that countries interconnected in the trade will not benefit from the decline (importer) or increase (exporter) prices that will occur in symmetrical conditions (Meyer and v. Cramon Taubadel, 2004).

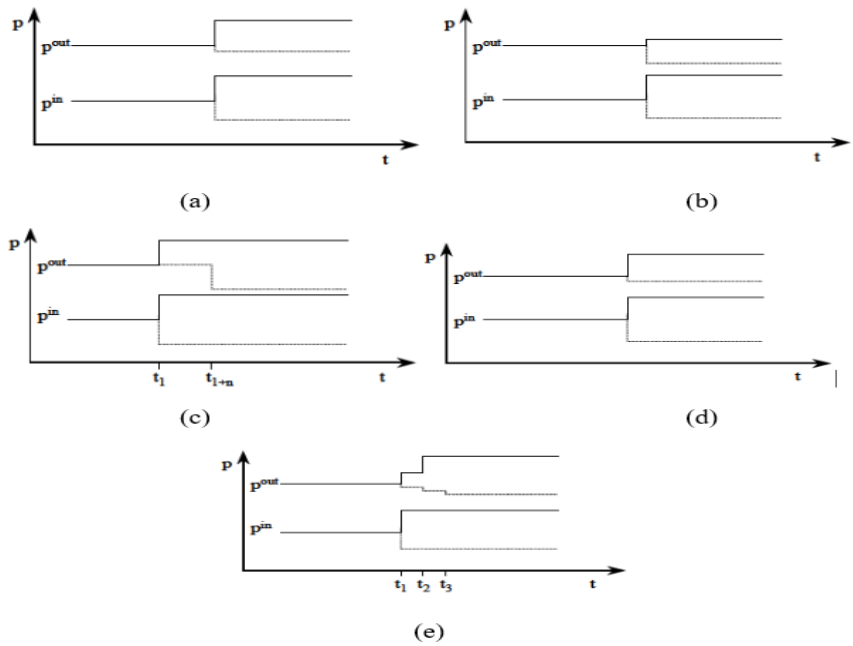
Based on the discussion, this study aims to analyze the existence of short-run and long-run asymmetrical prices of dairy products between Indonesia (importing country) and its main trading partners (exporting countries). The dairy product that is focused on in this study is Skim Milk Products (SMP) due to two reasons. First, the SMP is the largest imported dairy product compared to other dairy derivated products (Leong, 2014; AgriHQ Academy 2014). According to International Trade Center (2019), from the period 2010 to 2018 the average import of SMP in Indonesia was about 12,122 tons/kg. Secondly, the SMP is a commodity that shows strong growth in recent years and is expected to continue to grow in the future along with increasing in consumers' income in many countries (Fousekis et al., 2016). This is showed the SMP trading in the international market which has doubled from 2002-2003 (less than 1 million) to 2011-2013 (about 1.8 million).

2. Literature Review

According to Conforti (2004), price transmission is an analysis of how prices affect each actor in the market, both vertically (seen from the marketing chain) and spatially (seen from geographical differences). A price transmission from a geographically separated market, for the same commodity, can be analyzed by the concept of spatial market integration (Tomek and Robinson, 1990). In markets that interact spatially, the interaction of prices goes according to the law of one price, i.e., the price of a commodity set between two markets in different locations is the same, the difference is due to the transfer cost between both markets (Rapsomanikis et al., 2003). In this type of market, price changes in one market will affect prices in other markets (Asmarantaka, 2009). If there is trade between two regions, then the

price of a commodity in importing countries is equal to the price in exporting countries plus transportation costs (Ravalion 1986; Fousekis & Trachnas, 2016).

The price transmission can be divided into vertical and horizontal price transmission. Vertical price transmission means that the changing price from one level in the marketing chain is transmitted perfectly to the other levels along the chain (Goodwin, 2006). Horizontal price transmission refers to the linkage of prices in various markets. This can involve price transmission in various agricultural commodities (transmission of cross-commodity prices) (Esposti & Listorti, 2011), from non-agricultural to agricultural commodities, such as from oil or energy prices to agricultural commodities prices (Sierrta et al., 2008; Hassouneh et al., 2011), from international to the domestic market (Meyer & von Cramon-Taubadel, 2004) and on different purchasing contracts on the same commodity (Baldi et al., 2011). The concept of market integration refers to the selling power of products between markets that are spatially different, regardless of the presence or absence of equilibrium and spatial market efficiency (Barrett & Li, 2002; Thompson et al., 2002). However, if the idea of spatial, or horizontal, price transmission is limited to the price movements of certain products in different locations, the condition of spatial arbitration is the most important theoretical concept. The consequence of spatial arbitration is the Law of One Price (LOP), as has been derived by Marshall (1890; see also Fackler &Goodwin, 2001). It states that in markets associated with trade and arbitration, homogeneous goods will have a unique price, when stated in the same currency, after deducting the transaction costs. These theoretical concepts complement the concepts of spatial arbitration and LOP. In this context, market efficiency shows the market capacity to minimize costs when there is market equilibrium. In a competitive market with perfect information, arbitrage will ensure that the price difference will reflect only marketing costs.



Source: Meyer & von Cramon-Taubadel, 2004)

Figure 2. The types of Asymmetric Price Transmission

In microeconomic theory, any external shocks to the demand and supply side (including the variation of input price) between the producer and consumer in a market will result in the

same speed (and magnitude) of adjustments to the long-run equilibrium. However, if there is a significant difference in the response speed and magnitude of output price due to changes in input price, it indicates a market failure (Simioni et al., 2013). This reflects the asymmetry price transmission (APT).

There are five types of asymmetric price transmission (Meyer & von Cramon-Taubadel, 2004) shown in Figure 2, i.e., asymmetric price transmission positive, negative, based-on speed, based-on magnitude, and combination between speed and magnitude. To explain the differences among those types, it is assumed that a price (p^{out}) depends on another price (p^{in}). When p^{out} rapidly responds (with the same magnitude) to an increase in p^{in} than to its decrease, it refers to positive ATP (panel a in Figure 2). Conversely, the ATP negative refers to the more rapid response of p^{out} to a decrease in p^{in} (panel b in Figure 2). The based-on speed ATP explains the asymmetrical transmission in terms of speed adjustment. Increasing in the p^{in} at time t_1, will be responded immediately by p^{out} at the same time. When a p^{in} falls, p^{out} does not immediately respond but there is a lag for *n* and will be responded by p^{out} at time of t_{1+n} (panel c in Figure 2). The based-on magnitude ATP is then, when a p^{in} falls, p^{out} immediately respond but there is a different magnitude (panel d in Figure 2). The last one, combination of speed and magnitude, shows a different responses time and magnitude when there is a fall in p^{in} (panel e in Figure 2).

Meyer & von Cramon-Taubadel (2004) reported there are several main causes of price asymmetry, including (1) the existence of market power; (2) adjustment costs; (3) other causes, such as government intervention. Price transmission can take place in the short and long term. The fundamental difference between price transmission caused by market power and adjustment cost is time. A large adjustment cost will only occur in the short term, so it only delays the transmission process. In the long run, the price returns to symmetry (McCorriston 2000; Karantininis, Katrakilidis, & Persson 2011). The asymmetry caused by the market power will last longer because it not only affects the time of adjustment but also affects the magnitude of adjustment (Meyer & von Cramon-Taubadel, 2004).

Adjustment costs are costs incurred by the market actors to adjust the price (could be in the form of transportation costs, advertising costs, or fees in approving the contract price). In terms of government intervention, Indonesia has regulated the Supply and Distribution of Milk in the Regulation of the Minister of Agriculture (*Permentan*) Number 33 of 2018. Concerning imported milk, the government applies a 5% tariff for "raw materials" including SMP, and a 30% tariff for "end products" such as butter and cheese (Boediyono, 2008).

Several studies related to horizontal price transmission have also been studied (Kirnovos, 2004; Gil & Sanjuan, 2011; Rosa et al., 2014; Fousekis & Tachanas, 2016), but only a few studies have focused on case studies in Indonesia in terms of dairy products. One study that discusses the transmission of milk prices in Indonesia has been carried out by Nurunisa et al., (2014) who found that the markets of Indonesia and New Zealand are co-integrated, and New Zealand's position is very strong in the Indonesian market because of its status as the largest milk producer in the world. Fousekis & Trachanas (2016) investigated the strengths and patterns of spatial price linkages in the skim milk powder (SMP) market in the US, EU, and Oceania using the NARDL model and found a long-term relationship between prices. Another study by Rosa et al., (2014) used the vector error correction model (VECM) and found an association and dependence on the Italian market for oil prices and three agricultural commodities (wheat, corn, and soybeans) in the US market in the long run. Hamulczuk (2015), by using the error correction model (ECM), successfully confirmed the long-term dependence and the existence of asymmetrical prices of wheat products in Germany and Poland. Bakucs and Fertő (2008) studied the price transmission in the Hungarian milk market and found price asymmetry in both the short and long term. Jensen & Møller (2007), who examined the milk supply chain in Denmark, concluded that asymmetry only takes place in the short term, while in the long run, the price transmission takes place symmetrically.

3. Method

This study is carried out by implementing qualitative and quantitative methods. Qualitative analysis is performed to analyse the movement of milk prices in the Indonesian and international markets. While the quantitative method is used to analyze whether there have been asymmetrical SMP prices between Indonesia and its exporting countries. The data used in this study are secondary in the form of monthly time series price data (HS 040210) on the Indonesian market and international markets from 2010 to 2019.

The four exporting countries selected in this study are TheUnited States, Australia, Belgium, and New Zealand. This is because the four countries are the main milk exporters countries for Indonesia. Milk price data in the Indonesian market and international markets are obtained from the International Trade Center (ITC) and Trading Economics.

In estimating the price asymmetry, the Autoregressive Distributed Lag (ARDL) model and Error Correction Model (ECM) are the most popular methods. However, using ARDL as the method could lead to spurious in cointegration estimation, meanwhile, the ECM could estimate the cointegration better (Von Cramon-Taubadel, 1998; Frey & Manera, 2005). This study then used the ECM method developed by Von Cramon-Taubadel & Loy (1996), where asymmetric price transmission is separated between short-term and long-term.

The first step in constructing ECM in analysis is the stationarity test using Augmented Dick-Fuller (ADF) model as follows:

$$\Delta\chi_t = \alpha_0 + \gamma\chi_{t-1} + \sum_{i=1}^{p} \alpha_1 \Delta\chi_{(t-1)+1} + \varepsilon_t \quad (1)$$

The next step is to perform the cointegration test. This study uses the Johanssen Cointegration Test to find out the cointegration between the variables written in the following equation:

$$\lambda_{trace} = -T \sum_{i=k+1}^{n} (1+ \lambda i) \quad (2)$$

$$\lambda_{max}(r, r+1) = -T \ln(1 - \lambda r_{+1}) \quad (3)$$

Where λi is the estimation of I-value of the eigenvalue order in matrix II and r is the number of vectors in the cointegration vector on the null hypothesis.

After that, a causality test is carried out using Granger Causality aiming to ascertain the causal relationship between the variables tested. The Granger model is as follows:

$$\Delta PE_t = \alpha_o + \sum_{i=1}^{n} \beta_{PE} \Delta PE_{t-1} + \sum_{i=1}^{n} \beta_{PI} \Delta PI_{t-1} + ECT_{t-1} + e_t \quad (4)$$

$$\Delta PI_t = \alpha_o + \sum_{i=1}^{n} \beta_{PI} \Delta PI_{t-1} + \sum_{i=1}^{n} \beta_{PE} \Delta PE_{t-1} + ECT_{t-1} + e_t \quad (5)$$

where,

PE_t = SMP prices in exporting country (Rp/kg)
PI_t = SMP prices in importing market (Rp/kg)
PE_{t-1} = Lag of SMP prices in exporting country (Rp/kg)
PI_{t-1} = Lag of SMP prices in importing country (Rp/kg)
α_0 = Constant
β = Lag
ECT_{t-1} = *Error Correction Term*
e_t = *Error Term*
t = period of time (month) starting from 1, 2, 3, …, t

After all the tests have been carried out and the test results have fulfilled all assumptions, then the research can be continued using the Error Correction Model (ECM) developed by von Cramon-Taubadel &Loy (1998) in Weldesenbet (2013) to see the price transmission between Indonesia and exporting countries. We perform the models as follows:

a. At a time when the price of milk in the exporting countries affects the price of milk in the Indonesian market

$$\Delta PI_t = \alpha_0 + \sum_{i=1}^{n} \beta^{+} \Delta PI_{t-1}^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PI_{t-1}^{-} + \sum_{i=1}^{n} \beta^{+} \Delta PE^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PE^{-} + \sum_{i=1}^{n} \beta^{+} \Delta PE_{t-1}^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PE_{t-1}^{-} + ECT_{t-1}^{+} + ECT_{t-1}^{-} \quad (6)$$

b. At a time when the price of milk in the Indonesian market affects the price of milk on the exported country

$$\Delta PE_t = \alpha_0 + \sum_{i=1}^{n} \beta^{+} \Delta PE_{t-1}^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PE_{t-1}^{-} + \sum_{i=1}^{n} \beta^{+} \Delta PI^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PI^{-} + \sum_{i=1}^{n} \beta^{+} \Delta PI_{t-1}^{+} + \sum_{i=1}^{n} \beta^{-} \Delta PI_{t-1}^{-} + ECT_{t-1}^{+} + ECT_{t-1}^{-} \quad (7)$$

Each exporting country (United States, Australia, Belgium, and New Zealand) is treated separately. The short- and long-term asymmetrical price tests are executed by using the Wald test to ensure the existence of the asymmetric. The hypothesis is carried out using the F-test, as follows:

H_o: $\sum_{i=0}^{k1} \beta_{1i}^{+} = \sum_{i=0}^{k2} \beta_{1i}^{-}$ (short term)
H_o: $\beta_4^{+} = \beta_4^{-}$ (long term)

If in the short term the Wald test results show significant results, the asymmetrical prices that occurred are influenced by adjustment costs. Whereas, if the Wald test is significant in the long run, the asymmetrical prices are influenced by the presence of market power.

4. Results and Discussions

The pre-estimation stage of identification of the Augmented Dickey-Fuller (ADF) test is shown in Table 2. This procedure was implemented in Indonesia, the United States, Australia, Belgium, and New Zealand at stationary and first difference. It is very important to ensure the stationarity as the modeling of the nonstationary variable may cause spurious regression problems (Mesike, Okoh & Inoni, 2010). The stationary test was conducted to identify the consistency of the movement of time-series data to prevent spurious regression, where regression of one variable to another variable produces high R^2 but there is no meaningful economic relationship. This often happens when the time series data shows the characteristics of a strong trend over a period, In addition, the absence of the stationarity will cause the results will invalid for long-run predictions as well as be used to obtain policy recommendations (Yusuf & Falusi, 1999). The stationarity test results in Table 2 show that the SMP prices, in all studied countries, are stationary in the first difference condition or integrated in the same order. The existence of variables that are not stationary at the level indicates the existence of a long-run relationship or integration between each variable.

Table 1. Results of Stationarity Test

Country's Price	Level		First Difference	
	ADF Test	Prob.	ADF Test	Prob.
Indonesia	-1.283	0.635	-5.173**	0.000**
United States	-1.114	0.708	-6.732**	0.000**
Australia	-1.038	0.737	-7.309**	0.000**
Belgium	-0.865	0.796	-10.665**	0.000**
New Zealand	-1.234	0.657	-7.145**	0.000**

Note: * Stationary at level of 1%. ** Stationary at level of 5%. *** Stationary at level of 10%.

Engle and Granger's estimation method (Engle & Granger, 1987) provide a framework for examining cointegration which is used to identify long-run equilibrium relationship (Engle & Granger, 1987). Table 3 presents the results of the Johansen cointegration test. Based on the procedure, if the trace statistic value is greater than 5% (as a critical value). The test of this equation is based on SC criteria, with an assumption of no trend intercept and lag 2 as the optimum lag. Table 3 shows that the variables used in this study have cointegration. In other words, SMP domestic prices have a cointegrating relationship with USA, Australia, Belgium, and New Zealand prices at a 5% level of significance, respectively.

Table 3. Results of Cointegration Test

Price	Null Hypothesis	Trace Statistik	Critical Value (5%)	Max-Eigen Value	Critical Value (5%)
Indonesia → USA	None*	21.813	15.495	19.831	14.264
	At most 1	1.981	3.841	1.981	3.841
Indonesia→ Australia	None*	28.143	15.495	25.247	14.264
	At most 1	2.895	3.841	2.895	3.841
Indonesia→ Belgium	None*	33.891	15.495	31.065	14.264
	At most 1	2.825	3.841	2.825	3.841
Indonesia→ New Zealand	None*	29.072	15.495	26.877	14.264
	At most 1	2.195	3.841	2.195	3.841

Note: *Significant (Reject Ho)

Next, the testing of causality in this study uses the Granger causality test method. The null hypothesis in this study is that there was no influence from market prices in the exporter country and vice versa, whereas the alternative hypothesis shows there is influence from the exporters' market prices and vice versa. The causality test aims to ensure the direction of price transmission. Table 4 shows that there is a direct relationship between the price of SMP in the exporting countries (United States, Australia, Belgium, and New Zealand) and imported SMP prices in Indonesia. The SMP prices in exporting countries might influence the price formation of imported SMP in Indonesia.

Table 4. Results of Causality Test

Price Relationships (P)	Lag Number	F-stat
$P_{USA} \rightarrow P_{Indonesia}$	2	26.152*
$P_{Australia} \rightarrow P_{Indonesia}$	2	30.778*
$P_{Belgium} \rightarrow P_{Indonesia}$	2	52.621*
$P_{New\ Zealand} \rightarrow P_{Indonesia}$	2	41.991*

Note: *Significant (Reject Ho)

Analysis of price transmission was conducted to examine whether the price transmission between Indonesia and several SMP exporting countries occurred efficiently. If the transmission price took place symmetrically, the shock (increase/decrease) of reference prices was responded equivalently by the importers' market, both in terms of speed and magnitude.

This study uses the Error Correction Model (ECM) method developed by Von Cramon-Taubadel & Loy (1996), where asymmetric price transmission is separated between short-run

and long-run transmission. The difference between those two terms is based on the coefficient value of the independent variable and of the Error Correction Term (ECT). If both are identical, it can be concluded that there has been an asymmetrical transmission of SMP prices.

ECT in this model is divided into ECT $^{+}$ and ECT $^{-}$ (Meyer & von Cramon-Taubadel, 2004). ECT $^{+}$ describes the condition of price deviations when they are above the long-run equilibrium, which is when the decline in SMP prices in the United States, Australia, and New Zealand is not followed by a decline in SMP prices in Indonesia, and vice versa. On the other hand, ECT $^{-}$ describes the price deviation condition when it is below the equilibrium line, which is when the increase in SMP prices in the United States, Australia, and New Zealand is not followed by an increase in SMP prices in Indonesia, vice versa. Price movements can be stated to be on a balanced line if the increase or decrease in prices that occur at one level will be followed perfectly, both the magnitude and length of time adjustments by the market at the other level.

Based on Table 5, the estimation results of SMP asymmetrical prices between Indonesian and exporter markets. In the short run the formation of Indonesian SMP import prices was influenced by the increase in SMP import prices in Indonesia, the price of SMP exports in the United States in the period t-1, and the changes (increase and decrease) in SMP export prices in the United States in the period t.

Table 5. Results of SMP Asymmetrical Price between Indonesian and Exporting Countries

Variable	**USA→ Indonesia**	**Australia→ Indonesia**	**Belgium→ Indonesia**	**New Zealand→ Indonesia**
Constant	2.401[a]	2.658[a]	2.456[a]	2.469[a]
	(0.000)*[b]	(0.000)*[b]	(0.000)*[b]	(0.000)*[b]
ΔPI^{+}_{t-1}	2.084	2.146	2.121	2.103
	(0.015)**	(0.047)**	(0.010)**	(0.019)**
ΔPI^{-}_{t-1}	-0.286	-0.378	0.869	0.037
	(0.734)	(0.689)	(0.317)	(0.967)
ΔPE^{+}	3.203	1.863	1.868	1.376
	(0.018)**	(0.108)	(0.016)**	(0.078)***
ΔPE^{-}	-3.443	-1.857	-2.153	-1.836
	(0.001)*	(0.045)**	(0.002)*	(0.038)**
ΔPE^{+}_{t-1}	4.137	0.908	2.777	1.574
	(0.005)*	(0.523)	(0.001)*	(0.098)***
ΔPE^{-}_{t-1}	-0.779	-0.194	-0.662	-1.230
	(0.524)	(0.869)	(0.329)	(0.229)
ECT^{+}_{t-1}	-0.986	-0.206	1.319	0.744
	(0.089)**	(0.789)	(0.016)**	(0.219)
ECT^{-}_{t-1}	-0.972	-0.694	0.978	0.184
	(0.099)	(0.507)	(0.064)***	(0.808)
R^2	0.284	0.141	0.340	0.233
R^2-adj	0.226	0.072	0.286	0.171
F-Stat	4.899	2.038	6.381	3.756
	(0.000)	(0.049)	(0.000)	(0.000)
DW-stat	0.388	0.202	0.546	0.336

Note: a = coefficient, b = probability. *Significant at level of 1%. ** Significant at level of 5%. *** Significant at level of 10%.

From Table 5, it can be seen that ECT^+ is negative with a value of 0.986, and ECT^- was also negative with a value of 0.972. This ECT^+ coefficient shows that when the deviation was above the equilibrium, the deviation will not return to its equilibrium line (the import price of Indonesian milk will not adjust down instantly). The length of adjustment to obtain equilibrium refers to the coefficient value, which is approximately 10 months. Meanwhile, the ECT^- coefficient shows that when the deviation is below the equilibrium line, the deviation will not return to its equilibrium line (the import price of Indonesian milk was not adjusted instantly). The length of adjustment was also approximately 10 months.

In the case of Indonesia and Australia, the formation of SMP import prices in Indonesia was determined by the decrease in the price of SMP exports in Australia in period t and the increase in SMP import prices in Indonesia in the period t-1. In the long run, the price transmission relationship between Indonesia and Australia can be seen from ECT^+ and ECT^- coefficient. The variables did not affect the formation of SMP import prices in Indonesia. In the case of Indonesia and Belgium. In the short run, the SMP import prices in Indonesia were affected by the increase in the import prices of SMP in the Indonesian market, the export prices of SMP from the Belgian market period t-1, the changes in SMP export prices in period t-1, and the increase in the price of imported SMP in Indonesia in period t-1. In the long run, the deviations variables (ECT^+ and ECT^-) were significant, so the price of SMP exports in Belgium will affect the formation of SMP import prices in Indonesia. Lastly, the relationship of price transmission between Indonesia and New Zealand shows that in the short run, the SMP import prices in Indonesia were affected by the increase in SMP import prices in Indonesia, the price of SMP exports in period t-1, as well as the changes in SMP export prices in New Zealand in period t. In the long run, the deviation variables were identified to be insignificant.

The Wald test was carried out to ensure that there was an indication of the existence of asymmetry in the price transmission between related countries. Wald tests were performed on each variable, both in the case of positive and negative shocks in the short or long run. If in a transmission process between two countries, there is a variable that gives a different response to the positive and negative shocks (rejection of the null hypothesis), it can be said that asymmetric price has occurred in the market. Conversely, if there are no variables that give different responses to shocks (null hypothesis is not rejected or there is no significant variable), it can be said that the transmission of prices in both markets runs symmetrically. The Wald test results can be seen in Table 6.

Table 6. Results of Wald Test

Price Relationship	**Null Hypothesis**	**F-stat**	**Prob.**
USA → Indonesia	$\Delta PEAS^+ = \Delta PEAS^-$	11.528**	0.033**
	$\Delta PEAS^+_{t-1} = \Delta PEAS^-_{t-1}$	5.928**	0.016**
	$ECT^+ = ECT^-$	0.001	0.987
Australia → Indonesia	$\Delta PEAUS^+ = \Delta PEAUS^-$	4.923**	0.028**
	$\Delta PEAUS^+_{t-1} = \Delta PEAUS^-_{t-1}$	0.425	0.515
	$ECT^+ = ECT^-$	0.108	0.742
Belgium → Indonesia	$\Delta PEPRA^+ = \Delta PEPRA^-$	11.166*	0.000*
	$\Delta PECH^+_{t-1} = \Delta PECH^-_{t-1}$	7.739*	0.006*
	$ECT^+ = ECT^-$	0.156	0.692
New Zealand → Indonesia	$\Delta PESB^+ = \Delta PESB^-$	5.621**	0.019**
	$\Delta PESB^+_{t-1} = \Delta PESB^-_{t-1}$	3.419***	0.067***
	$ECT^+ = ECT^-$	0.275	0.601

Note: * Significant at the level of 1%. ** Significant at the level of 5%. *** Significant at the level of 10%

Table 7. Summary of Price Asymmetric Analysis between Indonesian and Exporting Countries

Relationship	Asymmetric	
	Short-run	Long-run
USA → Indonesia	√	X
Australia → Indonesia	√	X
Belgium → Indonesia	√	X
New Zealand → Indonesia	√	X

The implementation of the Wald test between the prices of US SMP exports on SMP import prices in Indonesia shows a different relationship between short-run and long-run price transmission. In the short run, it can be seen in period t and period t-1 that in that period there was price asymmetry in both countries. In addition, long-run price transmission relationships can be seen from the ECT value. The ECT value between the two countries had no significant effect. This leads to the conclusion that in the long run, there was an asymmetrical relationship between the price of those two markets. A similar result occurred in price relations between Indonesia and Belgium, also Indonesia and New Zealand. Between Indonesia and Australia, in the short run, the probability value has a significant effect on period t, which means that in that period there was an asymmetry between the two countries. However, in the long run, the ECT values had no significant effect indicating symmetrical price relations between Indonesia and Australia.

Based on Table 7, price transmission only occurs asymmetrically in the short run between the Indonesian market and international markets (United States, Australia, Belgium, and New Zealand). Price asymmetry can occur due to adjustment costs or menu costs especially if there is inflation in the market (Ball & Mankiw, 1994). Changes in prices from suppliers will create additional costs to inform price changes in the market (Meyer & v. Cramon-Taubadel, 2004; Ankamah-Yeboah, 2012). Although Peltzman (2000) found no correlation between menu costs and asymmetrical prices, Meyer & v.Cramon-Taubadel (2002 and 2004) reported that menu costs can be a cause of price asymmetry. Adjustment and menu costs will not cause price shocks and long-run price asymmetry.

The typical short-run asymmetric price transmission may have drawbacks as it shows market integration problems. It can be said that Indonesian consumers will not benefit from price reductions and the farm gate prices will not incentivize domestic producers as well. The asymmetry in the price transmission is commonly explained by the market concentration in the SMP value chains. In addition, the dairy sector policy, including SMP is heavily regulated in Indonesia. Based on the Minister of Finance Regulation (Permenkeu) Number 6/2017 in the Stipulation of the Goods Classification System and the Imposition of Import Duty Tariff on Imported Goods, Indonesia imposed an import tariff for SMP is 5 % and 10 % Value Added Tax. Moreover, Indonesia also implemented the Indonesian Dairy Blueprint 2013 – 2025 targeting higher domestic fresh milk absorption and the Minister of Agriculture issued Regulation No. 33 of 2018 to empower the small-scale milk producers. On the demand side, further intervention is carried out via the school milk program (Saptati & Priyono, 2021)

In addition, aside from regulating policies and market structure, the Indonesian importers usually have a price agreement with the supplier (exporter) before they start the transaction. After the two sides get the price agreement, then, a letter of credit (L/C) and the shipping can be executed. After the payment process has been started, the goods will be sent to Indonesia's port. However, until the imported goods arrived in Indonesia and can be out from Indonesia's port to be traded domestically, importers should follow some procedures and fulfill some requirements (see Ministry of Trade, Republic of Indonesia[i] and Minister of Finance Decree

Number 11/PMK.04/2019[2]). The contract price will be the reference price during the process of shipping goods and until the goods leave Indonesia's port. Those processes in sending goods from exporter countries to Indonesia's port also need quite a lot of time which leads to difficulties to adjust the price instantly if a sudden price change occurred. Most probably, the price adjustments will take place in the next period of the transaction. The long-run price transmission between Indonesia and the four exporting countries shows insignificant results.

5. Conclusions and Recommendations

The results of this study indicate that there is a short-run asymmetry between Indonesia (as importing country) and its main trading partners (exporting countries, i.e., The United States, Australia, Belgium, and New Zealand). This asymmetrical price transmission in the short run can be caused by adjusting costs. In the long run, the price transmission between Indonesia and the exporting countries occurs symmetrically.

In the case of short-run asymmetric prices, government intervention is needed to control SMP prices in the Indonesian market. One of the interventions is to perform trade facilitation to ease importing process by the Directorate General of Customs and Excise, Ministry of Finance, Republic of Indonesia. As discussed, after importers provided payment to the suppliers according to the price agreement, there are still several steps to fulfill by the importers until the SMP arrived. This process is expected to result in a longer delay in the price adjustments in the Indonesian market when sudden price changes occurred in the exporters' markets.

In addition, the Government of Indonesia should pay more attention to accelerate efforts in increasing domestic milk production to minimize the asymmetry of prices. The production of domestic milk is currently regulated by the Ministry of Agriculture. As such, the institutions need to implement more effective and efficient policies to increase domestic milk production as well as reduce the dependence on SMP imports by consistently implementing the Indonesian Dairy Blueprint 2013 – 2025 and the Regulation No. 33 of 2018 issued by the Minister of Agriculture to empower the small scale milk producers. Increasing domestic milk production is important since high dependency on SMP imports has placed Indonesia as a price taker in the SMP trade leading to vulnerability to price changes in the international market.

References

Alwis A, Edirisinghe J, & Athauda A. (2009). Analysis of factors affecting fresh milk consumption among the mid-country consumers. *Tropical Agricultural Research and Extension*. 12,: 103-109.

Amikuzuno J, Ogundari K. (2012): The contribution of agricultural economics to price transmission analysis and market policy in Sub Sahara Africa: What does the literature say? *In: 86th Annual Conference of the Agricultural Economics Society, University of Warwick.*

Bacukz LZ, & Fertõ, I. (2005). Marketing margins and price transmission in Hungarian pork meat market. *Agribusiness Journal*, 21, 273:286.

[BPS] Badan Pusat Statistik. (2018). Produksi dan Konsumsi Susu di Indonesia. Jakarta (ID): Kementerian Pertanian.

Barret CB,& Li JR. 2002. Distinguishing between equilibrium and integration in spatial price analysis. *American Journal of Agricultural Economics*, 84, 292:307.

Conforti P. (2004). Price transmission in selected agricultural markets. *Working Paper FAO Commodity and Trade Policy Research, No 7, March 2004.* http://www.fao.org/es/ESC/

[Dirjen PKH] Direktorat Jenderal Peternakan dan Kesehatan Hewan. 2019. Sistem Informasi Pelayanan Informasi Pasar. Jakarta (ID): Kementrian Pertanian.

Farid M, & Sukesi H. (2011). Pengembangan Susu Segar Dalam Negeri untuk Pemenuhan Kebutuhan Susu Nasional. *Buletin Ilmiah Litbang Perdagangan*. 5, 196-221.

Firdaus M. (2011). *Aplikasi Ekonometrika Data Panel dan Time Series*. Bogor (ID): IPB Press.

Fousekis P, & Trachanas E. 2016. Price transmission in the international skim milk powder markets. *Journal Applied Economics Volume 48, 2016.*

Engle R. F., and Granger C.W.J. (1987). Co-integration and error correction: representation, estimation and testing. *Econometrica*, 55, 251–276.Frey G, Manera M. 2005. Econometric models of asymmetric price transmission. Nota di Lavoro No. 100.2005. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-6419.2007.00507.

Goodwin BK. (2006). Spatial and vertical price transmission in meat markets. *Paper Presented at Workshop of Market Integration and Vertical and Spatial Price Transmission in Agricultural Markets*.

Gujarati D. (2004). *Basic Econometrics*. New York (US): The McGraw-Hill Companies.

Karantininis K, & Persson. (2001). Price Transmission in the Swedish Pork Chain: Asymmetric nonlinear ARDL. *Paper prepared for presentation at the EAAE 2011. Congress Change and Uncertainty Challenges for Agriculture, Food and Natural Resources.*

[Kementan] Kementrian Pertanian. (2017). Outlook Komoditas Pertanian Subsektpor Peternakan: Susu. Pusat Data dan Sistem Informasi Pertanian Sekretariat Jenderal - Kementrian Pertanian 2017. Jakarta (ID): Kementrian Pertanian.

[ITC] International Trade Center. (2019). Market info tools: trade statistics [Internet]. [diunduh pada 2019 Juni 10] tersedia pada http://www.intracen.org/itc/market-info-tools/trade-statistics/

Listorti G, & Esporti R. (2012). Horizontal price transmission in agricultural markets: fundamental concepts and open empirical issues. *Bio-based and applied economics*, 1,81-108.

McCorriston S, Morgan, Rayner. (2000). Price transmission: the interaction between firm behaviour and return of scale. Discussion paper. Univeristy of Nottingham. ISSN 1360-2438

Meyer J, von Cramon-Taubadel S. (2004). Asymmetric Price Transmission: A Survey. *Journalof Agricultural Economics*, 55, 581-611.

Mesike, C.S., Okoh, R.N. & Inoni, O.E. (2010). Supply Response of Rubber Farmers in Nigeria: An Application of Vector Error Correction Model. *Agricultural Journal*, 5(3), 146-150.Miller DJ, & Hayenga ML. 2001. Price cycles and asymmetric price transmission in the US Pork Market. *American Journal of Agricultural Economics*, 83, 552-562.

Nugroho A. (2010). Pasar Susu Dunia dan Posisi Indonesia. Jurnal Peternakan, Fakultas Peternakan, Universitas Brawijaya Malang.

Nurunisa V, Sinaga B, Winandi R, & Brümmer B. (2014). Price transmission of skim milk powder in indonessia: do skim milk powder import prices follow the prices in New Zealand? *Jurnal Agribisnis*, Fakultas Ekonomi dan Manajemen, Institut Pertanian Bogor.

Peltzman S. 2000. Prices Rice Faster than They Fall. *The Journal of Political Economy*, 108(3): 466-*502*.

Ravallion M (1986). Testing Market Integration. *American Journal of Agricultural Economics*, 68, 102-109.

Rosa F, Vasciaveo M, & Weaver RD. (2014). Agricultural and oil commodities: price transmission and market integration between US and Italy. *Bio-based and Applied Economics*, 3, 93-117;

Ruslan J, Firdaus M, & Suharno. (2016). Transmisi harga asimetri dalam rantai pasok bawang merah dan hubungannya dengan impor di Indonesia: studi kasus di Brebes dan Jakarta. *Buletin Ilmiah Litbang Perdagangan*. 101,03-128.

Sahara, & Wicaksena B. (2013). Asymetry in farm-retail price transmission: the case of chili industry in Indonesia. *Jurnal Ekonomi dan Kebijakan Pembangunan*, 2, 1-13.

Sanjuan, G.. (2001). Price Transmission Analysis: A Flexible Methodologial Approach Applied to European Pork and Lamb Markets. *Applied Economics*, 33, 123-131.

Saptati R.A, & Priyono (2021) Impact of integration of import tariff policy and strategic programs to increase milk production on the availability of fresh milk in IndonesiaE3S Web of Conferences 316, 01005. https://doi.org/10.1051/e3sconf/202131601005

Serra. T, & Goodwin. 2002. Price Transmission and Asymmetric Adjustment in the Spanish Diary Sectory. *Agriculturan and Applied Economics*, 35), 1-25.

Serra,T, &Gil JM. (2012). Price volatility in food markets: can stock building mitigate the price fluctuation? *Paper presentd to the International Association of Agricultural Economists, Foz do Iguaçu, Brazil, August 18-24.*

Simioni M, Gonzales F, Guillotreau P, & Le Grel L. (2013). Detecting asymmetric price transmission with consistent thresholds along the fish supply chain. *Canadian Journal of Agricultural Economics*, 61, 37-60.

Tomek W.G., & Robinson K.L. (1990). Agricultural Product *Prices. Agricultural Economics*, 9(,107-109.

[USDA] United States Department of Agriculture. (2015). Global Agricultural Information Network: Indonesia 2018 Dairy and Products Annual Report [Internet]. [diunduh pada 2019 Januari 16]. Tersedia pada https://www.fas.usda.gov/data/indonesia-dairy-and-products-annual-5.

Vavra P,& Goodwin BK. 2005. Analysis of price transmission along food chain. *Working papers OECD Food Agriculture and Fisheries*, 5: 1-28.

von Cramon-Taubadel S. (1998). Estimating asymmetric price transmission with the error correction representation: An application to the German pork market. *European Review of Agricultural Economics*, 25, 1–18.

von Cramon-Taubadel &S, Loy JP. 1996. Price asymmetry om the international wheat market: Comment. *Canadian Journal of Agricultural Economics*, 44, 311-317.

Weldensebet T. (2013). Asymmetric price transmission in the Slovak liquid milk market. *AGRICECON -CZECH*, 59,512-524.

Wilson P.(2011). Determinant of the farm gate price of milk: quantifying the impact of milk contract and selling arrangements. *Journal of Farm Management*, 14, 211-230.

Yusuf, S.A., & Falusi, A.O. (1999). Incidence analysis of the effects of liberalized trade and exchange rate policies on cocoa in Nigeria: An ECM approach. *Rural Economic Development*, 13, 3-14

[1]See website: http://djpen.kemendag.go.id/app_frontend/accepted_rsses/view/50f4f70d-633c-4b88-a2e2-01510a1e1e48

[2]See website: https://jdih.kemenkeu.go.id/fullText/2019/11~PMK.04~2019Per.pdf