The effect of food commodity price fluctuations on inflation in Pematang Siantar City

E F Fadhilah, Rahmanta* and S F Ayu

Magister of Agribusiness, Faculty of Agriculture, Universitas Sumatera Utara, Medan, Sumatera Utara, Indonesia.

E-mail: *rahmanta1213@gmail.com

Abstract. The large contribution of inflation in the food group influences the dynamics of economic growth in Indonesia, especially in Pematang Siantar City. The increase in commodity prices causes a decline in the value of the currency so that the purchasing power of society is low. This is because in real terms the level of community income decreases. Thus, the researcher wants to examine the effect of fluctuations in monthly food commodity prices in Pematang Siantar City from January 2013 to December 2017. The analytical tool used is the VAR analysis. The results, it can be concluded that in the short term two variables affect inflation i.e. inflation and rice. Whereas in the long-term, five variables influence inflation, namely rice, chicken, red chili, cooking oil, eggs, and corn. In the short, medium and long term, a large response to inflation is the red chili difference. Every time a standard deviation occurs, the shock of red chili will be responded to by inflation until it rises 0.164180 (short-term), 0.139068 (medium-term) and 0.139071 (long-term). Then the most dominant in explaining the diversity of inflation is red chili and purebred eggs.

1. Background

The issue of price stability has always been a concern of the government. So far, the implementation of food price policies has only been seen in the short term, but in the long-term the price of commodities in the country continues to rise. Rising prices of food commodities can continuously trigger inflation [1].

The large contribution of inflation in the food group (food commodities) influences the dynamics of economic growth in Indonesia, especially in the City of Pematang Siantar. As the second-largest city in North Sumatra Province, Pematang Siantar City is one of the cities that is affected by inflation. Besides, this city is one of the bases for the calculation of Inflation in North Sumatra Province [1].

The increase in commodity prices causes a decline in the value of the currency so that the purchasing power of society is low. This is because in real terms the level of community income decreases. Unstable inflation will cause uncertainty for economic actors in decision making [2]. Thus, the researcher wants to examine the effect of fluctuations in food commodity prices (rice, red chili, cooking oil, chicken meat, broiler eggs and corn) in Pematang Siantar City from January 2013 to December 2017 data analysis methods.
2. Methods

2.1. Method of collecting data

Data used are data on the development of monthly food commodity prices at the consumer level in Pematang Siantar City for the period of January 2013 to December 2017 and monthly CPI in Pematang Siantar City. The data was obtained from the Central Statistics Agency of North Sumatra Province and the Centre for Information on Food Price Strategies. Besides, various supporting data were obtained from relevant agencies such as the Regional Economic and Financial Study of North Sumatra Province, Bank Indonesia Working Paper, reading books, scientific journals, and articles from the internet that were trusted and under the research topic.

2.2. Data analysis methods

Identifying the effect of fluctuations in food commodity prices (rice, red chili, cooking oil, chicken meat, broiler chicken eggs, and corn) in Pematang Siantar City from January 2013 to December 2017 using analysis Vector Autoregression (VAR). The variables used are the monthly price of food commodities (rice, red chili, cooking oil, chicken meat, eggs and corn) as well as Pematang Siantar City CPI. VAR analysis is performed using EViews 10. Each variable uses a natural logarithm to facilitate calculations. The research model can be written as follows:

\[
\begin{align*}
\ln \text{INF}_t &= A_1 + A_2 \ln \text{INF}_{t-1} + A_3 \ln \text{BRS}_t + A_4 \ln \text{CAM}_t + A_5 \ln \text{MKG}_t + A_6 \ln \text{DGA}_t + A_7 \ln \text{TAR}_t + A_8 \ln \text{JAG}_t + \epsilon_{1t} \\
\ln \text{BRS}_t &= B_1 + B_2 \ln \text{BRS}_{t-1} + B_3 \ln \text{INF}_t + B_4 \ln \text{CAM}_t + B_5 \ln \text{MKG}_t + B_6 \ln \text{DGA}_t + B_7 \ln \text{TAR}_t + B_8 \ln \text{JAG}_t + \epsilon_{2t} \\
\ln \text{CAM}_t &= C_1 + C_2 \ln \text{CAM}_{t-1} + C_3 \ln \text{INF}_t + C_4 \ln \text{BRS}_t + C_5 \ln \text{MKG}_t + C_6 \ln \text{DGA}_t + C_7 \ln \text{TAR}_t + C_8 \ln \text{JAG}_t + \epsilon_{3t} \\
\ln \text{MKG}_t &= D_1 + D_2 \ln \text{MKG}_{t-1} + D_3 \ln \text{INF}_t + D_4 \ln \text{BRS}_t + D_5 \ln \text{CAM}_t + D_6 \ln \text{DGA}_t + D_7 \ln \text{TAR}_t + D_8 \ln \text{JAG}_t + \epsilon_{4t} \\
\ln \text{DGA}_t &= E_1 + E_2 \ln \text{DGA}_{t-1} + E_3 \ln \text{INF}_t + E_4 \ln \text{BRS}_t + E_5 \ln \text{CAM}_t + E_6 \ln \text{MKG}_t + E_7 \ln \text{TAR}_t + E_8 \ln \text{JAG}_t + \epsilon_{5t} \\
\ln \text{TAR}_t &= F_1 + F_2 \ln \text{TAR}_{t-1} + F_3 \ln \text{INF}_t + F_4 \ln \text{BRS}_t + F_5 \ln \text{CAM}_t + F_6 \ln \text{MKG}_t + F_7 \ln \text{DGA}_t + F_8 \ln \text{JAG}_t + \epsilon_{6t} \\
\ln \text{JAG}_t &= G_1 + G_2 \ln \text{JAG}_{t-1} + G_3 \ln \text{INF}_t + G_4 \ln \text{BRS}_t + G_5 \ln \text{CAM}_t + G_6 \ln \text{MKG}_t + G_7 \ln \text{DGA}_t + G_8 \ln \text{TAR}_t + \epsilon_{7t}
\end{align*}
\]

Explanation:
- LnINF<sub>t</sub> = Inflation at time t
- LnBRS<sub>t</sub> = Price of rice at time t
- LCAM<sub>t</sub> = Price of red chili at time t
- LnMKG<sub>t</sub> = Price of cooking oil at time t
- LnDGA<sub>t</sub> = Price of chicken meat at time t
- LnTAR<sub>t</sub> = Price of eggs at the time t
- LnJAG<sub>t</sub> = Corn price at time t
- A<sub>n</sub>, B<sub>n</sub>, ..., G<sub>n</sub> = Estimation parameter
- E<sub>t</sub> = Error term
3. Results and discussion

Analysing the effect of fluctuations in food commodity prices on inflation in Pematang Siantar City using the Vector Autoregression (VAR) and Vector Error Correction Model (VECM) models. Model identification is related to the identification of the equation used. The stages in using VAR analysis, that is (1) Data stationarity test; (2) Determination of optimal lag; (3) Model stability test; and (4) Cointegration Test. Furthermore, using VECM estimation if there is cointegration in the tested model [3].

3.1. Stationarity test

The stationarity test is carried out to ensure that there is no unit root in the research variable. The criteria used is Augmented Dickey-Fuller (ADF), with a confidence interval of 5%. The hypothesis tested is $H_0 = \text{not stationary or there is a root unit}$, while $H_1 = \text{stationary or there is no root unit}$. If the ADF statistical value is smaller than the MacKinnon critical value, then the decision is to reject $H_0$ or the data is declared stationary, otherwise, if the ADF statistical value is greater than the MacKinnon critical value then accept $H_0$, so the data is declared not stationary.

| Variable | ADF Statistic | 1% | 5% | 10% | Explanation |
|----------|---------------|----|----|-----|-------------|
| LnINF    | -6.289021     | -3.546099 | -2.911730 | -2.593551 | Stationer   |
| LnBRS    | -9.802292     | -3.546099 | -2.911730 | -2.593551 | Stationer   |
| LnDAR    | -7.670429     | -3.552666 | -2.914517 | -2.595033 | Stationer   |
| LnCAM    | -6.492948     | -3.546099 | -2.911730 | -2.593551 | Stationer   |
| LnMKG    | -5.635430     | -3.546099 | -2.911730 | -2.593551 | Stationer   |
| LnTAR    | -7.441630     | -3.546099 | -2.911730 | -2.593551 | Stationer   |
| LnJAG    | -12.46120     | -3.546099 | -2.911730 | -2.593551 | Stationer   |

Source: The data is processed with EViews 10

Based on the stationarity test results at the level in Table 1 above shows the results of the statistical ADF values on all variables are smaller than the MacKinnon critical value, then reject $H_0$ which means stationary at the level.

3.2. Optimal lag determination

| Lag  | LogL  | LR    | FPE   | AIC   | SC   | HQ    |
|------|-------|-------|-------|-------|------|-------|
| 0    | -1125.871 | NA    | 1.83e+09 | 41.19532 | 41.45080* | 41.29411 |
| 1    | -1074.212 | 88.29042 | 1.69e+09 | 41.09862 | 43.14245 | 41.88898 |
| 2    | -1033.014 | 59.92451 | 2.44e+09 | 41.38232 | 45.21450 | 42.86426 |
| 3    | -971.2529 | 74.11322 | 1.94e+09 | 40.91829 | 46.53882 | 43.09179 |
| 4    | -886.7835 | 79.86197 | 8.76e+08 | 39.62849 | 47.03737 | 42.49357 |
| 5    | -756.4348 | 90.05907* | 1.20e+08* | 36.67036* | 45.86759 | 40.22700* |

Source: The data is processed with EViews 10

Explanation:
* 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
Determination of the optimal Lag is based on the value of the Likelihood Ratio (LR) of the largest and Final Prediction Error (FPE), Akaike Information Criteria (AIC), Schwarz Information Criteria (SC), and the smallest Hannan-Quinn Information Criteria (HQ). Or in the output EViews 10 select the lag with the most code *. Based on the output in Table 2 it is stated that the optimal lag that will be used is the 5th optimal lag. All variables except SC in the 5th lag affect each other, not only in the current period but are interrelated to the previous four periods.

3.3. VAR model stability test

VAR stability testing is done by testing the roots of polynomial functions or roots of the characteristic polynomial. VAR estimation is stable if all roots have modulus < 1 and are in a unit circle. The stability of the VAR model will result in the estimation of Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD) being considered valid. The output results can be seen in Table 3. In the Table, it is explained that the modulus value < 1, so that the estimated VAR is stable.

| Root                  | Modulus          |
|-----------------------|------------------|
| 0.354052 - 0.600955i  | 0.697495         |
| 0.354052 + 0.600955i  | 0.697495         |
| 0.002206 - 0.577033i  | 0.577037         |
| 0.002206 + 0.577033i  | 0.577037         |
| -0.452789 - 0.346552i | 0.570189         |
| -0.452789 + 0.346552i | 0.570189         |
| 0.254863 - 0.473092i  | 0.537374         |
| 0.254863 + 0.473092i  | 0.537374         |
| -0.187523 - 0.499383i | 0.533431         |
| -0.187523 + 0.499383i | 0.533431         |
| -0.348741 - 0.393217i | 0.525585         |
| -0.348741 + 0.393217i | 0.525585         |
| 0.491831              | 0.491831         |
| 0.096557              | 0.096557         |

Source: The data is processed with EViews 10

3.4. Cointegration test

| Hypothesized No. of CE(s) | Eigenvalue | Trace Statistic | 0.05 Critical Value | Prob.** |
|---------------------------|------------|-----------------|---------------------|--------|
| None *                    | 0.662118   | 218.2674        | 125.6154            | 0.0000 |
| At most 1 *               | 0.595322   | 156.4190        | 95.75366            | 0.0000 |
| At most 2 *               | 0.458882   | 104.8531        | 69.81889            | 0.0000 |
| At most 3 *               | 0.339259   | 69.84845        | 47.85613            | 0.0001 |
| At most 4 *               | 0.274536   | 46.22800        | 29.79707            | 0.0003 |
| At most 5 *               | 0.251666   | 27.93417        | 15.49471            | 0.0004 |
| At most 6 *               | 0.181406   | 11.40950        | 3.841466            | 0.0007 |

Source: The data is processed with EViews 10

Cointegration test results to determine the existence of long-term relationship information between variables. If there is cointegration, then the next analysis uses VECM. However, if there is no cointegration, the analysis is continued using VAR. The criteria used in the cointegration test in this
study is the Johansen Cointegration Test. A model is stated to have cointegration if the trace statistic value is greater than the critical value.

Based on the results of Table 4, it shows that at a 5% confidence interval all equations have a trace statistic value greater than the critical value. Thus, there are seven cointegration equations so that there is a long-term relationship between variables.

3.5. Estimation of vector error correction model (VECM)

| Variable  | Coefficient | T-Statistic | T-Table (5%) | Interpretation |
|-----------|-------------|-------------|--------------|----------------|
| Short-Term|             |             |              |                |
| CointEq1  | -0.163117   | [-1.59808]  | 1.67065      | Not Significant|
| D(INF(-1))| -0.349052   | [-1.85891]*| 1.67065      | Significant    |
| D(INF(-2))| -0.145887   | [-0.73901]  | 1.67065      | Not Significant|
| D(BRS(-1))| -0.027875   | [-0.80032]  | 1.67065      | Not Significant|
| D(BRS(-2))| -0.060247   | [-1.67439]*| 1.67065      | Significant    |
| D(DAR(-1))| 0.007111    | [ 0.61257]  | 1.67065      | Not Significant|
| D(DAR(-2))| -0.008893   | [-1.02244]  | 1.67065      | Not Significant|
| D(CAM(-1))| 0.001583    | [ 0.36486]  | 1.67065      | Not Significant|
| D(CAM(-2))| 0.005190    | [ 1.31888]  | 1.67065      | Not Significant|
| D(MKG(-1))| -0.057853   | [-0.47192]  | 1.67065      | Not Significant|
| D(MKG(-2))| -0.147172   | [-1.40248]  | 1.67065      | Not Significant|
| D(TAR(-1))| -0.035068   | [-0.74921]  | 1.67065      | Not Significant|
| D(TAR(-2))| -0.033847   | [-1.06222]  | 1.67065      | Not Significant|
| D(JGG(-1))| -0.020698   | [-1.00899]  | 1.67065      | Not Significant|
| D(JAG(-1))| -0.007184   | [-0.49562]  | 1.67065      | Not Significant|
| C         | -0.017060   | [-0.13492]  | 1.67065      | Not Significant|
| Long-Term |             |             |              |                |
| D(BRS(-1))| 0.047306    | [ 0.50029]  | 1.67065      | Not Significant|
| D(DAR(-1))| 0.105887    | [ 4.36347]*| 1.67065      | Significant    |
| D(CAM(-1))| -0.015243   | [-2.01504]*| 1.67065      | Significant    |
| D(MKG(-1))| -1.069703   | [-5.41760]*| 1.67065      | Significant    |
| D(TAR(-1))| -0.616403   | [-7.63939]*| 1.67065      | Significant    |
| D(JAG(-1))| -0.224158   | [-4.22916]*| 1.67065      | Significant    |
| C         | 0.391961    |             |              |                |

*Source: The data is processed with EViews 10*

VECM explains the fluctuations in the prices of each commodity against coins in Pematang Siantar City in the short and long term. Correction parameter correction parameter (CointEq1) which is negative. Error model correction is declared valid and stable if the parameter value is negative with an absolute value of less than one and significant. The interpretation of the error correction value of -0.163117, which is equal to the short term in the long term in Pematang Siantar City, which is corrected every month by 0.16%.
Based on the results in Table 5 it can be seen that in the short-term two variables that influence inflation (INF) in the current period significantly at the 5% level, namely INF\(_{(t-1)}\) and BRS\(_{(t-2)}\). While in the long-term five variables that influence inflation (INF) significantly at the 5% level, namely BRS, DAR, CAM, MKG, TAR and, JAG. These variables are said to have a significant effect on inflation (INF) because the t-statistic value of each of these variables is greater than t-table (1.67065). Thus, food price inflation in the long-term and the short-term remains a significant driver for overall consumer price inflation and food prices in Pematang Siantar City [4].

Variables that have a significant effect in the short-term are only a few, it is because a variable reacts to other variables takes time so that in general the reaction of a variable to other variables occurs in the long-term [5].

3.6. Analysis of impulse response function (IRF)

Impulse Response Function (IRF) is used to see the effect of the shock of a standard deviation of a new variable on the current value and the future value of the observed model. In this study, the results of the IRF test will be displayed in the form of a table that is explained within the next 60 months of the study period. Then it will be seen in three periods namely short term (12 months beginning), medium-term (13th to 36th months) and long-term (37th to 60th months).

| No. | INF  | BRS    | DAR   | CAM   | MKG   | TAR    | JAG   |
|-----|------|--------|-------|-------|-------|--------|-------|
| 1   | 0.714075 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| 12  | 0.489309 | -0.052990 | 0.014113 | 0.164180 | 0.049420 | -0.100369 | 0.011723 |
| 13  | 0.498582 | -0.046944 | 0.001416 | 0.142267 | 0.051102 | -0.110514 | 0.009440 |
| 36  | 0.481967 | -0.051081 | 0.003193 | 0.139068 | 0.057740 | -0.101413 | 0.009300 |
| 37  | 0.482005 | -0.051082 | 0.003178 | 0.139078 | 0.057752 | -0.101425 | 0.009243 |
| 60  | 0.481977 | -0.051098 | 0.003179 | 0.139071 | 0.057749 | -0.101421 | 0.009265 |

*Source: The data is processed with EViews 10*

In Table 6 can be seen that in the short term shock the INF will be responded to by the INF itself up to 0.489309. IRF results that provide a large response to inflation (INF), the red chili difference (CAM). Every time a standard deviation occurs, the shock of red chili will be responded to by inflation to rise 0.164180.

In the medium-term, every time a standard deviation occurs shock INF will be responded to by the INF itself up to 0.481967. IRF results that provide a large response to inflation (INF), namely red chili (CAM). Every time a standard deviation occurs, the shock of red chili will be responded to by inflation until it rises 0.139068.

In the long-term, every time a standard deviation occurs, the INF shock will be responded by the INF itself up to 0.481977. IRF results that provide a large response to inflation (INF), namely red chili (CAM) Every time a standard designation occurs, the shock of red chili will be responded to by inflation until it rises 0.139071.

3.7. Analysis of forecast error variance decomposition (FEVD)

The FEVD analysis aims to predict the percentage contribution of variants of each food commodity due to the price shocks studied in explaining the diversity of inflation [6]. Besides, it can be seen which food commodity is the most dominant in influencing inflation in Pematang Siantar City in the next 60 periods of the research period [4]. Then it will be seen in three periods namely short term (12 months beginning), medium-term (13th to 36th months) and long term (37th to 60th months).

Based on the results of the FEVD analysis, two commodities are most dominant in explaining the diversity of inflation in Pematang Siantar City, namely red chili (CAM) and purebred chicken eggs (TAR). In the short-term period, the CAM value ranges from 0.000% - 9.975%. While TAR ranges from 0.000% - 3.569%. In the medium term, the value of CAM ranged from 9.772% - 8.218%. While the
TAR is around 3.618% - 3.754%. In the long-term period, the CAM shocks ranged from 8.192% - 7.832%. While the TAR is around 3.756% - 3.787%.

Table 7. Test result of analysis Forecast Error Variance Decomposition (FEVD)

| Month | S.E. | INF | BRS | DAR | CAM | MKG | TAR | JAG |
|-------|------|-----|-----|-----|-----|-----|-----|-----|
| 1     | 0.714| 100.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 12    | 1.950| 82.057 | 1.528 | 0.613 | 9.975 | 2.035 | 3.569 | 0.222 |
| 13    | 2.022| 82.397 | 1.475 | 0.571 | 9.772 | 1.957 | 3.618 | 0.208 |
| 36    | 3.201| 84.976 | 1.182 | 0.230 | 8.218 | 1.536 | 3.754 | 0.103 |
| 37    | 3.242| 85.020 | 1.177 | 0.224 | 8.192 | 1.529 | 3.756 | 0.101 |
| 60    | 4.084| 85.637 | 1.102 | 0.143 | 7.832 | 1.424 | 3.787 | 0.076 |

Source: The data is processed with EViews 10

This is allegedly due to high red chili demand and no food can substitute for chili needs. Red chili is not only consumed daily by the community but is one of the raw materials in the food industry. This has caused the value of consumption of red chili in Pematang Siantar City to be relatively large. Therefore, the increase in prices on red chilies caused inflation in Pematang Siantar City. While chicken eggs are one of the main sources of protein, which is suspected to be high demand, while purebred chicken egg stock is not sufficient to meet community needs. This has led to an increase in egg prices and to cause a variation in inflation in Pematang Siantar City.

4. Conclusions

In the short-term, two variables affect inflation (INF), namely INF and BRS. While in the long-term, five variables influence inflation (INF), namely BRS, DAR, CAM, MKG, TAR, and JAG.

IRF analysis results, namely in the short term a large response to inflation is the red chili difference. Every time a standard deviation occurs, the shock of red chili will be responded to by inflation until it rises 0.164180. In the medium term, the big response to inflation is red chili. Every time a standard deviation occurs, the shock of red chili will be responded to by inflation until it rises 0.139071. And in the long-term, the big response to inflation is red chili. Every time a standard deviation occurs, the shock of red chili will be responded to by inflation until it rises 0.139071.

FEVD analysis results, which are the most dominant in explaining the diversity of Pematang Siantar City inflation, namely red chili (CAM) and purebred chicken eggs (TAR). In the short-term period, the CAM value ranges from 0.000% - 9.975%. While TAR ranges from 0.000% - 3.569%. In the medium term, the value of CAM ranged from 9.772% - 8.218%. While the TAR is around 3.618% - 3.754%. In the long-term period, the CAM shocks ranged from 8.192% - 7.832%. While the TAR is around 3.756% - 3.787%.

References

[1] Badan Pusat Statistik Sumatera Utara [BPS-Statistics of Sumatera Utara] 2018 Consumer Price Indices of Four Cities in Sumatera Utara Province 2017 (Medan: Badan Pusat Statistik Sumatera Utara [BPS-Statistics of Sumatera Utara]
[2] Riyadh MI, Oktaviani R and Siregar H 2009 Analisis fluktuasi nilai tukar Rupiah dan inflasi indonesia periode 1999-2006 [Analysis of Rupiah exchange rates and indonesian inflation periods 1999-2006] Jurnal Forum Pascasarjana IPB 32 3 1-18
[3] Setiawan AF 2015 Fluktuasi Harga Komoditas Pangan dan Dampaknya terhadap Inflasi di Provinsi Banten [Food Commodity Price Fluctuations and Their Impacts on Inflation in Banten Province] (Bogor: Institut Pertanian Bogor)
[4] Zhang C, Meng C and Getz L 2014 Food price and inflation dynamic in China China Agricultural Economic Review 6 3 395-412
[5] Firdaus M 2009 Manajemen Agribisnis [Agribusiness Management] (Jakarta: Bumi Aksara)
[6] Juanda B and Junaidi 2012 *Ekonometrika Deret Waktu Teori dan Aplikasi [Econometrics Time Series Theories and Applications]* (Bogor: IPB Press)

**Acknowledgments**

We would like to thank the Ministry of Research, Technology and Higher Education (KEMENRISTEKDIKTI) DRPM as the institution that has funded this research through the 2019 Master Thesis Research scheme with contracts No. 46/UN5.2.3.1/PPM/KP-DRPM/2019. In addition to the Research Institute (Lembaga Penelitian) of the University of North Sumatra, which has contributed morally and materially in conducting this research.