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PRICE DYNAMICS AND RED CHILI PRICE LINKAGES BETWEEN MARKETS IN SURPLUS AND DEFICIT AREAS

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ABSTRACT
The price of red chilies in surplus and deficit areas in Indonesia is interrelated because an excess supply of red chilies in surplus areas can affect prices in deficit areas and vice versa. The study wants to provide information on the shape of price dynamics and price relationships between surplus and deficit markets. Using red chili price data for the weekly period from January 2019 to December 2021. The price of red chilies in the East Lombok market, West Nusa Tenggara Province (WNT) is a surplus area, and Kupang City, East Nusa Tenggara Province (ENT) is a deficit area. Data source from the National Strategic Food Price Information Center released by Bank Indonesia. Data were analyzed using the coefficient of variation (CV) and the Vector Error Correction Model (VECM) method. The study found that there are significant differences in price dynamics and there are price linkages in both the short and long term between markets in surplus and deficit areas. The differences in geography, distance, marketing infrastructure, and market information systems also contribute to price linkages between markets in surplus and deficit areas. Collaboration between market players, the government, and accurate and easily accessible market information is required to create effective price linkages throughout Indonesia.

KEY WORDS
Red chili, price dynamics, price linkage, VECM.

Red chilies are one of the vegetable commodities that have high economic value, because of their large role in meeting domestic needs as an export commodity and food industry. Indonesia is the fourth largest chili-producing country in the world after China, Mexico, and Turkey, (FAOSTAT, 2022). Red chili is one of Indonesia's strategic food commodities which are widely consumed in particular. National consumption needs for red chili are 254,670 tons per month, while total production reaches 281,712 tons, with a surplus of 27,042 tons.

Red chili production centers in Indonesia are still concentrated in several provinces in Indonesia. Indonesia has 34 provinces with more than 17 thousand islands, so it is known as an archipelagic country. Of the total annual chili production, it exceeds national needs, but there are disparities in availability between regions due to distribution and transportation constraints. Distribution and transportation are often hampered because of the vast territory of Indonesia. There are two provinces out of 34 provinces in Indonesia that can be categorized as red chili production surplus areas, namely West Nusa Tenggara (WNT), especially East Lombok district, and East Nusa Tenggara province (ENT), especially Kupang

City as deficit areas. The contribution of the WNT province to meeting the needs of Red Chili in the ENT province reached 88.89% in 2019, (BPS Indonesia, 2020).

The market in the surplus area in East Lombok and the market in Kupang City which experienced a deficit are related because both are located in the Eastern Indonesia region, but there are differences in the market conditions. East Lombok is known as an area rich in agricultural and fishery products, while Kupang City relies more on trade and service sectors. Price linkages between markets in these two regions can be studied from the point of view of two things, namely supply, and demand. In the context of the supply, surplus areas such as East Lombok will have more abundant supply compared to their local demand. So that there is a disparity in commodity prices between surplus and deficit regions. Usually, price surplus areas tend to be cheaper than deficit areas, such as Kupang City. The demand for red chili which is greater than the local supply in Kupang City will cause the price of goods in the market to become more expensive.

Does the price of red chili in the East Lombok market (surplus) and the market in Kupang City (deficit) form a pattern of price dynamics as shown by price fluctuations between regions? Price fluctuations provide an indication of whether or not there is a relationship between red chili prices between markets in surplus and deficit areas. The price of goods in an area is determined by many factors, such as accessibility, inter-regional transportation, infrastructure, season, amount of stock of goods available, and demand.

The results of studies on price relationships between markets were carried out in several countries, such as Ullah, H., & Malik, W. (2018); Mohamad, S., Kusairi, S., & Muhamad, R. (2019; Hao, Y., Zhen, X., & Wang, Y. (2020). Eshetu, B., & Hundie, T. (2020) These studies conclude that price linkages between markets can affect different sectors of the economy, and are influenced by factors such as demand, supply, geographical distance, and international trade flows. These results can provide a broader picture regarding the inter-market price linkages that occur in Indonesia, especially East Lombok and Kupang City.

The results of studies on price relationships between markets were carried out in several countries, such as Brenton, P., et al (2014); Dube, A. K., et al (2018); Nauly, D., et al (2021); Chitete, M., et al (2021); Nasir, M. A., Mulyo, J. H., & Dumasari, D. (2021). Rayhan, S. J., Islam, M. J., Kazal, M. M. H., & Kamruzzaman, M. (2019. These studies conclude that price interrelationships between markets can affect different economic sectors, and are influenced by factors such as demand, supply, geographical distance, and international trade flows. The results of this study can provide a broader picture of the inter-market price relationships that occur in Indonesia, especially East Lombok and Kupang City.

Recent studies on price interrelationships between markets by Zungo, M., & Kilima, F (2019); Kabiri, R., et al (2016); Akhter, S. (2017); Mukhlis, M., et al (2020); Nauly, D., et al (2021); Hendro, N., et al (2022); Singh, N.D., et al. (2022) who used the co-integration model and the autoregression vector model, concluded that there is a significant relationship between prices between markets and the influence of variables such as production, consumption, and imports on these prices.

The above studies conclude that the analysis of inter-market price linkages in surplus and deficit areas continues to be an important and relevant research topic at the international as well as domestic and local levels. Analytical methods such as cointegration analysis and autoregression vector models continue to be used to determine more specific relationships between prices and the factors that influence prices in the market.

Another study on the relationship between prices between surplus and deficit markets uses co-integration models and autoregression vectors by Mussema, R. (2006); Kustiari, R., et al. (2017); Akhter, S. (2017); Rayhan, S. J., et al (2019); Dube, A. K., et al (2018), provided the same conclusion as previous researchers, there is a significant relationship between prices between markets, as well as the influence of variables such as production, consumption, and imports.

Although much research has been carried out on inter-market price linkages, the price linkages between surplus and deficit markets are very spatial because of their very situational nature and the availability of information, infrastructure, geographical conditions of the region, government policies, technology, and others. This study wants to know the magnitude and pattern of red chili price dynamics and whether there is a price link between a surplus and a deficit market. This important study for the government and business people in the two regions to work together in developing the marketing of their commodities to be more efficient and to optimize the economic potential of the two regions.

METHODS OF RESEARCH

The object of research is Kupang City, East Nusa Tenggara Province (ENT) as a deficit area, and Lombok, West Nusa Tenggara Province (WNT) as a surplus area for red chilies. Figure 2 Using red chili price time series data for the weekly price period from January 2019 to December 2021. Data source from the Indonesian National Strategic Food Price Information Center, available online on the Bank Indonesia website.

Figure 1. Map of the Islands in Indonesia (34 including Provinces).
• WNT = West Nusa Tenggara. • ENT = East Nusa Tenggara

Price dynamics are measured by calculating the coefficient of variation (CV) of prices between surplus and deficit areas. Pappas and Hirschey (1995), mention, CV is a measure of risk associated with the expected value, where this value is obtained by dividing the standard deviation by that value. Price dynamics are observed in addition to using CVs as well as through graphical visualization methods.

The analysis of price linkages between markets in surplus and deficit areas uses the Vector Error Correction Model (VECM) approach, through the following stages:

Root test allow obtaining stationary data because generally, time series data are often not stationary. Stational data is needed to avoid spurious regression. In this test, if the data series of a variable is not stationary, it is carried out at the first difference level. If at this level it is not stationary then proceed to the second difference. The equation for this test is h:

$$\Delta P_t = \alpha_0 + \gamma P_{t-1} + \beta_i \sum_{j=1}^{m} \Delta Pt - 1 + \varepsilon_t$$

The optimal lag length is needed to observe the effect of each variable on the AIC variable in the VAR model. Determination of optimal lag length using Akaike Information Criterion (AIC) and Schwarz Criteria with the following formula:

$$\ln(aic) = \frac{\sum a_i^2}{n} + \frac{2k}{n}$$
$$\ln SIC = \ln\left(\frac{\sum a_i^2}{n}\right) + \frac{k}{n}\ln(n)$$

Cointegration Test is to determine whether there is a long-term relationship between red chili markets in surplus and deficit areas. Testing the hypothesis used statistical test trace test maximum eigenvalue test. The trace test and maximum Eigenvalue test values are greater than the t-statistic value, so the provisional assumption is rejected. Equation trace test and maximum eigenvalue:

$$\lambda_{trace} = -T \sum 1n\,(1- \hat{\gamma}_i)$$
$$\lambda_{max}\,(r, r+1) = -\,T \sum 1n\,(1- \hat{\gamma}_{i+1})$$

The VECM model is used to overcome the non-stationary data, where this model will gradually correct the imbalance, and deviation through short-term partial adjustments (Enders, 1995 and Gujarati, 2004). To find out the model specifications with ECM using a valid model, it can be seen in the test results statistics on the R2 coefficient or residual from the first regression, hereinafter referred to as the Error Correction Term. If the test results are significant, then the observed model specification is valid. If the relationship of the variables is cointegrated, this means that in the long run an equilibrium condition will be reached.

The VECM model used in this study is as follows:

$$\Delta \mathrm{PK}a_t = \alpha_0 + \sum_{I=1}^{P} \alpha_i\, \Delta \mathrm{PK}a_{t-1} + \sum_{I=1}^{P} \beta_i\, \Delta \mathrm{PK}0_{t-1} + \varepsilon_{it}$$

Granger Causality Test is done to find out whether there is a reciprocal relationship between variables, because each variable in the model has the opportunity to become an endogenous variable as well as an exogenous variable.

Response Impulse Function is done in order to find out the response of the variables observed from a shock in the variable itself and the endogenous variables in the system (Widarjono, 2018). The effect of a variable on a variable causing shock is shown by the standard deviation value which is visualized in the graph.

RESULTS AND DISCUSSION

Based on the CV value, it was found that the price of red chilies in the surplus areas of East Lombok, WNT Province, was more dynamic and risky than the deficit areas in Kupang City, ENT Province. This is shown by the CV value of a surplus area of 45.57% and a deficit area of 35.34%. However, when compared with the α value of 5%, the CV value in both regions is relatively large. Figure 2 provides an indication that there are similarities in the dynamics of red chili prices in surplus (East Lombok) and deficit (Kupang City) areas and shows the same trend in each time period from January.

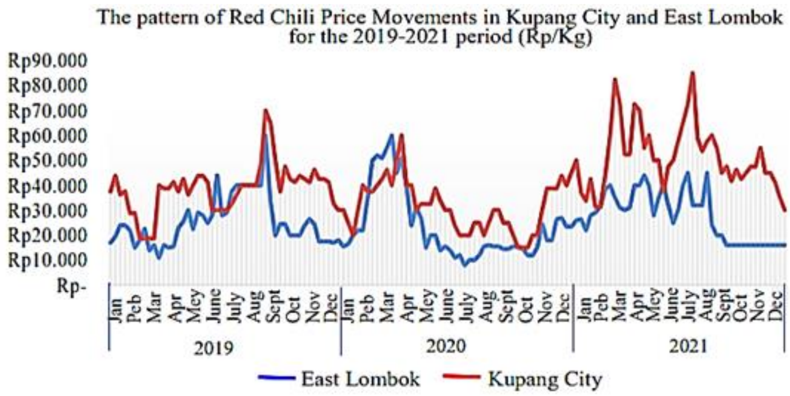

Figure 2 – Trend of Red Chili Price Movement in Kupang City and East Lombok for the January 2019 -December 2021 period

In these two regions, prices increased in the third and fourth quarters, although there will be a decline between these mid-terms. However, this does not apply in 2020 where there has been a significant change in trend, namely price increases that have occurred at the beginning of 2020 and changes that continue to occur whose trend is very different from the year before or after. This was caused by the economic shock that occurred in 2020 when the Covid 19 pandemic began to enter and spread in Indonesia. This almost similar trend occurs every June every year, which is marked by price changes in each city that intersect. This tangent graph shows the low price in Kupang City touching the highest price in East Lombok at the same time. In 2020 East Lombok reached the lowest price of IDR 8,000 ($0.52 US) and a high of IDR 52,000 ($.3.40 USD) which was the last highest price ever in East Lombok in that time period.

Based on these two calculations, it can be concluded that the surplus and deficit areas have almost the same red chili price trend. However, the price dynamics that occur in surplus areas are higher than those in deficit areas. This can be seen in the CV value in surplus areas (45% CV) >> of prices in deficit areas (CV 39%).

The stationary test of the times series data uses the augmented dickey-fuller (ADF) method, the results are shown in Table 1.

Table 1 – Time Series Data stationery Test Results for Red Chili Prices in Kupang City, 2019-2021

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.21734	0.0208
Test critical values:	1% level	-3.47253	
	5% level	-2.87997	
	10% level	-2.57667	

**Mackinnon (1996) one-side p-values.*

Table 1 provides information that the red chili price data in the deficit area (Kupang city) has been stationary at the level with the ADFtest-stat value. 3.21734 (α 5%) and probability 0.0208 (<α 5%). thus accepting H1.

The results of the stationary test for red chili price data in the Surplus area (East Lombok) were stationary at the level (table 2). Shown by the probability value of 0.0078 (α 5%) and the ADFtest-statistic value. (3.55337). Thus the hypothesis is accepted H1.

Table 2 – Time Series Data stationery Test Results for Red Chili Prices in East Lombok City, 2019-2021

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.55337	0.0078
Test critical values:	1% level	-3.47310	
	5% level	-2.88021	
	10% level	-2.57681	

**Mackinnon (1996) one-side p-values.*

Table 3 – Optimum Lag Test Results time series data for red chili prices in the cities of Kupang and East Lombok

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3023.821	NA	2.03e+16	43.22602	43.26804	43.24310
1	-2854.375	331.6299	1.91e+15*	40.86251*	40.98858*	40.91374*
2	-2851.849	4.873142	1.95e+15	40.88355	41.09367	40.96894
3	-2846.685	9.809943	1.92e+15	40.86694	41.16110	40.98648
4	-2843.676	5.631456	1.95e+15	40.88109	41.25930	41.03478
5	-2841.996	3.096680	2.01e+15	40.91423	41.37649	41.10208
6	-2837.476	8.201243	2.00e+15	40.90679	41.45310	41.12880
7	-2831.156	11.28454*	1.94e+15	40.87366	41.50401	41.12982
8	-2830.217	1.650743	2.02e+15	40.91738	41.63178	41.20769

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Secondary data processed, 2022.

Determining the length of the lag is important because later the optimal lag that is entered is too short, so it is feared that it will not be able to fully explain the sensitivity of the model. However, a lag that is too long will also result in an inefficient estimate due to reduced degrees of freedom (especially for models with small samples), therefore it is necessary to know the optimal lag before estimating VAR.

Table 3 provides an indication that the first lag is the optimum lag length in the VECM test. Then proceed with the cointegration test.

Johansen Cointegration Test Used to determine the long-term balance relationship of the two red chili price variables in surplus and deficit areas. Using trace statistics and maximum eigenvalue with a critical value of 0.05 to prove whether there is cointegration. Cointegration test results are shown in the table 4.

Table 4 – Cointegration Test Results for the City of Kupang and the City of East Lombok

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.075845	12.63912	12.32090	0.0442
At most 1	0.005370	0.807724	4.129906	0.4250

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.075845	11.83139	11.22480	0.0391
At most 1	0.005370	0.807724	4.129906	0.4250

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 4 trace statistic value (12.63912) > critical value (12.32090) at none*, equal to maximum eigenvalue (11.83139) > critical value (11.22480) with α 5%. This proves that the price of red chili in a deficit area (Kupang City) and a surplus area (East Lombok) has a long-run equilibrium relationship.

The next stage in this study is the VECM (vector error correction model) which is a method used to measure the effect of long-term and short-term relationships that occur when 2 variables have been cointegrated. The results of the VECM stage testing can be seen in the table below:

Table 5 – VECM test results, red chili price data for Kupang City and Lombok City

Cointegrating Eq1:	CointEq1
Kupang City	1.000000
East Lombok	-1.261774
	(0.25439)
	[-4.96000

Error Correction:	D(Kupang_City)	D(East_Lombok)
CointEq1	-0.186520	0.048170
	(0.04607)	(0.04103)
	[-4.04854]	[1.17395]
D(Kupang_City(-1))	0.057462	0.033136
	(0.07736)	0.06890
	[0.74277]	-2.208370
D(East_Lombok(-1))	0.159797	-0.073224
	(0.10018)	0.08923
	[1.59507]	-0.0820671

R-squared	0.163993	0.023705
Adj. R-squared	0.147047	0.003915
Sum sq. resids	7.07E+09	5.61E+09
S.E. equation	6909.764	6154.076
F-statistic	9.677353	1.197839
Log likelihood	-1557.437	-1539.832
Akaike AIC	20.54522	20.31358
Schwarz SC	20.62480	20.39316
Mean dependent	8.223684	3.289474
S.D. dependent	7481.707	6166.159

Determinant resid covariance (dof adj.)	1.74E+15
Determinant resid covariance	1.65E+15
Log likelihood	-3094.329
Akaike information criterion	40.84644
Schwarz criterion	41.04538
Number of coefficients	10

Source: Secondary data processed, 2022.

Table 5 provides that information:

1. In the short term, price changes in East Lombok during the past 1 lag have a significant negative effect on the city of Kupang at this time with a Tstatistic value |-2.208370| > critical value | 1.975189|. If the price increase in the previous 1 lag increased by 1 rupiah, it caused the price change in Kupang City to increase by 0.057462 rupiahs;
2. In the long run, price changes in East Lombok have a negative and significant effect on price changes in Kupang City with a statistical value | -4.96000| > Critical value | 1,925189|.

The results of the estimation of the price variable in surplus and deficit areas concluded that East Lombok as a surplus area has a relationship and influences price changes in Kupang City while it is a deficit area, the results of the VECM modeling test are in line with research conducted by Phillips et al., (2007); Vasilenko et al., (2012); Van Wingen et al., (2014); Brenton, P., et al (2014). Müller et al., (2016); Meyers & van Woerkom, (2017); Akhter, S. (2017). Elalaoui, O., et al (2018). Rayhan, S. J., et al (2019); Gitau, R., & Meyer, F. (2019) and Mukhlis, M., et al (2020); Surroca et al., (2020); Wati Sukma (2021) states that there is a short-term relationship between the two areas that are connected and have a positive influence. However, there are indications that prices in deficit areas adjust their prices more quickly when there is an increase compared to a decrease in prices in surplus areas, due to market power in intermediary traders.

Analysis of the causal relationship of each variable can be seen from the Granger causality test. In this study, the causality test was carried out using the Granger Causality Test.

Table 6 – Granger Causality Test

Null Hypothesis	Obs	F-Statistic	Prob.
Kupang_City does not Granger Caus e East_Lombok	152	0.01236	0.9877
East_Lombok City does not Granger Caus e Kupang City		8.90656	0.0002

Table 6 provides information that there is a one-way relationship between surplus and deficit areas, as evidenced by the probability values. Price linkages between markets often do not occur causality. This is corroborated by several previous findings by Gitau, R., & Meyer, F. (2019); Kustiari, R., et al (2017); Elalaoui, O., et al (2018); Hendro, N., et al (2022).

This study implies that agricultural commodity markets in Indonesia are generally partially linked, even though there are price differences between markets in surplus and deficit areas. The price difference between surplus and deficit areas due to limited means of transportation causes distribution channels to be hampered, especially when the weather is unfavorable. The flow of price information can also be a factor that influences the existence of price differences. If there is a price increase in a surplus area, it is likely that it will be transmitted to a deficit area. Gitau, R., & Meyer, F. (2019) proves the market case in Kenya. If there is a 1% price increase in the surplus market, then 0.72% of that price will be passed on to the deficit market and there will be no reverse relationship. This indicates that there is potential to increase the efficiency of agricultural commodity markets in Indonesia through increasing linkages between markets and improving infrastructure and supporting government policies, improving symmetrical market information.

CONCLUSION

The price of red chili in surplus areas (East Lombok) is more volatile than in deficit areas (Kupang City) with price dynamics moving in the same direction in both markets following price movements in surplus areas.

This study found that there is a close relationship between the price of red chili in markets in surplus and deficit areas. This relationship is related both in the long term and in the short term, where there is a one-way relationship. Price changes that occur in surplus areas will affect prices in deficit areas; however, the reverse does not occur.

The finding of inter-market red chili price linkages in surplus and deficit areas in Indonesia is important to maintain in order to maintain red chili price stability and create effective market integration. Therefore, cooperation between market players, government support, and accurate and easily accessible market information is needed to create effective price linkages throughout Indonesia.

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