DLSU Business & Economics Review 33(2) 2024 p. 101-119

RESEARCH ARTICLE

Comparing "Exclusion" to "Neutralization" in Computing Core Inflation and Testing Cointegration of Core with Headline Inflation: Results for the Philippines

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Core inflation removes volatile prices from headline inflation. One way for removal is "exclusion" of pre-selected items (e.g., food and energy) by setting their weights to zero, which is practiced in the Philippines and the United States, among other countries. Using Philippine Statistics Authority CPI data (January 2012–July 2021), this paper shows that core inflation by exclusion is illogical because it could be higher than headline inflation when the excluded items have positive inflations. To avoid this illogical result, this paper proposes "neutralization" by keeping the excluded items but making their CPIs constant, thus neutralizing them because they cannot contribute to inflation. This yields the logical result that core inflation is lower (higher) than the headline if the neutralized items have positive (negative) inflations. Moreover, headline inflation is not cointegrated with core inflation by exclusion but is cointegrated with core inflation by neutralization when the neutralized items have inflation contributions that are not significantly different from zero. Therefore, neutralization should replace exclusion because this finding implies headline inflation will diverge from core inflation by exclusion but not from core inflation by neutralization, a scenario with important implications for monetary policy in the Philippines and other countries that practice exclusion.

Keywords: Headline inflation, core inflation, exclusion, neutralization, cointegration

JEL classification: C43, C82, E31, E58

Changes in the overall consumer price index (CPI) or "headline" inflation should concern everybody because they affect our cost of living and influence government policies.[1] However, headline inflation is subject to price volatility from short-run disruptions, for example, from bad weather or abrupt supply changes that are beyond the control of monetary policy. From the United States' experience, these disruptions caused volatility in food and energy prices. Thus, computing "core" inflation entailed removing food and energy items to determine long-term price trends for policy purposes (Blinder, 1997). For similar reasons, the Philippines also removes the same items to compute core inflation (Bangko Sentral ng Pilipinas, 2020). [2]

This paper examines the "exclusion" method in the Philippines for removing price volatility from headline inflation to obtain core inflation. CPI data in Appendix Table 1 and Appendix Table 2 of this paper from the Philippine Statistics Authority (PSA) show that exclusion—by setting the weights of excluded items to zero—yields illogical results. However, the exclusion is unnecessary because "neutralization"—by keeping the excluded items but making their CPIs constant—will suffice to remove the inflation contributions of excluded items and remedy the illogical results from the exclusion method.

Section 2 presents PSA's procedure for computing headline inflation and core inflation by the exclusion of pre-selected non-core energy and food items. [3] An empirical illustration highlights the illogical results from exclusion and introduces this paper's proposed remedy by neutralization.

Section 3 replicates the preceding illustration by annual (i.e., same month in year to year) *headline*, *core by exclusion*, and *core by neutralization* inflation using CPI data covering 13 core and non-core commodity groups for 115 months (January 2012–July 2021). The empirical illustration shows that the illogical results of core inflation by exclusion persist over time and, thus, are misleading for inflation measurement and policy. In contrast, the neutralization results are more logical analytically and stand on a firmer statistical basis.

Section 4 raises the question of "what core inflation should measure." This question arises in light of alternative attempts to measure core inflation based on theories other than the cost of living underlying the CPI (Wynne, 2008). The question is also relevant to the long-run objective of core inflation measurement to achieve the same rate as headline inflation but with a lower variance (Luciani & Trezzi, 2019). This paper finds that this objective is achievable by keeping all items in the CPI basket while neutralizing those with inflation contributions that are not statistically significantly different from zero. Moreover, a sufficient but not necessary condition is derived for neutralization to lower core inflation variance below that of headline inflation.

Section 5 shows from the above CPI data that headline inflation and core inflations by exclusion or neutralization are all nonstationary. However, headline inflation is not cointegrated with core by exclusion. In contrast, it is cointegrated with core by neutralization when the neutralized items satisfy the criterion that their inflation contributions are not significantly different from zero, in which case neutralization maintains the mean and possibly lowers the variance of headline inflation. Therefore, by satisfying the above criterion, neutralization will not—but exclusion will—make core inflation diverge over time from headline inflation.

Section 6 concludes that the Philippines and other countries that practice exclusion should consider adopting neutralization in place of exclusion in practice as basis for inflation analysis and monetary policy.

Exclusion and Neutralization Methods for Core Inflation: Results in the Philippines

Following PSA procedures (2018), let

$$I^t \equiv \text{headline CPI} \quad ; \quad I_i^t \equiv \text{CPI of commodity group } i \quad ; \quad i = 1, 2, \cdots, K \,. \tag{1}$$

In Equation 1, t stands for a month or year and K is the total number of commodity groups. From Equation 1,

$$I^t = \sum_{i=1}^{K} S_i^F \, I_i^t \quad ; \quad 0 < S_i^F < 1 \quad ; \quad \sum_{i=1}^{K} S_i^F = 1 \,. \tag{2}$$

The weight S_i^F is given by

S_i^F = expenditure share of a commodity from 2012 Family Income and Expenditure (FIES) (3)

If the total number of core commodities is K^c then $(K - K^c) > 0$ is the number of non-core items to be excluded to obtain core CPI. In this case, PSA obtains the core CPI from Equations 1, 2, and 3 by setting the weights of the excluded non-core items to zero and "recalibrating" the weights of the remaining core commodities so that they sum to one. That is,

$$I^{ct} \equiv \text{core CPI} = \sum_{i=1}^{K^c} \left(\frac{S_i^F}{\sum_{i=1}^{K^c} S_i^F} \right) I_i^t \quad ;$$
$$0 < \sum_{i=1}^{K^c} S_i^F < 1 \quad ; \quad \sum_{i=1}^{K^c} \left(\frac{S_i^F}{\sum_{i=1}^{K^c} S_i^F} \right) = 1 \, . \tag{4}$$

As a result, exclusion increases the recalibrated weights of core commodities in core CPI in Equation 4 above their weights in headline CPI in Equation 2 because PSA's exclusion procedure implies

$$S_i^F = 0 \ \text{ if } \ i = (\#2, \#9) \text{ in Table 1} \quad ;$$
$$1 > \frac{S_i^F}{\sum_{i=1}^{K^c} S_i^F} > S_i^F > 0 \ \text{ if } \ i \neq (\#2, \#9) \, . \tag{5}$$

Consequently, in Table 1, Equation 5 makes it possible for core inflation to be higher (lower) than headline inflation when the excluded non-core items, (#2, #9), have positive (negative) total contributions to headline inflation. This result is, however, illogical (i.e., contrary to common sense or normal expectation) because the normal result of excluding a positive amount from an existing value is to decrease but not increase this value.

Table 1 replicates BSP's illustration of PSA's exclusion procedure. The commodities excluded by PSA are #2 (non-core "food") and #9 (non-core "energy") to obtain core CPI from headline CPI.

Columns *a*, *b*, and *c* show the data for Equations 1, 2, and 3 to compute the *headline* CPI in columns *e* and *f*. The core CPI in columns *g* and *h* by neutralization differs from headline by keeping the non-core CPIs constant. In contrast, the core CPI in columns *j* and *k* by exclusion differs from the headline by setting the non-core weights to zero, as shown in column *i*. The ratio in Equations 4 or 5 is used to recalibrate the weights of the remaining core items in column *i*.

To show that core CPI inflation by exclusion could be misleading, let *t* change from 0 to 1 where the change is between any two periods. From Equation 2, the relative change in headline CPI is

$$\frac{I^1}{I^0} = \frac{\sum_{i=1}^{K} S_i^F I_i^1}{\sum_{i=1}^{K} S_i^F I_i^0} = \sum_{i=1}^{K} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0} \right) \frac{I_i^1}{I_i^0} \quad ;$$
$$\sum_{i=1}^{K} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0} \right) = 1 \, . \tag{6}$$

Therefore, Equation 6 yields

$$\frac{I^1}{I^0} - 1 = \sum_{i=1}^{K} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0} \right) \left(\frac{I_i^1}{I_i^0} - 1 \right) \equiv \text{headline inflation;} \tag{7}$$

$$\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0} \equiv \text{weight of a commodity group in headline inflation;} \tag{8}$$

$$\left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0} \right) \left(\frac{I_i^1}{I_i^0} - 1 \right) \equiv \text{contribution of a group to the headline inflation} \tag{9}$$

By applying the data in columns *a*, *b*, *c*, and *d* in Table 1 into Equations 1 to *5*, $I^0 = 115.55132$ *and* $I^1 = 119.32323$—rounded to 115.6 and 119.3 in columns *e* and *f*—to yield the headline inflation of 3.3%.

The differences between the effects of exclusion and neutralization on headline CPI inflation may now be shown. By applying the same procedures in Equations 6 to 9 to core CPI in Equation 4,

$$\frac{I^{c1}}{I^{c0}} = \frac{\sum_{i=1}^{K^c} S_i^F I_i^1}{\sum_{i=1}^{K^c} S_i^F I_i^0} = \sum_{i=1}^{K^c} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0} \right) \frac{I_i^1}{I_i^0}$$
$$; \quad \sum_{i=1}^{K^c} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0} \right) = 1 \; ; \tag{10}$$

$$\frac{I^{c1}}{I^{c0}} - 1 = \sum_{i=1}^{K^c} \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0} \right) \left(\frac{I_i^1}{I_i^0} - 1 \right) \equiv \text{core inflation} \tag{11}$$

$$\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0} \equiv \text{weight of a community group in core inflation} \tag{12}$$

$$\left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0} \right) \left(\frac{I_i^1}{I_i^0} - 1 \right) \equiv \text{contribution of a commodity group to core inflation.} \tag{13}$$

Consider that Equations 4 and 5 imply that the exclusion of F&E, i = (#2, #9), raises (lowers) the contribution of a remaining commodity to core inflation in Equation 13 above (below) its contribution to headline inflation in Equation 9 if this commodity has a positive (negative) inflation. That is, for a remaining commodity $i \neq$ (#2, #9),

Table 1. *Headline, Exclusion, and Neutralization Methods for CPI Inflation*

	Commodity Groups	CPI by Commodity Groups				CPI Inflation						
						Headline Inflation rate = 3.3 %		Core by Neutralization Inflation rate = 2.7 %		Core by Exclusion Inflation rate = 3.5 %		
		FIES 2012 Weights (percent) a	March 2018 CPI (2012 index = 100) b	March 2019 CPI c	Inflation Rate (percent) d	March 2018 CPI $e = a \times b$	March 2019 CPI $f = a \times c$	March 2018 CPI Constant Non-core CPI $g = a \times b$	March 2019 CPI $h = a \times c$	Recalibrated FIES 2012 Weights (percent) i	March 2018 CPI $j = i \times b$	March 2019 CPI $k = i \times c$
	All Items	**100.0**				**115.6**	**119.3**	**115.6**	**118.6**	**100.0**	**114.1**	**118.1**
1	Food and Non-alcoholic Beverages: Core	17.6	118.3	124.0	4.8	20.8	21.8	20.8	21.8	22.8	26.9	28.2
2	Food and Non-alcoholic Beverages: Non-core	20.8	123.3	126.0	2.2	25.6	26.2	25.6	25.6	0.0	0.0	0.0
3	Alcoholic Beverages, Tobacco, and other Vegetable-based Tobacco Products	1.6	183.9	203.7	10.8	2.9	3.2	2.9	3.2	2.1	3.8	4.2
4	Clothing and Footwear	2.9	116.3	119.2	2.5	3.4	3.5	3.4	3.5	3.8	4.4	4.5
5	Housing, Water, Electricity, Gas and Other Fuels	22.0	109.6	113.3	3.4	24.2	25.0	24.2	25.0	28.5	31.3	32.3
6	Furnishings, Houshold Equipment and Routine Maintenance of the House	2.9	115.2	119.1	3.4	3.4	3.5	3.4	3.5	3.8	4.4	4.5
7	Health	3.9	114.7	119.2	3.9	4.5	4.6	4.5	4.6	5.0	5.8	6.0
8	Transport Energy: Core	6.0	106.7	109.1	2.2	6.4	6.6	6.4	6.6	7.8	8.3	8.5
9	Transport Energy: Non-core	2.0	89.9	96.3	7.1	1.8	1.9	1.8	1.8	0.0	0.0	0.0
10	Communication	2.9	101.0	101.3	0.3	3.0	3.0	3.0	3.0	3.8	3.8	3.8
11	Recreation and Culture	1.4	111.3	114.7	3.1	1.6	1.6	1.6	1.6	1.8	2.0	2.1
12	Education	3.3	120.0	115.4	-3.8	3.9	3.8	3.9	3.8	4.3	5.1	4.9
13	Restaurants and Miscellaneous Goods and Services	12.6	112.0	116.1	3.7	14.1	14.6	14.1	14.6	16.3	18.3	18.9

Source: Authors' calculations from PSA CPI data (January 2012 – July 2021) in Appendix Table 1 and Appendix Table 2 of this paper.

Note: The exclusion procedure above is illustrated in BSP (2020), Primer on core inflation. Following this procedure, the weights in column i equal the weights in column a divided by the sum of the weights after exclusion of non-core items #2 and #9 (100 - 20.76672 - 2.02013 = 77.21315).

$$0 < \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) < \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) \quad \text{if} \quad \left(\frac{I_i^1}{I_i^0} - 1\right) > 0 \,; \tag{14}$$

$$0 > \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) > \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K^c} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) \quad \text{if} \quad \left(\frac{I_i^1}{I_i^0} - 1\right) < 0 \,. \tag{15}$$

Suppose that the contributions of F&E from Equation 9 are positive. Consider that it is possible from Equations 14 and 15 for the net change in the contributions of the remaining commodities, $i \neq (\#2, \#9)$, to be positive. In this case, it is necessary and sufficient that this positive net change exceeds the positive contributions of F&E that are lost by exclusion in order for core inflation to exceed headline inflation in the illogical case shown in Table 1.

Recall from Equation 5 that exclusion sets the weights of F&E, $i = (\#2, \#9)$, to zero and yields

$$S_i^F = 0 \quad ; \quad \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) = 0 \quad ; \quad i = (\#2, \#9) \,. \tag{16}$$

That is, exclusion removes the contribution of F&E by taking them out of the CPI basket. In Table 1, the effect of Equation 16 is to increase the weights of the remaining core groups in column *i*, according to the recalibrated weights in Equations 4 or 5. This increase in weights blows up the positive contributions of remaining core groups that could more than compensate for the loss of the positive contributions of #2 and #9, thus pushing core inflation higher to 3.5%, above headline inflation of 3.3%. This result makes core inflation by exclusion illogical because it is higher than the headline inflation after excluding items #2 and #9, which have positive inflation rates in column *d*.[6]

However, setting the weight of a commodity to zero is not necessary to remove its inflation contribution because this can be achieved by keeping the commodity in the CPI basket but "neutralizing" it by setting its CPI constant. That is, neutralization of F&E requires[7]

$$I_i^0 = I_i^1 \quad ; \quad \left(\frac{S_i^F I_i^0}{\sum_{i=1}^{K} S_i^F I_i^0}\right)\left(\frac{I_i^1}{I_i^0} - 1\right) = 0 \quad ; \quad i = (\#2, \#9) \,. \tag{17}$$

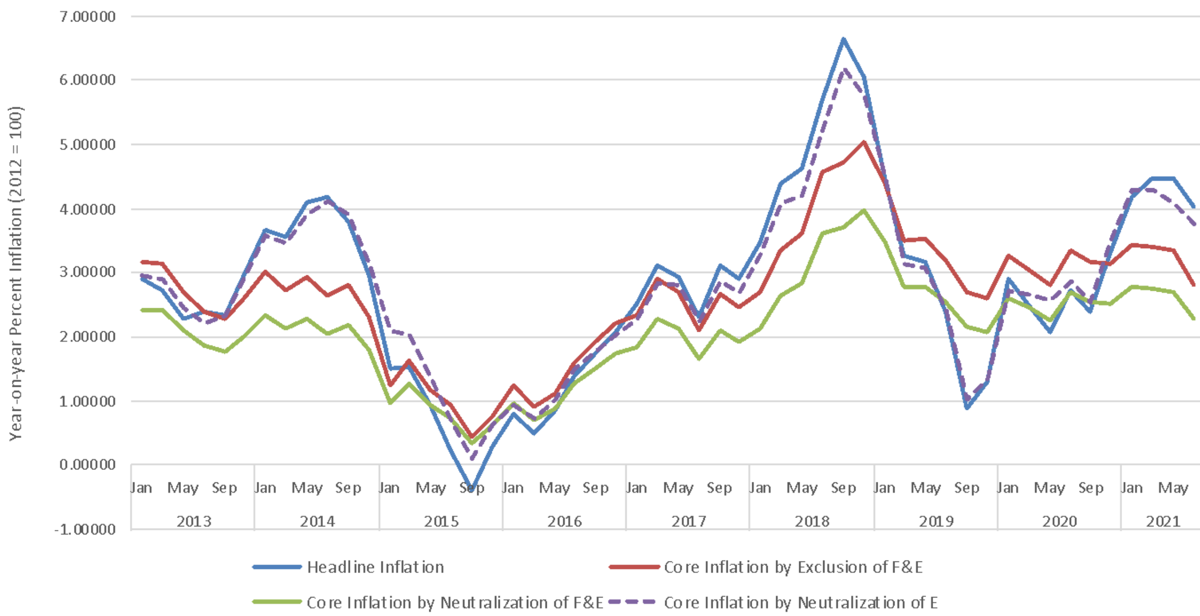
Mathematically, neutralization requires computing contributions to headline inflation by Equation 9 and then subtracting the sum of the contributions of the "neutralized" commodities.

In Table 1, the neutralization columns *g* and *h* are put next to the headline columns *e* and *f* to show the logical relationship between them. Notice that columns *e* and *g* are identical, which shows that the initial situation (March 2018) is the same for headline and neutralization. They differ only in the final situation (March 2019) because neutralization keeps the CPIs of the neutralized items (#2 and #9) constant in March 2018 or the same in March 2019. Thus, if the CPIs of #2 and #9 are rising, which actually happened from March 2018 to March 2019, keeping them constant makes the neutralization CPI (118.6) lower than the headline CPI (119.3) in March 2019. Logically, therefore, core inflation by neutralization (2.7%) is lower than headline inflation (3.3%). This result generalizes to saying that core inflation by neutralization is lower (higher) than headline inflation if the total inflation contributions of the neutralized commodities are positive (negative).

Effects of Non-Core Commodities on Inflation

Monthly CPI data from January 2012 to July 2021 replicate the results in Table 1 to obtain monthly headline CPI, core CPI by exclusion, and core CPI by neutralization. The non-core items excluded or neutralized are food and transport energy. These yield year-on-year (same month in year *t* to year *t*+1) inflation rates as shown in Figure 1, where F&E means non-core food (#2) and non-core energy (#9) in Table 1. For brevity, F is *non-core food* and E is *non-core energy* that are either excluded or neutralized, depending on the discussion.

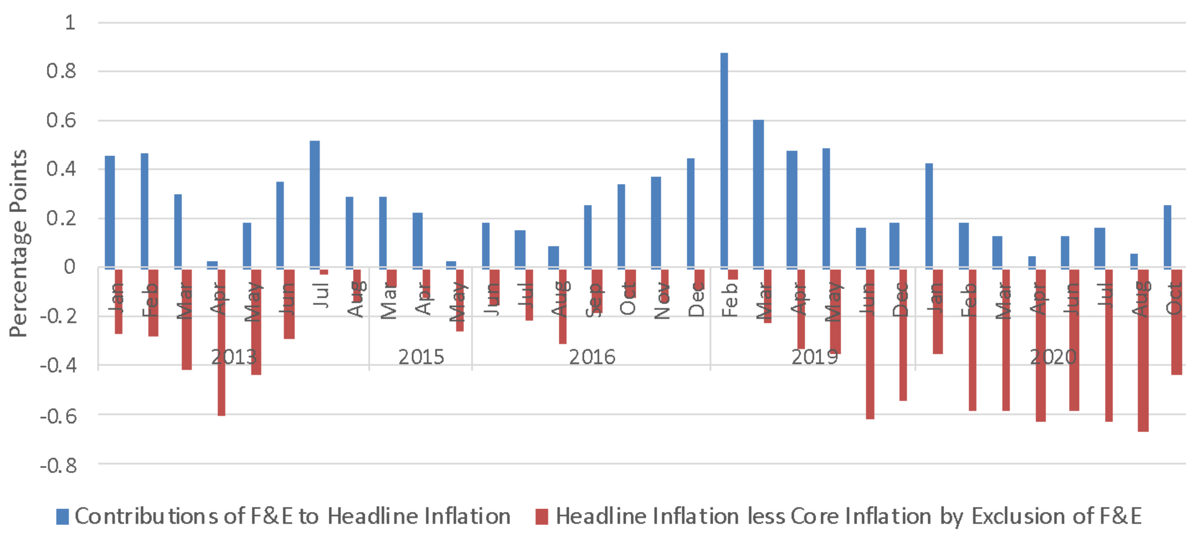
The illogical result in Table 1—where core inflation by exclusion was higher than headline inflation when F&E had a positive total contribution to inflation—is shown in Figure 2 to have happened in 32 out of



Source: *Authors' calculations from PSA CPI data (January 2012 – July 2021) in Appendix Table 1 and Appendix Table 2 of this paper.*
Note: *Similar plots of headline inflation (blue) and core inflation by the exclusion of F&E (red) may be found in BSP (2020). The plots of core inflations by neutralization of E (dashed purple) and of F&E (green) are the authors' own.*

Figure 1.

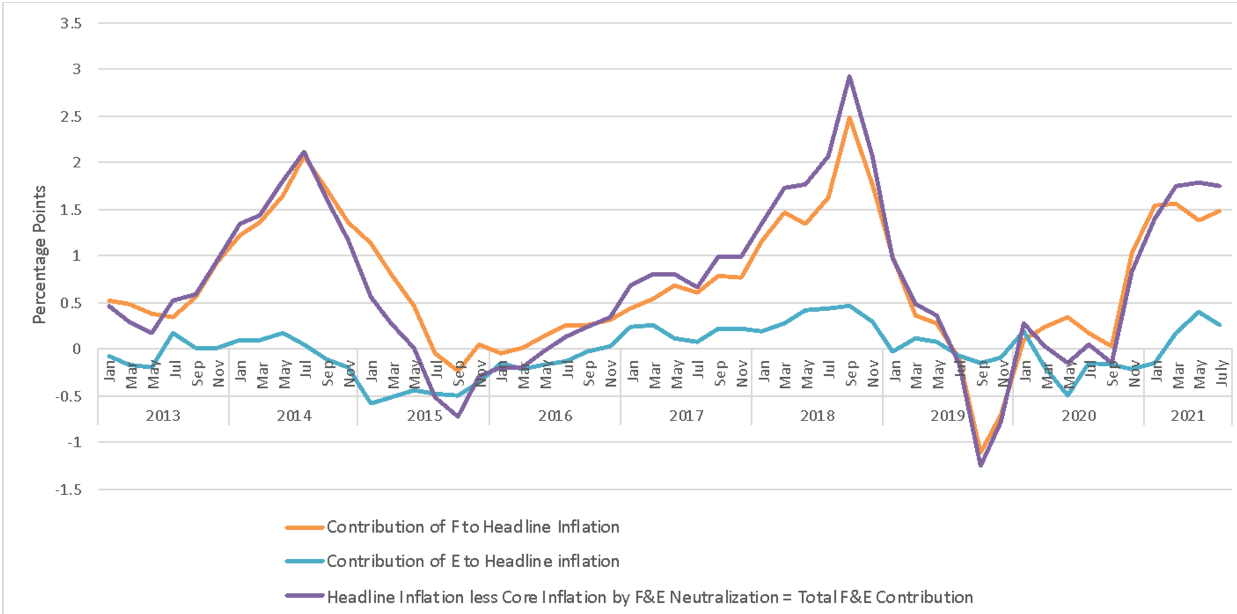
Comparing Headline and Core Inflations by Exclusion and Neutralization



Source: Authors' calculations from PSA CPI data.

Figure 2.

Misleading Core Inflation by Exclusion



Source: Authors' calculations from PSA CPI data.

Figure 3.

Contributions of F&E to Headline Inflation

103 cases during January 2013–July 2021 or 31% frequency.

Logically, core inflation should be lower (higher) than headline inflation after the removal of F&E if these removed items have a positive (negative) total contribution. However, this logical result could be violated if removal is by exclusion, as shown in Figure 2, where for each positive blue bar, there is a corresponding negative red bar. A negative red bar means that core inflation by exclusion is higher than headline inflation, which is illogical because, in the same period, the inflation contributions of F&E are positive, as shown by a corresponding positive blue bar.

From the above discussion, Figure 2 implies that in Figure 1, the vertical distance between headline inflation and core inflation by exclusion mismeasures the inflation contribution of F&E. As a result, core inflation by exclusion—shown in Figure 1 by the red line generated by following PSA procedures—is misleading for policy purposes. The culprit, once again, is the increase in weights of the remaining commodities to compensate for the loss of weights of the excluded commodities because weights must sum to one according to column *i* in Table 1.

The "true" total inflation contribution of F&E is the vertical distance between headline inflation and core inflation by F&E neutralization in Figure 1.[8] This total F&E contribution is plotted by the purple line in Figure 3 and displays high volatility. Disaggregation of this total shows that most of the price volatility is from F, shown by the orange line, than from E in green.

It is apparent in Figure 3 that a simple -test of the null hypothesis of a zero mean of inflation contributions—based on 103 observations (Jan 2013–July 2021)—cannot be rejected in the case of E (t = -0.6800 *and* p = 0.4981) with a statistically insignificant negative mean (– 0.0175 %) but can be rejected in the case of F (t = 10.0376 *and* p = 0.0000) with a statistically significant positive mean (0.7067 %).[9]

What Should Core Inflation Measure?

So far in this paper, core inflation has been analyzed in relation to headline CPI inflation that, in theory, refers to a change in the cost-of-living index (COLI). However, there have been attempts to measure core inflation not anchored on the COLI as a theoretical basis. In reviewing various alternative approaches to measuring core inflation, Wynne (2008) noted that:

> A common theme . . . is that there is some concept of monetary inflation that is distinct from changes in the cost of living and that is a more appropriate target of monetary policy. . . . this theme has motivated several authors to look at alternative estimates of the central tendency of the distribution of prices as the best estimate of core or monetary inflation. Other authors have used dynamic frameworks along with neutrality propositions from monetary theory to try to estimate core inflation. All of these approaches suffer from this fact: There is simply no agreed upon theory of money that can serve as a basis for inflation measurement that could plausibly replace the theory of the cost of living.[10] (underscoring supplied, p. 223)

Thus, a COLI-based CPI framework for core inflation remains viable.[11] In this regard, there is the view in the literature (Luciani & Trezzi, 2019) that the objective of core inflation measurement is to have the same average rate as headline inflation over long periods but with a lower variance to serve the purposes of long-term monetary policy. This raises the question: Which technique for core inflation measurement—exclusion or neutralization—could achieve the above objective?

Based on the preceding findings, this paper proposes that core inflation (a) keep all commodities in the CPI basket; (b) count the inflation contributions of commodities that pass the criterion of having means that are statistically significantly different from zero (e.g., F in Figure 3); and (c) neutralize those commodities that fail this criterion (e.g., E). Graphically in Figure 1, conditions (a), (b), and (c) shift up green core inflation by neutralization closer to blue headline inflation and banish red core inflation by exclusion because (a) implies no exclusion. In effect, core inflation by neutralization and headline inflation have exactly the same commodity composition and have statistically the same (i.e., no significant difference) mean inflation rates. In contrast, core inflation by neutralization may have a lower variance or lower standard error and standard deviation, as shown later in Table 2. Hence, neutralization may permit more precise inflation forecasts for monetary policy purposes.

Moreover, the above conditions argue against the "pre-selection" of F and E by reconsidering the old rationale for their CPI exclusion that volatility in food and energy prices are to some extent due to "causes" (e.g., weather for food and geopolitics for energy) that cannot be directly addressed by central bank monetary policy (Labonte, 2008). This rationale may appear sound, but it is not fully sensible because monetary policy also needs to address the "aftereffects"—of weather and geopolitics—if they make statistically significant differences in food and energy prices. In the latter event, the aftereffects on inflation invite monetary policy attention regardless of the causes.

At this point, the preceding discussion invites tests between headline inflation and core inflation by neutralization in light of Figure 3, which showed by simple *t*-tests that E may be neutralized but not F. In this case, the appropriate tests are paired *t*-tests of three null hypotheses of zero mean of differences between (A) headline and core by F neutralization, (B) headline and core by E neutralization, and (C) headline and core by F&E neutralization. These paired *t*-tests are equivalent to tests of no differences in means, and the results are shown in Table 2.

Table 2. *Testing No Differences in Means Between Headline and Core by Neutralization*

Hypothesis	*t* and *p*	Pairs tested	Mean	Std. Err.	Std. Dev.	95% Conf. Interval
A	t = 10.0376	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.0000	Core by F Neutralization	2.0758	0.0973	0.9877	1.8828 - 2.2688
B	t = - 0.6800	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.4981	Core by E Neutralization	2.8000	0.1288	1.3067	2.5446 - 3.0554
C	t = 7.9560	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.0000	Core by F&E Neutralization	2.0952	0.0782	0.7941	1.9400 - 2.2504

Source: Author's calculations from PSA CPI data.

The results indicate rejection of A, no rejection of B, and rejection of C. The rejections of A and C are consistent with the fact shown in Figure 3 that F has a mean that is significantly different from zero, but E has a mean that is not. Therefore, neutralizing F alone or both F&E yield a mean of core inflation that is significantly different from the mean of headline inflation.

However, B cannot be rejected because Figure 3 shows E has a mean that is not significantly different from zero, implying that the means of headline inflation and core inflation by neutralization of E are statistically the same. But as shown in Table 2, core inflation, in this case, has lower variance (i.e., lower standard error and standard deviation) than headline inflation and, thus, is more precise for forecasting with a narrower 95% confidence interval around its mean.

Tests similar to Table 2 for pairs of headline and core by exclusion are shown in Table 3. To evaluate the results in the above tables, it is important to bear in mind that the inflation contribution lost when a commodity is excluded is the same as when it is neutralized because this contribution is given by Equation 9 that becomes lost (zero) by exclusion in Equation 10 or by neutralization in Equation 11. Therefore, the difference in means between the headline and core by neutralization equals the mean of the contributions of the neutralized commodity or item. Recall from Figure 3 that the mean of the contributions of E is -0.0175 and that of F is 0.7067. Logically, because the mean of E is negative, Table 2 shows that when E is neutralized, the mean of core inflation rises exactly above the mean of the headline by 0.0175 = 2.8000 – 2.7825. By the same logic, because the mean of F is positive, the mean of core inflation, when F is neutralized, falls exactly below the mean of the headline by -0.7067 = 2.0758 – 2.7825.

Unfortunately, a visual comparison of means in Tables 2 and 3 reveals that the above exact rise or fall in means of core inflation in Table 2 when F or E is neutralized does not hold in Table 3 when F or E is excluded, although the contribution lost when a commodity is neutralized is the same as when it is excluded.

For example, Table 3 shows that the mean of core inflation when E is excluded rises above the mean of headline inflation by 0.0697 = 2.8522 – 2.7825, which is puzzling because the rise should logically equal 0.0175, the absolute value of the mean (-0.0175) of the contributions of E. This implies that the differences in means in Table 3 mismeasure the mean of the contributions of the excluded commodities. Therefore, it is statistically ill-advised to use PSA's core inflation by exclusion of F&E defined by the red line in Figure 1.

At this juncture, the analytic basis for Table 2—where neutralization lowers core inflation variance (or its square root, the standard deviation) below that of headline inflation—may be shown. Let headline inflation from t to $t+1$ be denoted by $H^{t,t+1}$ so that Equation 7 generalizes to

$$\text{Headline inflation} \equiv H^{t,t+1} \equiv \frac{I^{t+1}}{I^{t}} - 1 = \sum_{i=1}^{K} \left(\frac{S_i^F I_i^t}{\sum_{i=1}^{K} S_i^F I_i^t} \right) \left(\frac{I_i^{t+1}}{I_i^t} - 1 \right). \quad (18)$$

Moreover, let the contribution of a commodity to $H^{t,t+1}$ be $c_i^{t,t+1}$, which is given in Equation 18 by

$$c_i^{t,t+1} \equiv \left(\frac{S_i^F I_i^t}{\sum_{i=1}^{K} S_i^F I_i^t} \right) \left(\frac{I_i^{t+1}}{I_i^t} - 1 \right) \quad ;$$

Table 3. *Testing No Differences in Means Between Headline and Core by Exclusion*

Hypothesis	*t* and *p*	Pairs tested	Mean	Std. Err.	Std. Dev.	95% Conf. Interval
A*	t = 3.4659	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.0008	Core by F Exclusion	2.5716	0.1199	1.2165	2.3339 - 2.8094
B*	t = - 2.8682	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.0050	Core by E Exclusion	2.8522	0.1311	1.3303	2.5922 - 3.1122
C*	t = 1.6727	Headline	2.7825	0.1471	1.4934	2.4906 - 3.0743
	p = 0.0975	Core by F&E Exclusion	2.6565	0.0981	0.9954	2.4620 - 2.8511

Source: Author's calculations from PSA CPI data.

$$H^{t,t+1} = \sum_{i=1}^{K} c_i^{t,t+1} \; . \tag{19}$$

It follows from Equation 19 that commodity contributions to headline inflation are not independent because the weights must sum to 1. Hence, over time from $t = 0, \cdots, T$, the variance of $H^{t,t+1}$ depends on the variances of the individual $c_i^{t,t+1}$ and on the covariances between pairs (i, j) $i \neq j$. Therefore, dropping the time superscript for simplicity, it follows from the standard formula for the variance of a sum (Anderson, 2003) that Equation 19 yields

$$Var(H) = Var\left(\sum_{i=1}^{K} c_i\right) = \sum_{i=1}^{K} Var(c_i) + 2\sum_{i<j} Cov(c_i, c_j) \; . \tag{20}$$

The value of Equation 20 equals the sum of all the elements of a symmetric variance-covariance matrix where the first term is the sum of the diagonal elements and the second term is the sum of the off-diagonal elements, given that symmetry comes from the fact that $Cov\,(c_i, c_j) = Cov\,(c_j, c_i)$. For all the $K = 13$ commodities individually identified in Table 1, the value of Equation 20 during 115 months (January 2012–July 2021) is obtained from the variances and covariances in Table 4. From this table, it can be verified that

$$Var(H) = \sum_{i=1}^{K} Var(c_i) + 2\sum_{i<j} Cov(c_i, c_j) = 0.883 + 1.347 = 2.230 \; . \tag{21}$$

Recall that variance, by definition, is the square of standard deviation. Thus, the value of *Var (H)* in Equation 21, 2.230, equals the square of the standard deviation of headline inflation, 1.493, in Table 2.

Suppose now that Energy, #9 in Table 1 and Table 4, is neutralized by keeping its CPI constant. That is, for $i = 9$ in Equation 21,

$$c_9^{t,t+1} \equiv \left(\frac{S_9^F I_9^t}{\sum_{i=1}^{K} S_i^F I_i^t}\right)\left(\frac{I_9^{t+1}}{I_9^t} - 1\right) = 0 \quad ; \quad I_9^t = I_9^{t+1}, \text{all } t \; . \tag{22}$$

Let the core inflation with neutralization of #9 be denoted by J_9. In this case, Equation 22 implies that

$$Var(c_9) = 0 \quad ; \quad Cov(c_9, c_j) = 0 \; ; \tag{23}$$

$$Var(J_9) = Var\left(\sum_{i\neq 9}^{K} c_i\right) = \sum_{i\neq 9}^{K} Var(c_i) + 2\sum_{i\neq 9} Cov(c_i, c_j) \; . \tag{24}$$

Table 4. *Variance-Covariance Matrix of Commodity Contributions to Headline Inflation.*

Commodities (Table 1)	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.056	0.079	0.016	0.001	0.048	0.003	0.005	0.005	0.018	0.001	0.000	-0.013	0.017
2	0.079	0.524	0.016	0.002	0.152	0.003	0.006	0.043	0.095	0.001	0.002	-0.020	0.024
3	0.016	0.016	0.028	0.000	0.022	0.003	0.002	0.010	0.016	0.000	0.001	-0.004	0.013
4	0.001	0.002	0.000	0.000	0.002	0.000	0.000	-0.002	-0.001	0.000	0.000	0.001	0.000
5	0.048	0.152	0.022	0.002	0.141	0.004	0.006	0.000	0.077	0.001	0.003	-0.014	0.021
6	0.003	0.003	0.003	0.000	0.004	0.001	0.000	0.001	0.001	0.000	0.000	-0.001	0.001
7	0.005	0.006	0.002	0.000	0.006	0.000	0.001	0.001	0.003	0.000	0.000	-0.002	0.002
8	0.005	0.043	0.010	-0.002	0.000	0.001	0.001	0.047	0.007	0.000	-0.002	-0.007	0.007
9	0.018	0.095	0.016	-0.001	0.077	0.001	0.003	0.007	0.065	0.001	0.001	-0.009	0.014
10	0.001	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
11	0.000	0.002	0.001	0.000	0.003	0.000	0.000	-0.002	0.001	0.000	0.001	0.000	0.000
12	-0.013	-0.020	-0.004	0.001	-0.014	-0.001	-0.002	-0.007	-0.009	0.000	0.000	0.008	-0.006
13	0.017	0.024	0.013	0.000	0.021	0.001	0.002	0.007	0.014	0.000	0.000	-0.006	0.011
	0.235	0.925	0.121	0.002	0.462	0.017	0.024	0.110	0.289	0.003	0.007	-0.069	0.103

Source: Author's calculations from PSA CPI data.

Following Equations 23 and 24, neutralization yields the variance-covariance matrix in Table 5, from which

$$Var(J_9) = \sum_{i\neq 9}^{K} Var(c_i) + 2\sum_{i\neq 9} Cov(c_i, c_j)$$
$$= 0.814 + 0.893 = 1.707\,. \quad (25)$$

Note that the 1.707 value of in Equation 25 equals the square of the standard deviation of core inflation by E neutralization, 1.307, which is lower than 1.493 for headline inflation in Table 2.

The change in variance due to neutralization may be obtained by subtracting Table 5 from Table 4 element by element, and the results are shown in Table 6. To get some insight into Table 6, note that neutralization changes the weight of the inflation contribution of the neutralized commodity, as can be seen by comparing Equation 19 and Equation 22. This changes the weights of the others because the weights must sum to 1 and, thus, changes variances and covariances from Table 4 to Table 5. However, most of the latter changes round off to zero at two decimal places in Table 6, where it appears that the non-zero changes at three decimal places are essentially the same as the elements in row 9 and column 9 in Table 4 that sum to the value of the right-hand side of Equation 26 below. Therefore, allowing for rounding discrepancies, the condition for the decrease in variance due to neutralization may be given as

$$Var(H) - Var(J_9) \approx Var(c_9) +$$
$$2\sum_{j\neq 9} Cov(c_9, c_j) \geq 0\,. \quad (26)$$

The reason for Equation 26 is that by neutralizing #9 in Table 5, the variance and covariances of #9 in Table 4 appear to be the only ones that remain in Table 6.

Empirically, the condition in Equation 26 is satisfied because Equations 21, 25, and 26, using Table 4, yield

$$Var(H) - Var(J_9) = 0.523 \approx 0.065 +$$
$$0.447 = 0.512\,. \quad (27)$$

However, it is important to note from Equation 26 that neutralization does not necessarily lower variance because—while $Var(c9) \geq 0$ is true by property of variance—$Cov(c_9, c_j)$ could be positive, zero, or negative. But it appears that to satisfy Equation 26, $\Sigma_{j\neq 9}\, Cov(c_9, c_j) \geq 0$ is sufficient, although not necessary because Equation 26 could be true even if $\Sigma_{j\neq 9}\, Cov(c_9, c_j) \leq 0$ given that $Var\,(c9) \geq 0$. By looking at Table 6, the above sufficient condition means that in Table 4, the sum of the covariances in the row and column of the neutralized commodity is non-negative.

Therefore, lowering the variance is an empirical issue but is very likely in practice because violating the above sufficient condition is very rare, as may be seen in Table 4, where it is violated only by row 12 and column 12 for Education, from which $\Sigma_{j\neq 12}$

Table 5. *Variance-Covariance Matrix of Commodity Contributions to Core Inflaction with Energy Neutralization*

Commodities (Table 1)	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.056	0.078	0.016	0.001	0.048	0.003	0.005	0.005	0	0.001	0.000	-0.013	0.017
2	0.078	0.522	0.016	0.002	0.151	0.003	0.006	0.043	0	0.001	0.002	-0.020	0.024
3	0.016	0.016	0.028	0.000	0.022	0.003	0.002	0.010	0	0.000	0.001	-0.004	0.013
4	0.001	0.002	0.000	0.000	0.002	0.000	0.000	-0.002	0	0.000	0.000	0.001	0.000
5	0.048	0.151	0.022	0.002	0.141	0.004	0.006	0.000	0	0.001	0.003	-0.014	0.020
6	0.003	0.003	0.003	0.000	0.004	0.001	0.000	0.001	0	0.000	0.000	-0.001	0.001
7	0.005	0.006	0.002	0.000	0.006	0.000	0.001	0.001	0	0.000	0.000	-0.002	0.002
8	0.005	0.043	0.010	-0.002	0.000	0.001	0.001	0.047	0	0.000	-0.002	-0.007	0.007
9	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0.001	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000
11	0.000	0.002	0.001	0.000	0.003	0.000	0.000	-0.002	0	0.000	0.001	0.000	0.000
12	-0.013	-0.020	-0.004	0.001	-0.014	-0.001	-0.002	-0.007	0	0.000	0.000	0.008	-0.006
13	0.017	0.024	0.013	0.000	0.020	0.001	0.002	0.007	0	0.000	0.000	-0.006	0.011
	0.215	0.826	0.105	0.003	0.382	0.016	0.021	0.102	0.000	0.003	0.005	-0.059	0.089

Source: Author's calculations from PSA CPI data.

$Cov(c_{12}, c_j) = -0.076$ and $Var(c_{12}) = 0.008$. The result of substituting these values into Equation 26 is negative, which by subtraction implies that the variance of core inflation rises with the neutralization of Education.

Except in the case of Education, it can be verified that Table 4 yields core inflation with lower variance than headline inflation by neutralizing any commodity. However, for core inflation by neutralization to achieve the other goal of having statistically the same mean as headline inflation, this study proposed the neutralization criterion that the commodity should have a mean of inflation contributions that is not significantly different from zero. Interestingly, this study found that only Energy or #9 satisfies the above criterion. Therefore, when Energy in Figure 3 is neutralized, the core inflation by neutralization is defined in Figure 1 by the dashed purple line that visually is very close to the blue line defining headline inflation. This is supported in Table 2 by the non-rejection of hypothesis B, which states that there is no statistically significant difference in means between headline inflation and core inflation by neutralization of energy in the Philippines. In a way, this statistical finding justifies the current official use of headline inflation as the basis for BSP's inflation-targeting policy and for NWPC's wage-setting decisions. However, using core inflation with neutralized Energy appears to be a better alternative for having the same mean and lower variance (or standard deviation) compared to headline inflation.

Finally, although the condition for neutralization to lower core inflation variance is simple—as given by Equations 26 and 27 from the difference between Table 4 and Table 5—a similar condition for exclusion to lower core inflation variance is not that simple. The reason is that exclusion reduces the number of commodities so that the dimension and all elements of the variance-covariance matrix—from contributions of remaining commodities to core inflation by exclusion—are entirely different from Table 5. Therefore, unlike the logical or systematic relation between Table 4 and Table 5 that yields Table 6, there is no such relation between the variance-covariance matrix for core inflation by exclusion and the variance-covariance matrix in Table 4 for headline inflation.

Cointegration Tests Between Headline and Core Inflation by Exclusion or Neutralization

Variables like inflation rates embody "accumulated" changes over time and, for this reason, are referred to as *integrated* variables in the sense that integration connotes accumulation. Because of accumulated changes, integrated variables are nonstationary. However, nonstationary variables could move together over time without drifting apart from each other, in which case they are considered *cointegrated* variables.

For nonstationary variables not to drift apart (i.e., cointegrated), their differences should be stationary, which is testable. Formally, cointegration means stationarity of the residuals from the regression of nonstationary variables (Banerjee et al., 1993; Holden et al., 1994). However, testing for cointegration requires prior tests of the non-stationarity of the variables under study, which are headline inflation and core inflations by exclusion and neutralization, as portrayed in Figure 1.

The inflation rates in Figure 1 are in levels measured

Table 6. *Changes in Variance-Covariance Due to Energy Neutralization (Table 4 minus Table 5)*

Commodities (Table 1)	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.000	**0.001**	0.000	0.000	0.000	0.000	0.000	0.000	**0.018**	0.000	0.000	0.000	0.000
2	**0.001**	**0.002**	0.000	0.000	**0.001**	0.000	0.000	0.000	**0.095**	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.016**	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**-0.001**	0.000	0.000	0.000	0.000
5	0.000	**0.001**	0.000	0.000	**0.001**	0.000	0.000	0.000	**0.077**	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.001**	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.003**	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.007**	0.000	0.000	0.000	0.000
9	**0.018**	**0.095**	**0.016**	**-0.001**	**0.077**	**0.001**	**0.003**	**0.007**	**0.065**	**0.001**	**0.001**	**-0.009**	**0.014**
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.001**	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.001**	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**-0.009**	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.014**	0.000	0.000	0.000	0.000

Source: Authors' calculations from CPI data in Appendix Table 1 and Appendix Table 2.

Table 7. *Tests of Non-Stationarity*

CPI Inflation Rate	Levels			First Differences		
	ADF Test	PP Test	KPSS Test	ADF Test	PP Test	KPSS Test
Headline	-2.1473	-8.6264	0.3461***	-3.3716***	-44.3940***	0.0729
Exclusion of Food (F)	-1.8756	-7.6941	0.6850*	-3.5392***	-46.2893***	0.0820
Exclusion of Energy (E)	-2.2506	-9.1323	0.3280***	-3.6106***	-48.1670***	0.0678
Exclusion of Food & Energy (F&E)	-1.9740	-7.8335	0.7416*	-3.3732***	-62.7220***	0.1118
Neutralization of F	-1.8828	-7.6988	0.7281*	-3.4074***	-51.7510***	0.1029
Neutralization of E	-2.2495	-9.1298	0.3313**	-3.6102***	-48.1600***	0.0679
Neutralization of F&E	-1.9829	-7.8293	0.8027***	-3.3711***	-62.7150***	0.1118

Source: Authors' calculations from PSA CPI data.

*Note: ADF is augmented Dickey-Fuller by Dickey and Fuller (1979) and Hamilton (1994); PP is by Phillips and Perron (1988); and KPSS is by Kwiatkowski, Phillips, Schmidt, and Shin (1992). The null hypothesis of the ADF and PP tests is non-stationarity, which is the alternative hypothesis of the KPSS test (i.e., the null of KPSS is stationarity). The number of asterisks, *,**, and *** indicate 10%, 5%, and 1% level of significance, respectively, of rejecting the null hypothesis.*

as year-on-year percent values. For the purposes of this study, nonstationary tests are applied to the levels of the inflation rates and also to their *first-differences* and the results are presented in Table 7 for seven CPI inflation rates listed in the first column as headline, core by exclusion of F, core by exclusion of E, core by exclusion of F&E, core by neutralization of F, core by neutralization of E, and core by neutralization of F&E.

As noted in Table 7, the null hypothesis of ADF and PP is non-stationarity while that of KPSS is stationarity. The absence of * means the null is not rejected (i.e., the presence of * means null rejection). Therefore, the results in Table 7 are unanimous in finding that the levels of all the inflation rates are nonstationary, and the first differences of all inflation rates are stationary. Because the latter means integrated of order 0 or I(0), the implication is that all the levels are nonstationary and integrated of order 1 or I(1). Because the levels are I(1), the residuals in pair-wise regressions of headline with (a) core by exclusion of F, (b) core by exclusion of E, (c) core by exclusion of F&E, (d) core by neutralization of F, (e) core by neutralization of E, and (f) core by neutralization of F&E need to be examined for stationarity or I(0) to establish cointegration of each pair.

Note that the regression residuals are comparable to the vertical distances between the graphs of headline inflation and the graphs of core inflations by exclusion or of core inflation by neutralization in Figure 1. Moreover, these vertical distances are related to the way the inflation contributions of F&E to headline inflation are treated by the exclusion and neutralization methods. In this light, the issue of the stationarity of the residuals in each of the above six pairs of regressions may be judged by the logic or lack thereof behind the vertical distances between the graphs of headline inflation and those of core inflations by exclusion or neutralization.

Recall that Figure 2 shows the vertical distances between headline inflation and core inflations by exclusions of F&E are illogical because they do not systematically measure the inflation contributions of F&E. In this case, the null hypothesis of no stationarity may not be rejected from testing the residuals of the regressions between headline and core by exclusions of F in (a), E in (b), and F&E in (c). That is, headline inflation and core inflation by exclusion may not be cointegrated and, therefore, could diverge from each other over time.

In contrast, the vertical distances between headline inflation and core inflation by neutralization are logical because these distances equal the inflation contributions of F, E, or F&E depending on which one (or both) is neutralized. However, because Figure 3 shows that the mean of the contributions of E to headline is not significantly different from zero, the residuals of the regression between headline and core by neutralizing E will also be zero by property of regression. In this case, the residuals are stationary with zero mean, implying cointegration between headline and core inflation by neutralizing E.

In the contrary case where the mean of the

Table 8. *Engle-Granger and Johansen Tests of No Cointegration*

	Engle-Granger Tests					
	No Cointegration Between Headline and Core Inflation by **Exclusion** of			No Cointegration Between Headline and Core Inflation by **Neutralization** of		
	Food (F)	Energy (E)	F&E	Food (F)	Energy (E)	F&E
Test statistic using CPI inflation	-2.78	-2.37	-2.51	-2.75	-4.20***	-2.48
	Johansen Tests					
	Trace Statistic Approach					
	No Cointegration Between Headline and Core Inflation by **Exclusion** of			No Cointegration Between Headline and Core Inflation by **Neutralization** of		
	Food (F)	Energy (E)	F&E	Food (F)	Energy (E)	F&E
Test statistic using CPI inflation	16.03	19.7	16.88	15.47	29.53***	16.64
	Maximum Eigenvalue Approach					
	No Cointegration Between Headline and Core Inflation by **Exclusion** of			No Cointegration Between Headline and Core Inflation by **Neutralization** of		
	Food (F)	Energy (E)	F&E	Food (F)	Energy (E)	F&E
Test statistic using CPI inflation	13.59	13.48	14.67	13.20	22.14***	14.60

Source: Authors' calculations from PSA CPI data.

Note: The Engle-Granger cointegration tests were implemented in two steps. First, six pairs of regressions of headline inflation against each core inflation by exclusion of (1) F, (2) E, or (3) F&E and against each core inflation by neutralization of (4) F, (5) E, or (6) F&E were estimated. Second, Augmented Dickey-Fuller (ADF) tests of the stationarity of the regression residuals were performed using the Schwarz-Bayesian Information Criterion as basis for lag selection. In these tests, the null hypothesis of non-stationarity of the residuals is equivalent to the null hypothesis of no cointegration.

The Johansen cointegration tests were performed using the optimal number of lags based on four selection criteria: (i) Schwarz-Bayesian Information Criterion, (ii) Akaike Information Criterion, (iii) Hannan-Quinn Information Criterion, and (iv) Final Prediction Error. If the selection criteria were not unanimous, (i) was used.

*The number of asterisks, *,**, and *** indicate 10%, 5%, and 1% level of significance, respectively, of rejecting the null hypothesis of no cointegration.*

contributions to headline of F is significantly different from zero, also shown in Figure 3, the residuals of the regression between headline and core by neutralizing F may not be stationary, implying no cointegration. By implication, there may also be no cointegration between headline inflation and core inflation by neutralizing F&E.

The above "qualitative" inferences from Figures 1, 2, and 3 are equivalent to saying that the null hypothesis of no cointegration may not be rejected except between headline inflation and core inflation by neutralizing E that could be cointegrated. These qualitative inferences are empirically borne out by the cointegration test results in Table 8.

As explained in the note underneath Table 8, the Engle-Granger (1987) cointegration test is a two-step procedure starting with estimation of pair-wise regressions of headline inflation paired with either core inflation by exclusion of (1) F, (2) E, or (3) F&E; or with core inflation by neutralization of (4) F, (5) E, or (6) F&E. The next step is an ADF test on the stationarity of the residuals in each regression. The null hypothesis of no cointegration is tested by the null hypothesis of non-stationarity of the residuals, which Table 8 shows is rejected at the 1% level of significance only in the regression of headline inflation and core inflation by neutralization of E, implying cointegration in this regression.

However, the choice of the dependent variable in the Engle-Granger (1987) first-step regression could lead to different conclusions. For this reason, Table 8 presents alternative cointegration tests by Johansen (1988) that improved the Engle-Granger two-step method by avoiding the issue of choosing a dependent variable in the first step as well as issues created when errors are carried over from the first-step regression to the second-step analysis of the stationarity of the regression residuals (Armstrong, 2001; Glen, 2020).

Using two approaches—the trace statistic approach and the maximum eigenvalue approach—the Johansen test assumes the null hypothesis of no cointegration between headline inflation paired with either core inflation by exclusion of F, E, or F&E; or with core inflation by neutralization of F, E, or F&E. Thus, there are 12 pair-wise results from the two approaches of the Johansen cointegration test.

Based on both Engle-Granger and Johansen tests, Table 8 shows no case where the null hypothesis of no cointegration between headline inflation and core inflation by exclusion may be rejected. That is, the results show no cointegration at all between headline and core inflations by exclusion of either F, E, or F&E. In contrast, there is cointegration between headline inflation and core inflation by neutralization but only of E, where the null hypothesis of no cointegration may be rejected at the most significant 1% level.

The important empirical implication of the results in Table 8 is that headline inflation will diverge over time from core inflation by exclusion of F, E, or F&E and from core inflation by neutralizing F or F&E—due to lack of cointegration—but not from core inflation by neutralizing E due to cointegration. Therefore, only core inflation by neutralizing E is viable as a basis for forecasting headline inflation, especially since the results in Tables 2 to 6 showed that neutralizing E allows core inflation to track headline inflation with the same mean but with a lower variance.

However, it should be noted that the neutralization of E is based on the finding of this study that E is the only one among the existing 13 commodity groups that satisfied the neutralization criterion of having headline inflation contributions that are not significantly different from zero. However, satisfying this criterion depends on the level of aggregation. It is possible that if the 13 groups are further disaggregated, additional subgroups may qualify for neutralization.

Conclusion

This paper found that core inflation by the exclusion of pre-selected commodities from the CPI basket yields illogical results that are misleading in practice. In contrast, it showed that the alternative by neutralization—keeping all commodities in the CPI basket and setting constant the CPIs of those with inflation contributions that are not statistically significantly different from zero—is a logical and practical procedure for measuring core inflation. This benefits policymakers by permitting them to focus on commodities with prices that make statistically significant differences to headline inflation and, therefore, really matter to the economy. Moreover, the analytic advantage is that the core inflation rate will be statistically the same as the headline inflation rate, but core inflation will have a lower variance, thus permitting more precise inflation forecasts for monetary policy purposes consistent with the overall or headline price trends. This is supported by the finding that headline inflation is not cointegrated with core inflation by exclusion but is cointegrated with—therefore, will not, over time, diverge from—core inflation by neutralization of energy. However, in principle, this cointegration holds more generally with core inflation by neutralization—not just of energy—but of commodities that satisfy the neutralization criterion that their contributions to headline inflation are not significantly different from zero. Thus, the long-term objective of core inflation measurement to keep track of headline inflation is technically and practically more achievable by neutralization than by exclusion. Therefore, countries that now practice exclusion should consider adopting neutralization as the basis for core inflation measurement in pursuit of monetary policy objectives.

Acknowledgments

The authors are very grateful to Epictetus Patalinghug at the University of the Philippines; Lawrence Dacuycuy and Jesus Felipe both at De La Salle University; and Michael Abrigo and Roehl Briones both at the Philippine Institute for Development Studies for their helpful suggestions and encouraging comments while this study was underway. Moreover, they are very grateful to Ferdinand Co, Laura Fermo, and Iluminada Sicat, all at BSP, and Divina Gracia del Prado at PSA for facilitating the presentation and lending their expertise in the discussions of an earlier version—without the cointegration analyses and results—of this paper at the 2nd BSP International Research Fair, 12-13 July 2022, in Manila. Not the least, they extend very special thanks to Elena Varona at PSA for providing the core and non-core CPI data for this study. The usual disclaimer applies that the findings in this paper reflect those of the authors and not of any other individual or institution.

Notes

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[2] This paper was presented at the 60th Philippine Economic Society Annual Meeting and Conference, 9-11 November 2022, Novotel Manila. An earlier version—without the cointegration analyses and results—was also presented at the 2nd BSP International Research Fair, 12-13 July 2022, in Manila.

[3] In the Philippines, headline inflation is used by the Bangko Sentral ng Pilipinas (BSP) as basis for inflation targeting and by the National Wages and Productivity Commission (NWPC) in wage-setting decisions.

[4] BSP (2020) selected countries other than the Philippines that practice exclusion and described their excluded commodities. These are the United States, Brazil, Chile, Colombia, Iceland, Israel, Peru, Poland, Korea, Thailand, and Malaysia that are among the 27 countries operating a full-fledged inflation-targeting regime (Hammond, 2012).

[5] The exclusion method was adopted before PSA's creation after inter-agency discussions in 2003 among the BSP, NWPC, Department of Trade and Industry, National Economic Development Authority, National Statistics Office (NSO), the National Statistical Coordination Board (NSCB), and the Statistical Research and Training Center (SRTC). PSA was created a decade later on December 29, 2013 by the Philippine Statistical Act of 2013 (RA 10625) by merging the NSO, NSCB, the Bureau of Labor and Employment Statistics and the Bureau of Agricultural Statistics. The same law created the Philippine Statistical Research and Training Institute to replace the SRTC.

[6] The exclusion procedure and result in Table 1 do not necessarily represent the exclusion method in other countries. Note that CPI aggregation in the Philippines in Equation 2 has fixed 2012 FIES weights. In contrast, the United States also practices exclusion but uses the personal consumption expenditure (PCE) deflator from the GDP accounts as the basis for headline inflation (Luciani & Trezzi, 2019). However, this PCE deflator does not have fixed weights because it is based on a chained Fisher price index (Landefeld & Parker, 1997). Moreover, the Fisher price (quantity) index weights are much more complicated—based on combinations of Laspeyres and Paasche quantity (price) indexes and their weights—as shown by the Fisher additive decomposition (Balk, 2004; Dumagan, 2002) that could be the basis for decomposing headline PCE inflation in the United States.

[7] To the best of the authors' knowledge, there is no earlier reference in the literature related to the CPI about this paper's "neutralization" method for computing core inflation than its first proposal by Dumagan (2022).

[8] The headline inflation contribution of a component is given by the value of Equation 9. Technically, this value equals the change in headline inflation in Equation 7 when only the CPI of this component is kept constant. However, this equality does not hold exactly because keeping the CPI of a component constant still changes its inflation weight in Equation 8 and the weights of the other components. But the data show empirically that the effect is negligible—equal to zero percentage points in most cases when rounded to the first decimal place—so that the equality holds practically.

[9] This finding implies that food (F) prices, but not energy (E) prices, contribute significantly to Philippine headline inflation. In line with this finding, Labonte (2008) noted a study in the United States (Gavin & Mandal, 2002) that found food prices to be a better predictor of future inflation than any other measure including core inflation.

[10] Wynne (2008) categorized the alternative core inflation measures into exclusion indexes, central-tendency statistical measures, variance-weighted indexes, regression-weighted indexes, model-based trend inflation measures, and component-smoothing indexes. However, there is no mention of "neutralization" proposed in this paper.

[11] COLI is the ratio of the minimum expenditure at the new prices to the minimum expenditure at the old prices to maintain the same utility level. The Philippine CPI is based on a Laspeyres price index that by the axioms of expenditure minimization is an upper-bound to the COLI.

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Appendix

Table 1. Consumer Price Indices in the Philippines (2012 = 100)
Source: Philippines Statistics Authory

Year	Month	All Items	Food and Non-Alcoholic Beverages	Food and Non-Alcoholic Beverages		Alcoholic Beverages and Tobacco	Clothing and Footwear	Housing, Water, Electricity, Gas, and other Fuels	Furnishing, Household Equiptment and Routine Maintenance of the House	Health	Transport	Transport			Recreation and Culture	Education	Restaurants and Miscellaneous Goods and Services
				Core	Non-Core							Core	Non-Core				
2012 Weights		100.0	38.3377	17.5710	20.7667	1.5838	2.9324	22.0353	2.9479	3.8947	8.0579	6.0378	2.0201	2.9264	1.4060	3.2833	12.5945
2012	Jan	98.6	98.8	98.5	99.1	97.6	97.8	97.9	97.5	99.0	99.4	99.2	100.0	99.8	99.3	97.6	98.8
2012	Feb	98.7	98.5	98.3	98.7	98.1	98.0	98.5	97.6	99.0	100.4	99.4	103.4	99.8	99.3	97.6	98.8
2012	Mar	98.9	98.5	98.4	98.6	98.5	98.2	98.9	98.1	99.1	101.5	99.7	106.9	99.8	99.4	97.6	99.0
2012	Apr	99.6	99.2	99.2	99.2	99.1	99.1	99.8	99.2	99.6	102.2	100.5	107.3	99.9	99.7	97.6	99.5
2012	May	99.5	99.1	99.4	98.8	99.5	99.7	99.7	99.5	99.8	101.0	100.4	102.8	100.0	99.9	97.6	99.9
2012	Jun	99.9	99.5	99.7	99.3	99.8	100.2	100.1	100.1	100.0	99.0	100.0	96.0	100.2	100.1	101.7	100.1
2012	Jul	100.2	100.1	100.2	100.0	100.1	100.5	100.8	100.5	100.3	97.7	100.1	90.5	100.2	100.2	101.7	100.3
2012	Aug	101.0	101.2	100.9	101.5	100.8	100.9	101.8	101.1	100.4	99.2	100.1	96.5	100.1	100.3	101.7	100.4
2012	Sep	101.0	101.4	101.2	101.6	101.1	101.1	100.7	101.4	100.5	100.5	100.1	101.7	100.1	100.3	101.7	100.6
2012	Oct	101.0	101.3	101.2	101.4	101.5	101.3	100.6	101.5	100.7	100.3	100.1	100.9	100.1	100.4	101.7	100.8
2012	Nov	101.0	101.3	101.4	101.2	101.9	101.5	100.7	101.7	100.8	99.5	100.2	97.4	100.1	100.4	101.7	101.0
2012	Dec	100.9	101.2	101.4	101.0	102.2	101.7	100.5	101.8	100.9	99.4	100.2	97.0	100.1	100.5	101.7	101.0
2013	Jan	101.4	101.5	101.5	101.5	111.4	102.0	101.3	102.3	101.3	99.5	100.3	97.1	100.1	100.6	101.7	101.4
2013	Feb	101.6	101.4	101.5	101.3	122.5	102.2	101.0	102.6	101.9	100.1	100.5	98.9	100.1	100.7	101.7	101.6
2013	Mar	101.6	101.2	101.6	100.9	126.1	102.5	100.9	102.6	102.0	99.9	100.5	98.1	100.1	100.9	101.7	101.9
2013	Apr	101.8	101.2	102.0	100.5	127.1	102.8	101.3	103.0	102.4	99.1	100.5	94.9	100.1	101.1	101.7	102.3
2013	May	101.8	101.3	102.1	100.6	128.5	103.0	101.4	103.2	102.5	98.7	100.5	93.3	100.1	101.1	101.7	102.3
2013	Jun	102.4	101.6	102.3	101.0	130.8	103.4	101.9	103.4	102.7	99.4	100.5	96.1	100.1	106.2	105.8	102.5
2013	Jul	102.6	102.0	102.4	101.7	131.1	103.5	101.6	103.6	102.9	100.2	100.5	99.3	100.1	106.3	105.9	102.6
2013	Aug	102.8	102.5	102.5	102.5	131.3	103.6	101.4	103.7	103.0	100.4	100.4	100.4	100.1	106.3	105.9	102.8
2013	Sep	103.3	103.6	102.7	104.4	131.6	103.7	101.8	103.9	103.1	100.9	100.5	102.1	100.1	106.4	105.9	102.9
2013	Oct	103.4	104.2	103.0	105.2	131.8	103.8	101.4	104.0	103.2	100.2	100.5	99.3	100.1	106.5	105.9	103.0
2013	Nov	103.9	104.6	103.3	105.7	132.0	103.9	102.8	104.1	103.4	100.1	100.6	98.6	100.1	106.6	105.9	103.1
2013	Dec	104.7	105.4	103.8	106.8	132.9	104.3	104.2	104.3	103.6	100.9	100.6	101.8	100.1	106.6	105.9	103.3
2014	Jan	105.2	106.1	104.4	107.5	133.5	104.9	104.7	105.0	103.8	101.1	100.7	102.3	100.2	106.7	105.9	103.4
2014	Feb	105.3	106.3	104.6	107.7	134.3	105.3	104.8	105.4	104.1	101.2	100.8	102.4	100.2	106.8	105.9	103.6
2014	Mar	105.2	106.3	104.8	107.6	135.2	105.6	104.0	105.5	104.3	101.2	100.9	102.1	100.2	106.9	105.9	103.8
2014	Apr	105.5	106.6	105.0	108.0	135.3	105.9	105.0	105.7	104.5	101.1	100.9	101.7	100.2	107.0	105.9	103.9
2014	May	105.9	107.2	105.4	108.7	135.6	106.4	105.5	105.9	104.6	101.1	100.9	101.7	100.2	107.1	105.9	103.9
2014	Jun	106.3	108.1	105.7	110.1	135.8	106.8	104.6	106.2	104.7	101.3	101.3	101.3	100.2	107.3	110.6	104.0
2014	Jul	106.9	109.3	106.2	111.9	136.0	107.1	104.3	106.4	105.3	102.2	102.2	102.2	100.2	107.4	110.7	104.1
2014	Aug	107.1	110.2	106.8	113.1	136.2	107.5	104.3	106.8	105.5	101.1	102.1	98.1	100.3	107.6	110.7	104.3
2014	Sep	107.3	110.4	107.4	112.9	136.6	107.6	104.3	106.9	105.7	100.8	102.2	96.6	100.3	107.7	110.7	104.5
2014	Oct	107.2	110.4	107.4	112.9	136.8	107.8	104.2	107.1	105.9	100.0	102.2	93.4	100.2	107.7	110.8	104.6
2014	Nov	107.0	110.3	107.6	112.6	137.4	108.1	103.7	107.2	105.9	98.8	102.2	88.6	100.2	107.7	110.8	104.8
2014	Dec	106.7	110.3	107.6	112.6	137.7	108.3	103.0	107.2	106.3	96.3	101.5	80.8	100.2	107.8	110.8	104.9
2015	Jan	106.8	110.9	108.0	113.4	138.2	108.5	102.8	107.6	106.6	93.8	101.0	72.3	100.2	107.9	110.8	105.1
2015	Feb	106.9	110.5	107.9	112.7	138.6	108.8	103.6	107.7	106.6	94.3	102.2	70.7	100.2	107.9	110.8	105.2
2015	Mar	106.8	110.0	108.0	111.7	139.1	109.0	104.0	107.8	106.7	95.3	102.1	75.0	100.1	107.9	110.8	105.2
2015	Apr	107.0	110.1	108.2	111.7	139.3	109.1	104.5	108.1	106.8	95.3	102.1	75.0	100.1	107.9	110.8	105.4
2015	May	106.9	109.9	108.5	111.1	139.5	109.3	104.1	108.1	106.9	96.2	102.1	78.6	100.1	108.0	110.8	105.4
2015	Jun	106.9	109.8	108.5	110.9	140.0	109.5	103.3	108.3	107.1	96.4	102.1	79.4	100.1	108.1	114.2	105.5
2015	Jul	107.1	110.3	108.6	111.7	140.2	109.6	103.2	108.3	107.4	95.8	102.1	77.0	100.1	108.2	114.2	105.7
2015	Aug	107.1	110.6	108.9	112.0	140.3	109.6	103.0	108.4	107.4	94.6	102.1	72.2	100.1	108.2	114.2	105.7
2015	Sep	106.9	110.5	109.0	111.8	140.5	109.8	102.1	108.5	107.4	94.5	102.7	70.0	100.2	108.3	114.2	105.8
2015	Oct	107.0	110.6	109.3	111.7	140.6	109.8	102.1	108.5	107.6	94.8	102.8	70.9	100.2	108.3	114.3	106.1
2015	Nov	107.3	111.4	109.6	112.9	141.3	110.1	102.2	108.7	107.8	94.6	102.9	69.8	100.2	108.4	114.3	106.4
2015	Dec	107.5	111.5	109.7	113.0	141.9	110.4	102.7	108.9	107.9	95.0	104.0	68.1	100.2	108.5	114.3	106.4
2016	Jan	107.6	111.9	110.3	113.3	142.7	110.5	102.6	109.2	108.2	93.5	103.3	64.2	100.3	108.5	114.3	106.3
2016	Feb	107.4	111.5	110.2	112.6	143.4	110.7	102.8	109.3	108.4	91.9	102.0	61.7	100.3	108.6	114.3	106.5
2016	Mar	107.4	111.1	110.2	111.9	144.3	110.8	102.7	109.4	108.4	92.7	102.6	63.1	100.2	108.7	114.3	107.1
2016	Apr	107.7	111.0	110.5	111.4	144.6	110.9	103.5	109.6	108.6	93.2	102.3	66.0	100.3	108.8	114.3	107.3
2016	May	107.9	111.4	110.8	111.9	145.1	111.3	103.3	109.8	109.0	94.2	102.6	69.1	100.5	108.9	114.3	107.4
2016	Jun	108.3	111.9	111.0	112.7	146.2	111.6	103.5	110.0	109.3	94.4	102.3	70.8	100.5	109.1	117.4	107.5
2016	Jul	108.5	112.2	111.0	113.2	147.1	112.0	104.0	110.3	109.8	94.0	102.1	69.8	100.5	109.3	117.5	107.7
2016	Aug	108.5	112.3	111.4	113.1	147.5	112.2	104.0	110.7	109.8	93.2	102.2	66.3	100.5	109.3	117.5	107.7
2016	Sep	108.7	112.6	111.8	113.3	148.0	112.5	103.7	110.9	110.1	93.7	102.3	68.0	100.6	109.4	117.5	107.8
2016	Oct	108.9	113.1	112.3	113.8	148.1	112.7	103.6	111.1	110.3	94.1	103.0	67.5	100.6	109.4	117.5	108.0
2016	Nov	109.5	114.0	113.1	114.8	150.0	112.9	104.3	111.2	110.9	94.5	102.5	70.6	100.6	109.6	117.9	108.1
2016	Dec	109.9	114.1	113.2	114.9	151.1	113.3	104.6	111.4	111.1	96.7	104.7	72.8	100.6	109.6	117.9	108.3

Appendix

Table 2. Consumer Price Indices in the Philippines (2012 = 100)
Source: Philippines Statistics Authory

Year	Month	All Items	Food and Non-Alcoholic Beverages	Food and Non-Alcoholic Beverages		Alcoholic Beverages and Tobacco	Clothing and Footwear	Housing, Water, Electricity, Gas, and other Fuels	Furnishing, Household Equiptment and Routine Maintenance of the House	Health	Transport	Transport			Recreation and Culture	Education	Restaurants and Miscellaneous Goods and Services
				Core	Non-Core							Core	Non-Core				
2012 Weights		100.0	38.3377	17.5710	20.7667	1.5838	2.9324	22.0353	2.9479	3.8947	8.0579	6.0378	2.0201	2.9264	1.4060	3.2833	12.5945
2017	Jan	110.3	114.8	113.6	115.8	152.0	113.6	104.7	111.6	111.6	97.0	103.9	76.4	100.6	109.5	117.9	108.4
2017	Feb	110.7	114.9	113.6	116.0	153.7	113.8	105.9	111.8	111.8	97.3	104.1	77.0	100.7	109.7	117.9	108.6
2017	Mar	110.7	114.3	113.4	115.1	155.1	114.0	106.5	112.2	112.0	98.0	105.4	75.9	100.7	109.8	117.9	108.7
2017	Apr	111.1	114.7	113.5	115.7	155.3	114.1	107.0	112.4	112.0	98.5	106.3	75.2	100.7	109.8	117.9	108.7
2017	May	111.0	114.8	113.6	115.8	155.8	114.3	106.8	112.4	112.1	98.2	106.2	74.3	100.7	109.9	117.9	108.8
2017	Jun	111.0	115.3	113.7	116.7	156.4	114.5	105.4	112.5	112.4	97.8	105.9	73.6	100.7	110.2	119.7	109.2
2017	Jul	111.1	115.3	113.8	116.6	157.1	114.6	105.3	112.9	112.6	97.7	105.8	73.5	100.7	111.0	120.0	109.4
2017	Aug	111.3	115.6	114.2	116.8	157.6	114.8	105.6	113.0	112.6	98.5	106.0	76.1	100.8	111.0	120.0	109.5
2017	Sep	112.0	116.3	114.7	117.7	157.9	114.9	107.0	113.2	112.7	99.3	106.2	78.7	100.8	110.9	120.0	109.9
2017	Oct	112.3	116.7	114.9	118.2	158.7	115.0	107.2	113.3	112.8	99.4	105.7	80.6	100.8	110.9	120.0	109.9
2017	Nov	112.8	117.4	115.4	119.1	159.3	115.2	107.7	113.4	112.9	99.9	105.9	82.0	100.9	110.9	120.0	110.1
2017	Dec	113.1	118.1	115.7	120.1	160.6	115.3	107.5	113.7	112.9	100.6	106.3	83.6	100.9	111.0	120.0	110.4
2018	Jan	114.1	119.8	116.8	122.3	170.5	115.8	107.6	114.0	113.9	101.4	106.5	86.2	100.9	111.1	120.0	110.8
2018	Feb	114.9	120.4	117.3	123.0	179.6	116.1	108.7	114.5	114.2	102.8	106.6	91.4	100.9	111.2	120.0	111.3
2018	Mar	115.5	121.0	118.3	123.3	183.9	116.3	109.6	115.2	114.7	102.5	106.7	89.9	101.0	111.3	120.0	112.0
2018	Apr	116.1	121.5	118.9	123.7	186.3	116.6	110.2	115.5	115.1	103.3	106.8	92.8	101.0	111.4	120.0	112.4
2018	May	116.1	121.4	118.9	123.5	187.8	116.8	110.0	115.7	115.2	104.3	106.9	96.5	101.0	111.5	120.0	112.8
2018	Jun	116.8	122.3	119.6	124.6	188.9	117.0	110.2	115.9	115.4	104.7	106.8	98.4	101.1	111.7	124.5	113.1
2018	Jul	117.4	123.4	120.5	125.9	190.9	117.4	111.2	116.6	116.8	105.4	108.1	97.3	101.2	112.0	115.3	113.5
2018	Aug	118.4	125.4	121.6	128.6	191.6	117.5	111.4	116.9	117.1	106.2	108.6	99.0	101.2	113.8	115.4	113.9
2018	Sep	119.5	127.6	122.8	131.7	192.3	117.8	111.9	117.2	117.3	107.2	108.8	102.4	101.3	114.2	115.4	114.3
2018	Oct	119.8	127.7	123.2	131.5	193.0	117.9	112.3	117.5	117.7	108.2	109.0	105.8	101.3	114.3	115.4	114.5
2018	Nov	119.6	126.8	123.7	129.4	194.0	118.3	112.2	117.9	118.0	108.8	112.3	98.3	101.3	114.4	115.5	115.1
2018	Dec	118.9	126.0	123.7	127.9	195.4	118.5	111.9	118.0	118.3	104.6	110.6	86.7	101.3	114.5	115.5	115.2
2019	Jan	119.1	126.5	124.0	128.6	198.0	118.7	111.9	118.5	118.8	103.9	110.4	84.5	101.3	114.6	115.4	115.6
2019	Feb	119.3	126.1	123.9	128.0	201.6	118.9	112.7	118.8	119.0	104.0	108.6	90.3	101.3	114.7	115.4	115.8
2019	Mar	119.3	125.1	124.0	126.0	203.7	119.2	113.3	119.1	119.2	105.9	109.1	96.3	101.3	114.7	115.4	116.1
2019	Apr	119.6	125.2	124.5	125.8	204.7	119.4	113.7	119.2	119.3	107.2	110.0	98.8	101.4	114.8	115.4	116.3
2019	May	119.8	125.5	125.1	125.8	205.6	119.6	113.6	119.4	119.3	108.0	110.5	100.5	101.4	115.0	115.4	116.5
2019	Jun	119.9	125.6	125.2	125.9	206.5	119.8	113.5	119.5	119.7	106.4	110.5	94.1	101.4	115.3	118.9	116.8
2019	Jul	120.2	125.8	125.6	126.0	207.7	120.4	113.7	120.0	120.5	106.1	110.1	94.1	101.5	115.6	120.2	117.2
2019	Aug	120.4	126.1	126.3	125.9	210.9	120.8	113.4	120.3	120.7	106.0	110.2	93.4	101.5	115.7	120.7	117.5
2019	Sep	120.6	126.4	127.0	125.9	219.8	121.0	112.8	120.6	120.9	106.2	110.3	93.9	101.5	115.8	120.7	117.7
2019	Oct	120.8	126.6	127.7	125.7	224.8	121.2	113.0	120.7	121.1	106.4	110.3	94.7	101.5	115.9	120.7	117.8
2019	Nov	121.1	126.8	127.8	126.0	228.2	121.4	113.5	121.2	121.6	106.2	110.4	93.6	101.6	116.0	120.8	118.2
2019	Dec	121.9	128.2	128.1	128.3	231.4	121.6	114.0	121.6	121.7	106.9	111.2	94.0	101.7	116.1	120.8	118.3
2020	Jan	122.6	129.3	128.5	130.0	236.0	121.9	114.7	122.2	122.2	107.0	110.8	95.6	101.7	116.3	120.8	118.6
2020	Feb	122.4	128.7	128.5	128.9	238.3	122.1	114.7	123.0	122.4	105.9	110.7	91.6	101.7	116.4	120.8	118.8
2020	Mar	122.3	128.4	128.9	128.0	240.4	122.4	114.6	124.1	122.6	104.0	110.6	84.3	101.8	116.5	120.8	119.1
2020	Apr	122.2	129.4	130.1	128.8	241.4	122.5	113.9	124.2	122.6	100.6	110.7	70.4	101.7	116.6	120.8	119.1
2020	May	122.3	129.2	130.3	128.3	242.6	122.5	113.8	124.3	122.7	102.1	112.3	71.6	101.7	116.6	120.8	119.3
2020	Jun	122.9	129.0	130.1	128.1	244.8	122.7	113.8	124.4	123.1	109.0	118.6	80.3	101.8	116.7	120.8	119.5
2020	Jul	123.5	128.8	130.1	127.7	247.8	123.0	114.6	124.8	123.9	112.8	121.8	85.9	101.8	116.9	120.8	120.1
2020	Aug	123.3	128.4	130.1	127.0	248.2	123.1	114.4	125.0	124.1	112.7	121.6	86.1	101.8	115.6	120.8	120.2
2020	Sep	123.4	128.3	130.3	126.6	248.1	123.2	114.1	125.1	124.3	115.0	125.4	83.9	101.9	115.2	121.9	120.4
2020	Oct	123.8	129.3	130.4	128.4	250.2	123.3	114.0	125.2	124.4	114.8	125.7	82.2	101.9	115.2	122.1	120.6
2020	Nov	125.1	132.2	131.8	132.5	256.3	123.4	114.4	125.4	124.5	114.3	125.4	81.1	101.9	115.3	122.1	120.8
2020	Dec	126.2	134.3	132.8	135.6	259.6	123.6	114.5	125.6	124.9	115.8	126.4	84.1	101.9	115.4	122.1	121.3
2021	Jan	127.8	137.2	134.0	139.9	263.7	123.9	115.3	125.7	125.3	116.3	126.2	86.7	101.9	115.5	122.1	122.1
2021	Feb	128.1	137.3	134.1	140.0	267.3	124.0	115.7	126.0	126.0	116.9	126.0	89.7	102.0	115.6	122.1	122.6
2021	Mar	127.8	135.9	133.4	138.0	269.4	124.4	115.6	126.4	126.2	118.4	126.5	94.2	102.0	115.8	122.1	122.8
2021	Apr	127.7	135.6	132.8	138.0	270.4	124.5	115.6	126.8	126.4	118.6	127.0	93.5	102.0	115.9	122.1	123.2
2021	May	127.8	135.1	132.5	137.3	271.3	124.6	116.1	127.4	126.6	118.9	127.0	94.7	102.0	115.9	122.1	123.8
2021	Jun	128.0	135.0	132.3	137.3	272.1	124.7	116.5	127.5	126.7	119.5	127.0	97.1	102.0	116.0	122.1	124.2
2021	Jul	128.5	135.1	132.6	137.2	273.0	125.1	117.6	127.7	127.7	120.7	127.0	101.9	102.1	116.1	122.1	124.4