BANGKO SENTRAL NG PILIPINAS
BSP Working Paper Series
Series No. 2020-02

June 2020

Relative price changes, asymmetric adjustments and aggregate inflation: Evidence from the Philippines

Joselito R. Basilio and Faith Christian Q. Cacnio

Relative price changes, asymmetric adjustments and aggregate inflation: Evidence from the Philippines

Joselito R. Basilio and Faith Christian Q. Cacnio

Abstract

The paper uses disaggregated price data to determine whether the higher moments of the distribution of relative price changes provide information on the adjustments and persistence of aggregate price conditions in the Philippines. It takes into account the changes that occurred in relative price movements between the pre-inflation targeting (i.e., 1994 to 2001) and inflation targeting (i.e., 2002 – M9 2019) periods. Results indicate that the dispersion of relative price changes and the skewness of their distribution are positively related to movements in short-run inflation. Moreover, price adjustments are observed to be asymmetric which can have significant effects on short-run inflation.

JEL classification: E3, E31, E52

Keywords: relative price changes, distribution of price changes, asymmetric price adjustments, inflation, inflation targeting

Corresponding authors: Joselito R. Basilio (basiliojr@bsp.gov.ph) and
Faith Christian Q. Cacnio (fcacnio@bsp.gov.ph)

Table of Contents

Relative price changes, asymmetric adjustments and aggregate inflation: Evidence from the Philippines

Joselito R. Basilio and Faith Christian Q. Cacnio[1]

1. Introduction

Classical theory makes a distinction between inflation and relative price changes. Inflation, as Milton Friedman pointed out, is always and everywhere a monetary phenomenon. It is fluctuations in money supply that determine the price level. Relative price changes are determined by real factors such as gyrations in the supply and demand for different goods. Thus, in theory, real price changes should not affect inflation. Milton Friedman emphasized this point when he wrote about the high inflation rates in the early 1970s:

> *" It is essential to distinguish changes in relative prices from changes in absolute prices. The special conditions that drove up the prices of oil and food required purchasers to spend more on them, leaving less to spend on other items. Did that not force other prices to go down or to rise less rapidly than otherwise? Why should the average level of all prices be affected significantly by changes in the prices of some things relative to others?"* (1974, p.74)

Accordingly, with an unchanged money stock, relative price adjustments are done through increases in the nominal prices of some goods and decreases in others. Ball and Mankiw (1995) noted that Friedman's analysis implicitly assumes that nominal prices are perfectly flexible. However, this is not often the case in the short-run. Frictions, like menu costs, can affect price changes. Firms experiencing price shocks will only change their prices if the desired adjustment is large enough to warrant paying the associated menu cost. Moreover, asymmetries in price adjustments could arise (Ball and Mankiw, 1994). Positive shocks to firms' desired prices are more likely to result in greater adjustments than negative shocks of the same size. This implies that asymmetric adjustments in relative prices could be inflationary in the short-run.

Empirical studies (e.g. Vining and Elwertowski, 1976; Fischer, 1981; Amano and Macklem, 1997) in in this area looked at the statistical relationship between the higher moments (i.e., variance and skewness) of the distribution of price changes and inflation.[2] These studies have generally observed that relative price variability is closely associated with

[1] Department of Economic Research and Center for Monetary and Financial Policy, respectively. This paper was presented at the BSP-BIS Conference on "Inflation dynamics in Asia and the Pacific" held in Manila last 19 – 20 August 2019. An abridged version of this paper will appear in a BIS conference volume. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bangko Sentral ng Pilipinas. Any remaining errors are solely of the authors.

[2] An earlier work that investigated the movements in individual prices relative to the aggregate price level is that of Mills (1927).

fluctuations in aggregate inflation and that short-run movements in inflation are positively related to the skewness of the distribution of relative price changes.[3]

Following this line of inquiry, this paper looks into the link between the distribution of relative price changes and short-run inflation in the Philippines. The paper uses disaggregated price data to determine whether the higher moments of the distribution of price changes provide information on the adjustments and persistence of aggregate domestic price conditions. The empirical exercises make additional observations after controlling for the other factors that affect headline prices (e.g. oil prices, rice supply conditions, seasonality and business cycles). One particular factor that the paper takes into account in its analysis is the adoption of inflation targeting in the Philippines in 2002. The paper assesses the changes that may have occurred in relative price movements between the pre-inflation targeting (i.e., 1994 to 2001) and inflation targeting (i.e., 2002 – M9 2019) periods.

Our results indicate a link between relative price variability and short-run inflation in the Philippines. High inflation periods, and to a lesser extent, deflationary episodes are associated with higher levels of price change variability. Additionally, the skewness of the distribution of price changes was observed to be positively related to movements in inflation. During periods of rising inflation, a positively skewed distribution suggest that some commodities are experiencing larger price changes relative to the others and these are putting an upward pressure on the general level of prices. The tails or shocks to prices of the different goods and services can be isolated and these can have significant effects on overall inflation under certain conditions. The higher moments of the price distribution can likewise provide some explanation on the observed decline in the sensitivity of short-run inflation to demand pressures. Between the pre-inflation targeting and inflation targeting periods, the frequency of price changes declined and the duration between price adjustments increased to 1.6 months from 1.4 months. These findings partly explain the low price volatility and stable inflation that the country experienced during the inflation targeting period and the observed flattening of the Phillips curve.

The observation that relative price changes can be inflationary in the short-run could complicate the conduct of monetary policy. Monetary policy cannot really affect relative price changes given that these are determined by developments in the real sector of the economy. Moreover, there are asymmetries in price adjustments which could also cause inflationary pressures in the short-run.

This paper is the first study to use disaggregated price data to analyze the relationship between relative price changes and short-run aggregate inflation in the Philippines. It is outlined as follows: section 2 describes the data used and provides some initial observations on relative price changes in the Philippines, section 3 explores the link

[3] While a number of studies done for different countries have found a strong correlation between inflation and its higher moments, these empirical findings have been questioned by the work of Bryan and Cecchetti (1999) and, to some extent, by Verbrugge (1999). These authors argued that the observed correlation between inflation and its higher moments are due to small-sample bias. However, Ball and Mankiw (1999) countered that Bryan and Cecchetti's claim is based on their analytical model's departure from the classical model's explanation on the factors that affect the general price level.

between relative price change distribution and short-run inflation in the country, section 4 looks into the asymmetry of price changes and provides an assessment of its relationship to inflation, and section 5 concludes.

2. Description of the data and some initial observations

The paper uses the Philippine Statistics Authority's (PSA) disaggregated monthly CPI data (i.e., 3-digit commodity groups)[4] for the period January (M1) 1994 – September (M9) 2019. The dataset contains 94 items that are categorized under 11 major commodity groups (Table 1). Annex 1 provides the details of the commodity items that are under each CPI commodity group. There are CPI items that have missing values. Annex 2 details the items that were either non-existent in the earlier part of the time series (e.g. mobile phones and phone cards in the early 1990's) or were not included in the CPI basket.

Table 1
CPI commodity groups (2012=100)

CPI Components	No. of 3-digit CPI Items
1. Food and non-alcoholic beverages	13
2. Alcoholic beverages, tobacco, etc.	5
3. Clothing and footwear	6
4. Housing, water, electricity, gas and other fuels	8
5. Furnishings, household equipment and routine maintenance of the house	11
6. Health	7
7. Transport	10
8. Communication	3
9. Recreation and culture	17
10. Education	7
11. Restaurant, miscellaneous goods, and services	7
ALL ITEMS	94

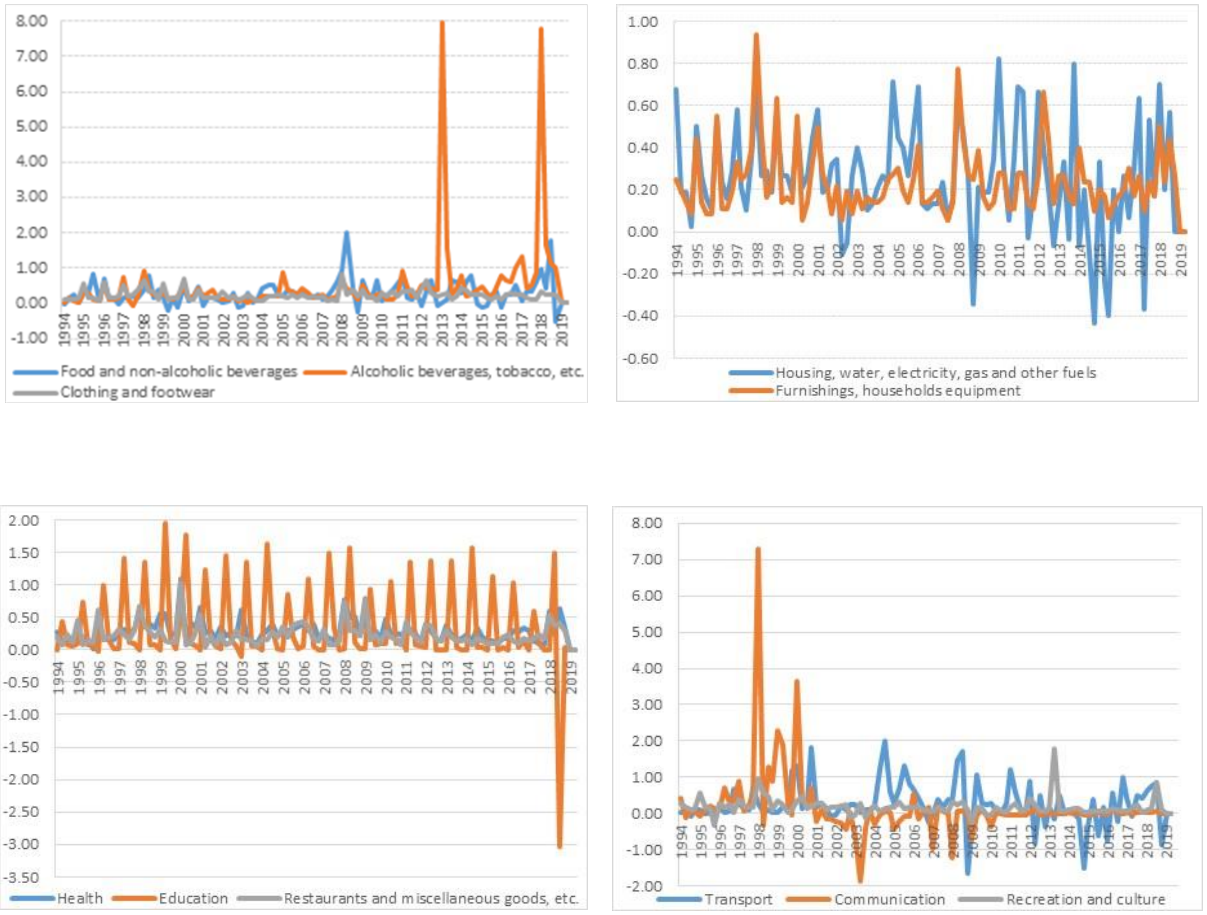
Source: Philippine Statistics Authority

Figure 1 plots the average month-on-month inflation for the 11 major CPI commodity groups. It gives an overview of the differing patterns of price changes for both consumer goods and services. The food and non-alcoholic beverages, transport, and housing, water, electricity, gas and other fuels commodity groups display larger price movements relative to the other commodity groups. These price changes, in part, can be attributed to the impact of the volatilities in the prices of staple goods like rice and oil. For the alcoholic beverages and tobacco products group, the observed spikes in prices (i.e., 2013 and 2018) can be traced to the imposition of steep excise taxes during these years. Meanwhile, education shows an intermittent pattern of price changes capturing the periodic increases in tuition fees and other school charges across all education levels in the country.

[4] Disaggregated CPIs used in the study are coded with 3-digits (hence, the reference as 3-digit CPI). This is except for the "cereals" CPI. Following the PSA standard of separating rice, corn and other cereals (which are all sub-items of the "cereals" CPI even if "cereals" is already a 3-digit CPI) in its statistical table releases, the analysis in this paper likewise treats rice, corn and other cereals as 3-digit items.

Lower price changes are seen for commodity groups like restaurants and miscellaneous goods, health, furnishings and household equipment, and clothing and footwear.

Figure 1
Average month-on-month inflation for the 11 major CPI commodity groups (in percent)



Source: Philippine Statistics Authority

The varying patterns of price changes are further explored using disaggregated CPI data (i.e., 3-digit level). Table 2 shows the average frequency of price changes for each commodity groups as well as the average duration between these price movements. These are based on the changes in the prices of the different commodity items that are categorized under each group. Table 2 yields some initial observations about price movements in the Philippines:

1. Prices in the Philippines, on average, change in about 75.6 percent of the time (i.e., price increases and decreases). Between 1994 and M9 2019 (i.e., 308 months), there were 200 months when prices increased and 29 months when they decreased. Price

increases, on average, occur every 1.5 months while price decreases happen every 10.4 months.

2. Increases in prices are almost seven times more likely to occur than price decreases and nearly three times more prevalent than the absence of a price change.

3. Prices stayed the same at an average rate of once every four months, or equivalently at 24.4 percent of the entire period.

4. Although they account for a relatively small percentage, price decreases, on average, constituted 12.7 percent of the total price changes (i.e., price increases and decreases).

5. Among the commodity groups, food and non-alcoholic beverages, alcoholic beverages and tobacco, housing, utilities, gas and other fuels, and restaurant and miscellaneous goods experienced higher rates of price changes relative to other commodity groups. Conversely, the frequencies of price changes are substantially less in education and communication compared to the others.

Table 2
Frequency and duration of price changes:
1994 – M9 2019, 1994 – 2001 and 2002 – M9 2019
CPI commodity groups (2012=100)

	1994 – M9 2019			1994 – 2001 (Pre-inflation targeting)			2002 – M9 2019 (Inflation targeting)		
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Total no. of months	**301**			**95**			**213**		
Frequency of price change (in no. of months)									
All items	200	29	73	63	8	18	136	20	57
Food and non-alcoholic beverages	215	71	23	63	22	10	152	48	14
Alcoholic beverages, tobacco, etc.	270	15	23	80	8	8	191	7	15
Clothing and footwear	257	13	38	78	6	11	179	8	27
Housing, water, electricity, gas, & other fuels	235	46	27	75	10	9	160	35	18
Furnishings, households equipment	244	16	48	76	7	12	168	9	36
Health	253	13	42	80	3	12	173	9	31
Transport	150	45	113	45	9	41	97	29	88
Communication	79	61	169	40	13	43	52	42	119
Recreation and culture	177	26	106	64	8	23	109	20	84
Education	55	7	188	11	2	24	44	6	163
Restaurants, miscellaneous goods & services	262	10	37	82	4	9	170	8	35
Share to total number of periods (in percent)									
All items	66.0	9.6	24.4	70.8	9.0	20.2	63.8	9.4	26.8
Food and non-alcoholic beverages	69.8	23.1	7.5	66.3	23.2	10.6	71.4	22.5	6.6
Alcoholic beverages, tobacco, etc.	87.7	4.9	7.4	84.2	8.4	8.4	89.7	3.4	7.2
Clothing and footwear	83.4	4.4	12.3	82.3	6.1	11.6	84.0	3.6	12.6
Housing, water, electricity, gas, & other fuels	76.3	14.9	8.8	79.4	11.0	9.6	75.1	16.2	8.5
Furnishings, households equipment	79.2	5.2	15.5	80.0	7.4	12.9	78.9	4.2	16.9
Health	82.1	4.1	13.7	84.4	4.2	10.5	81.2	4.4	14.4
Transport	48.7	14.6	36.7	47.4	9.5	43.2	45.5	13.6	41.3
Communication	25.6	19.8	54.9	42.1	13.7	45.3	24.4	19.7	55.9
Recreation and culture	57.5	8.4	34.4	67.4	8.4	24.2	51.2	9.3	39.4
Education	22.0	2.8	75.2	29.7	5.4	64.9	20.7	2.6	76.5
Restaurants, miscellaneous goods & services	85.1	3.1	12.0	86.3	4.2	9.5	79.8	3.7	16.3
Duration between price changes (median average, in no. of months)									
All items	1.5	10.4	4.1	1.4	11.1	4.9	1.6	10.0	3.7
Food and non-alcoholic beverages	1.5	3.9	14.0	1.5	4.5	8.6	1.5	3.6	17.8
Alcoholic beverages, tobacco, etc.	1.1	25.7	11.8	1.2	15.4	13.6	1.1	53.3	11.8
Clothing and footwear	1.2	24.5	7.3	1.2	23.8	9.5	1.2	23.5	7.7
Housing, water, electricity, gas, & other fuels	1.3	9.4	15.8	1.3	7.9	13.6	1.3	9.1	20.7
Furnishings, households equipment	1.3	18.1	5.9	1.3	16.3	7.6	1.4	18.2	4.7
Health	1.3	34.2	5.9	1.2	19.0	7.7	1.3	30.4	5.3
Transport	2.6	16.4	1.8	1.7	13.6	2.6	2.6	16.3	1.9
Communication	3.3	7.2	2.2	1.5	19.0	8.6	4.4	7.6	2.0
Recreation and culture	1.7	13.7	3.0	1.5	10.0	5.1	1.7	13.7	2.8

	1994 – M9 2019			1994 – 2001 (Pre-inflation targeting)			2002 – M9 2019 (Inflation targeting)		
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Education	5.4	44.3	1.3	4.6	20.6	1.4	5.1	50.7	1.3
Restaurants, miscellaneous goods & services	1.3	33.0	6.3	1.2	39.6	8.6	1.3	42.6	5.8

Source: Philippine Statistics Authority; Authors' calculation

Adoption of inflation targeting in the Philippines: impact on relative price changes

A significant policy shift that occurred over the 1994 to M9 2019 sample period is the adoption of inflation targeting as the framework for monetary policy in the Philippines in 2002. Empirical studies (e.g. Guinigundo, 2017) observed that changes occurred in the country's inflation dynamics following the adoption of inflation targeting. Inflation persistence gradually declined as the inflation process shifted from being backward-looking to more forward-looking. The Bangko Sentral ng Pilipinas (BSP) managed to keep inflation within target leading market agents to adopt a more forward-looking view in their assessment of current inflation. With increased monetary policy credibility, expected inflation started to weigh more in the pricing decisions of firms and consumers. In 2010, the BSP adopted a fixed medium-term inflation target which helped promote a long-term view on inflation. This, in turn, increased the predictability of monetary policy and, in the process, helped anchor inflation expectations.

To assess the potential impact of inflation targeting on price changes, we divide our sample period to 1994 to 2001 and 2002 to M9 2019 and compare the movements in relative prices between these periods. In Table 2, prices (on all items), on average, are shown to have changed less (i.e., price increases and decreases) during the inflation targeting period (73.7 percent) relative to the pre-inflation targeting period (79.8 percent). The frequency of price increases declined significantly in the inflation targeting period (64.3 percent) compared to the 1994 to 2001 period (70.7 percent). Moreover, the proportion of price decreases and no price changes increased in the 2002 to M9 2019 period.

Among the commodity groups, food and non-alcoholic beverages, which has the largest weight in the CPI basket, as well as alcoholic beverages, tobacco, etc., clothing and footwear and education experienced higher shares of price increases in the inflation targeting period relative to the pre-inflation targeting period. Most of the items in the food and non-alcoholic beverages commodity group (e.g. rice, other cereals, fish and seafood, milk, cheese and eggs) had higher frequency of price increases in the 2002 – M9 2019 period compared to the 1994 - 2001 period. Price increases in food items, particularly of agricultural commodities, are for the most part due to weather-related disturbances that caused lower supply and disruptions in the supply chain. The incremental increase in the tax rates of alcoholic beverages and tobacco products resulted in significant adjustments in the prices of alcoholic beverages and tobacco products starting in 2014. Since the 1990s, the cost of education in the Philippines, particularly for higher education, has been on a rising trend. Private schools have been given greater leeway in increasing tuition fees. These institutions can petition for tuition fee increases every year based on a set of factors,

including the quality of education that the school offers and the mission and vision of the institution. Meanwhile, selected clothing materials, ready-made apparels and footwear have shown higher annual average increases in prices during the 2009 – M9 2019 period.

Lower proportions of price increases were observed for the commodity groups of housing, water, electricity, gas, and other fuels, restaurant, miscellaneous goods and services and transport in the inflation targeting period relative to the pre-inflation targeting period.

The duration between price increases were, on average, at 1.4 months over the 1994 to 2001 period. This lengthened to 1.6 months in the 2002 to M9 2019 period. Within the commodity groups, there was a notable lengthening in the duration between price changes for transport, communication, recreation and culture and education in the 2002 to M9 2019 period.

The observed decline in the frequency of price changes and the lengthening of the duration between price adjustments correspond to the period of lower average inflation in the economy. Inflation declined from an average of 7.6 percent between 1994 and 2001 to 3.8 percent in the 2002 to M9 2019 period. The rates of price change for the different commodity groups likewise declined between the two periods considered (Table 3).

Table 3
Inflation rate (y-o-y): 1994 to 2001 and 2002 to M9 2019
(2012=100)

	1994 - 2001	2002 - M92019
ALL ITEMS	7.6	3.8
Food and non-alcoholic beverages	5.8	4.5
Alcoholic beverages, tobacco, etc.	6.0	6.9
Clothing and footwear	5.8	3.0
Housing, water, electricity, gas and other fuels	8.0	3.4
Furnishings, households equipment	5.9	2.9
Health	9.0	3.9
Transport	9.5	4.2
Communication	12.5	-1.0
Recreation and culture	4.1	1.8
Education	15.8	4.8
Restaurants and miscellaneous goods, etc.	6.0	3.0

Source: Philippine Statistics Authority; Authors' calculation

3. Relative price change distribution and aggregate inflation

Empirical evidence has shown that inflation is positively correlated with relative price changes. A number of theories has been explored in the literature to explain this observation. One is the Lucas approach (1973) which assumed imperfect information and argued that unanticipated changes in the price level and increased relative price variability are caused by unanticipated changes in the money supply. Another theory emphasized the costs associated with changing prices (i.e. menu costs) which can affect the decision of firms in updating their prices.

While inflation can result in relative price changes, Vining and Elwertowski (1976) suggested that the behavior of individual prices relative to each other can affect the general price level. They showed this by establishing a statistical relationship between the higher moments (i.e., variance and skewness) of the distribution of price changes and inflation. Fischer (1981) likewise observed that relative price variability can influence inflation if price rigidity is assumed asymmetric. Ball and Mankiw (1994) tested this causality using a menu cost model of price adjustment. Given trend inflation, Ball and Mankiw (1994) argued that asymmetries in price adjustments would arise. Firms will respond more to positive shocks to their desired prices than they would to negative shocks of a similar magnitude. Thus, asymmetric adjustments in relative prices could be inflationary in the short-run. During periods with large variances of relative price changes, inflation increases above trend and output declines.

Following the work of Vining and Elwertowski (1976), we determine the link between relative price changes and short-run inflation in the Philippines. We do this by looking at the distribution of price adjustments and the corresponding shape of the distribution of the price changes. The starting point is the calculation of the frequency of price adjustments as well as non-adjustments. It is then followed with the estimation and analysis of the corresponding (changing) shape of distribution over time in terms of the second and third moments (i.e., standard deviation and skewness).

To estimate the frequency and magnitude of price changes for each jth three-digit level disaggregated (CPI) item, we use the following equations: [5,6]

Frequency of price changes: $$F_j = \frac{\sum_{i=1}^{n_j}\sum_{t=2}^{t} NUM_{ijt}}{\sum_{i=1}^{n_j}\sum_{t=2}^{t} DEN_{ijt}}$$ Equation 1

Frequency of price increases: $$F_j^+ = \frac{\sum_{i=1}^{n_j}\sum_{t=2}^{t} NUMUP_{ijt}}{\sum_{i=1}^{n_j}\sum_{t=2}^{t} DEN_{ijt}}$$ Equation 2[7]

Average price increase in percent $$\overline{\Delta}_j^+ = \frac{\sum_{i=1}^{n_j}\sum_{t=2}^{t} NUMUP_{ijt}\,(\ln P_{ijt} - \ln P_{ij,t-1})}{\sum_{i=1}^{n_j}\sum_{t=2}^{t} NUMUP_{ijt}}$$ Equation 3

where the price available at *t* is given as:

$DEN_{ijt} = 1$ if P_{ijt} and $P_{ij,t-1}$ are observed in t; 0 otherwise.

Price change at *t* is defined to be: $NUM_{ijt} = 1$ if $P_{ijt} \neq P_{ij,t-1}$; 0 otherwise.

[5] These equations and corresponding descriptions are from Abenoja and Basilio (2018)

[6] The i[th] refers to the geographical location for which the three-digit CPI data is available for each region in the country. It is not included in the actual computations.

[7] One can also estimate the frequency of price decreases and the average price decrease by changing the $NUMUP_{ijt}$ with $NUMDW_{ijt}$ in equations 2 and 3.

To distinguish between price increases from price decreases, the former is set as:

$$NUMUP_{ijt} = 1 \text{ if } P_{ijt} > P_{ij,t-1}; \text{ 0 otherwise.}$$

Meanwhile, price decrease at t is set as: $NUMDW_{ijt} = 1$ if $P_{ijt} < P_{ij,t-1}$; 0 otherwise.

The distribution of price changes is derived for each month. The shape of these distributions, in turn, allowed us to generate the monthly values of the higher moments of the distribution. Annex 3 presents a summary of the descriptive statistics of the distributions of price changes across the 94 commodity items.

Previous studies that examined the relationship between relative price changes and short-run inflation have highlighted two important observations: i) relative price variability is closely associated with fluctuations in aggregate inflation; and ii) short-run movements in inflation are positively related to the skewness of the distribution of relative price changes. We determine whether these observations hold for the case of the Philippines.

First observation: The variability of relative price changes is closely associated with movements in short-run inflation.

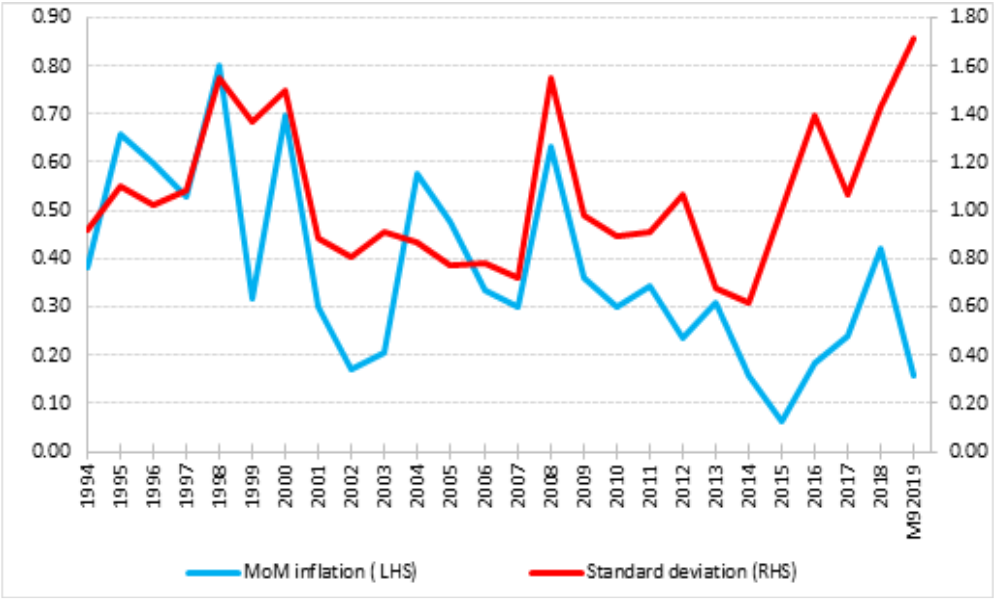
Vining and Elwertowski (1976) argued that the more unstable or less predictable the general price level becomes relative to its trend value, the more the dispersed are the relative price increases. Similarly, Fischer (1981, 1982) showed that relative price variability is correlated with changes in inflation.

In Figure 2, we present a comparison of the inflation rate and the variance of relative prices. Inflation rate is the month-on-month (MoM) rate of increase in the CPI while the variance of relative prices is the standard deviation of the rates of change (MoM) of the 94 individual commodities of the CPI under consideration. Figure 2 reveals that high variability of relative price changes in the Philippines point to rising levels of inflation. Higher relative price change variability implies a higher frequency of price changes in the economy. To a lesser degree, higher dispersion of relative prices can also indicate a period of deflation (2016). The observed peaks in inflation (i.e., 1998, 2000, 2018) were attributed to supply side shocks. Still reeling from the impact of the 1997 Asian financial crisis, the Philippines experienced poor weather conditions and drought in 1998 which adversely affected its agricultural harvest. This led to double-digit food inflation during the year. In 2000, rising oil prices and higher electricity rates drove up non-food inflation. Higher food and energy prices likewise caused the increase in the inflation rate in 2018. Meanwhile, in 2015 and 2016, low international oil price and ample food supply largely contributed to the decline in the rate of inflation. An important observation that appears in Figure 2 is the low level of relative price variability between 2001 and 2007 despite high inflation rates in 2004 – 2006 due to supply side shocks. A possible explanation for this is that the supply shocks that occurred during this period triggered second-round effects (i.e. increased in transportation fares, higher utility charges, adjustments in minimum wages across the country) that led to higher inflation. Moreover, the national government implemented tax reform measures in 2005 and

2006. In 2005, the value added tax (VAT) exemptions for several industries, including power, electricity, air and sea transport, were lifted. Energy and oil companies were allowed to pass on the 10 percent VAT to their consumers. The following year, in 2006, the national government increased the VAT rate for good and services from 10 percent to 12 percent. These developments contributed to a permanent increase in the prices of most of the goods and services in the economy.

Figure 2

Inflation rate and standard deviation of relative prices (month-on-month, in percent)



Source: Philippine Statistics Authority; Authors' calculations

Figure 2 also reflects the observed decline in the volatility of inflation following the adoption of inflation targeting. Inflation volatility declined from an average of 2.5 percent in the 1994 to 2001 period and to 2.0 percent in the 2002 to M9 2019. With the exception of 2008 and 2016, relative price variability remained relatively low over the 2002 to 2018 period.

Second observation: Short-run movements in inflation are positively related to the skewness of the distribution of relative price changes (Ball and Mankiw, 1994, 1995).

In the event of shocks, firms will change their prices only if the intended adjustment is large enough to warrant paying the attendant menu cost. This implies that firms respond to large shocks but not to small shocks. Hence, the larger the shocks, the larger would be its impact on the price level in the short-run. Under these assumptions, Ball and Mankiw (1995) argued that changes in the aggregate price level are positively related to the skewness of the distribution of relative price changes. Furthermore, they asserted that this relationship is even stronger than the inflation-variance relationship. Vining and Elwertowski (1976) noted that the distribution of individual price changes is generally highly skewed and asymmetrical. They also argued that the direction of the skew is similar to the direction of the rate of inflation.

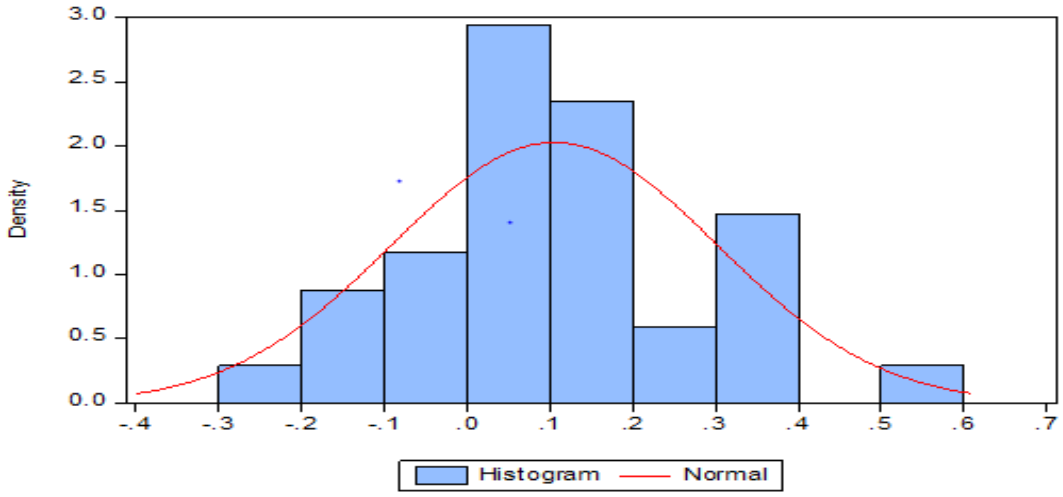
An assessment of the distribution of the price changes in the Philippines shows that it is positively skewed. This relates to the finding in Table 2 which shows a higher frequency of price increases in the country relative to price decreases or no price increases. Moreover, a positively skewed distribution of relative price changes signify that price increases in certain commodities could be large enough to result in inflationary pressures. The distribution

became less positively skewed and more symmetrical in the 2002 – M6 2019 period relative to the 1994 to 2001 period.

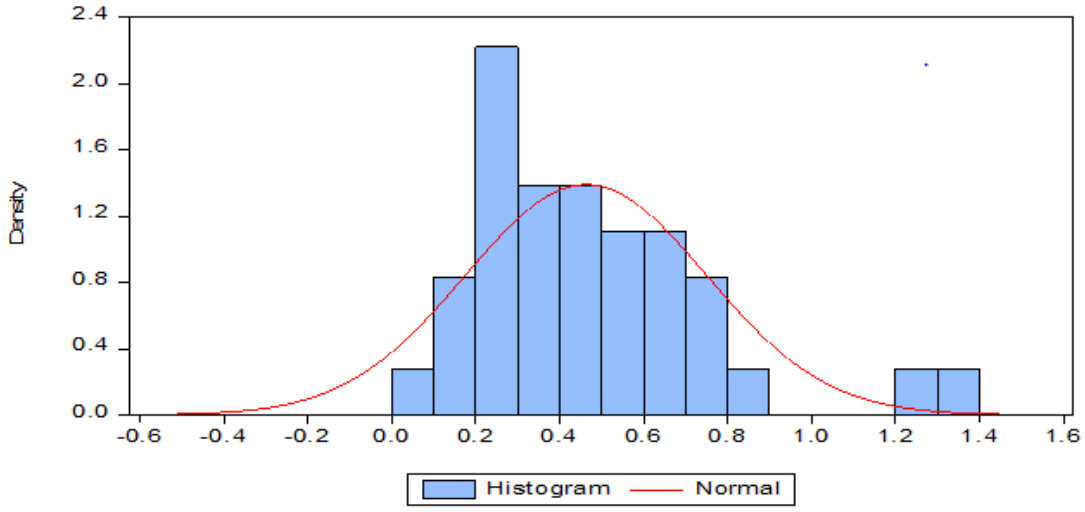
We look at two particular periods in our data to see whether the skewness of the distribution of relative price changes provide information on the direction of aggregate inflation. The first period is 2004 to 2006 (inflationary period) and the second period is from the latter part of 2014 to early 2017 (deflationary episode). In Figure 3, the distribution of price changes during the period of relatively high inflation is shown to be positively skewed while the period with declining prices has a slightly negatively skewed distribution.

Figure 3
Distribution of relative prices

2004 - 2006 (inflationary period)



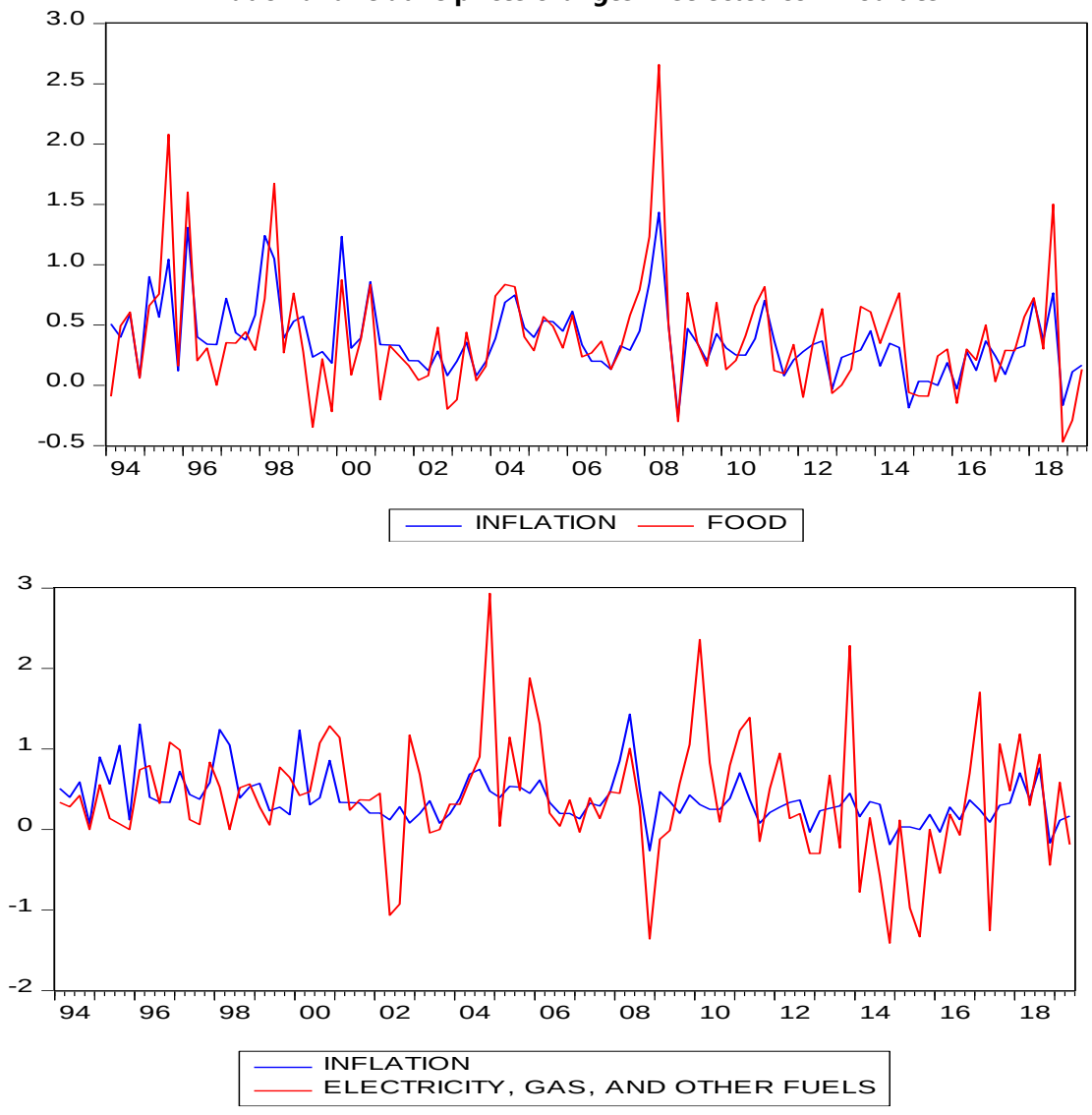
2014 - 2017 (deflationary period)



Source: Philippine Statistics Authority; Authors' calculations

During periods of rising inflation, a positively skewed distribution implies that some commodities are experiencing larger price changes which outweigh possible price decreases (or no price movements) in the other commodities. The converse holds during periods of declining prices. For the Philippines, price pressures have always been attributed to supply side shocks, particularly to food, oil and energy items. Figure 4 plots inflation against the price changes in food, oil, and energy.[8] The graphs show that, during periods of inflation (deflation), price changes in the food, oil and energy items are larger (lesser) than average inflation. This signifies that price changes in these commodities pull up (down) the general level of prices in the economy.

Figure 4
Inflation and relative prices changes in selected commodities



Source: Philippine Statistics Authority; Authors' calculations

[8] The sub-commodity group food is comprised of rice, corn, flour, cereals, bread, pasta, other bakery products, meat, fish and seafood, milk, cheese, eggs, oils and fats, fruits, vegetables, sugar, jam, honey, chocolate and confectionery, coffee, tea, cocoa, mineral water, soft drinks, fruit and vegetable juices.

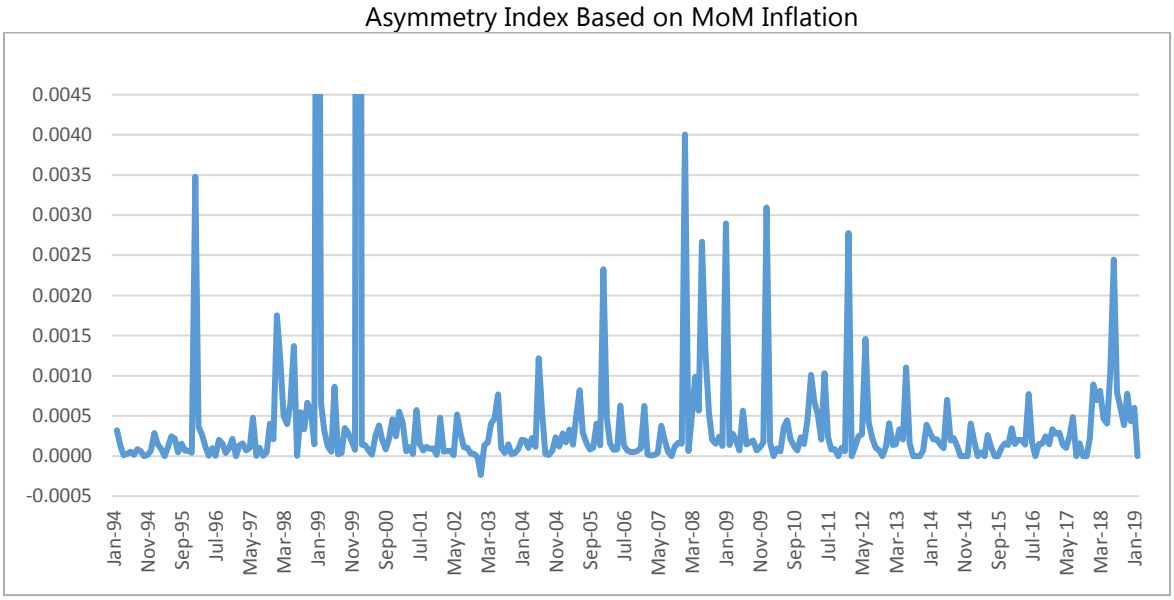
4. The asymmetry in the distribution of price changes and inflation

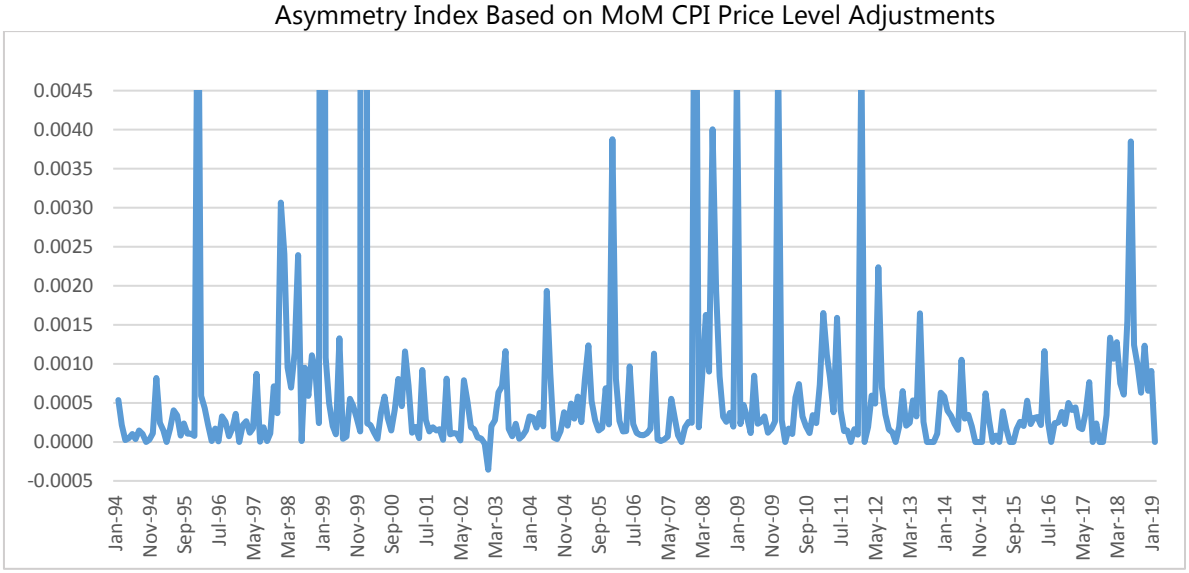
Ball and Mankiw (1994) asserted that asymmetric adjustments in relative prices could be inflationary in the short-run. Hence, we looked at the asymmetry of the distribution of the price changes in the Philippines and see how it relates to the positive relationship observed for inflation and the relative price variability and skewness of price changes in the Philippines. Data on the distribution of the price changes and inflation and the availability of the monthly series of variances and skewness allowed us to analyse the corresponding asymmetry of the distribution. Consistent with the methodology used in Ball and Mankiw (1995), we estimated the asymmetry indices for each month over the sample period of January 1994 to June 2019. The procedure for the estimation of the asymmetry indices is given in Annex 5. The output of the estimation produces the index for measuring the asymmetry of the distribution of disaggregated price changes/inflation for each month. Figure 5 plots two measures of asymmetry. The upper panel is based on the distributions over time of the month-on-month inflation figures for the 94 disaggregated CPI items. The lower panel measures asymmetry based on the distributions of MoM price adjustments (i.e., change in the CPI level) for the same cross-section of CPI items.

Estimates of the asymmetry index based on distributions of inflation data and CPI price level changes show consistency of results. For example, both charts in Figure 5 generally have the same peaks. Periods with large tails usually coincided with one-off periods where specific CPI items exhibited irregular spikes in inflation. This was the case for the peaks in January 1996 (start of the implementation of the Tax Reform Act of 1994 [Jurado, 2017]), January 1999 (period of higher food prices related to the occurrence of El Nino/La Nina and period of depreciating currency during the Asian Financial Crisis), January 2000 (higher prices of crude oil amid a newly deregulated downstream oil industry and major change in the base year and components of the CPI), January 2006 (implementation of the reformed value-added tax or RVAT Law and hikes in world crude oil prices), January 2008 (sustained increase in global oil prices that peaked at an all-time high in mid-2008), January 2010 (El Nino period), January 2012 (implementation of the "Sin Tax" Law), and January 2018 (implementation of a comprehensive tax reform package and the eventual rise in global oil prices and domestic rice supply issues).

The measures of asymmetry capture large movements in both relative prices and aggregate inflation. Moreover, applying various cut-off points for estimating asymmetry did not reduce the high correlation of the two measures. The use, therefore, of either of the two measures and the changing of the cut-off points should not affect the regressions and the corresponding interpretation of the regression results. Further analysis also yields the observation that the values of the asymmetry index are generally positive. This signifies an upward trend in price indices (i.e. positive inflation) over time, despite downward adjustments for some items for given periods.

Figure 5
Estimated Asymmetry Indices, January 1994-June 2019
(2012=100)





Source: Philippine Statistics Authority; Authors' calculations

4.1 Inflation and price asymmetry: some regressions

We use the asymmetry indices that were generated in the previous section to assess short-run inflation dynamics in the Philippines based on the following specification:

$$\pi_t = \alpha + \theta_\pi \pi_{t-1} + \theta_\sigma \sigma_t + \theta_\kappa \kappa_t + \theta_{Asym} Asym_t + \sum_{\forall i} \theta_i exo_{t,i} + \varepsilon_t \quad \text{Equation 4}$$

where:

π_t	=	short-run inflation (month-on-month CPI change, in percent)
α	=	constant for the regression
π_{t-1}	=	lagged π_t
σ_t	=	standard deviation of the distribution of disaggregated price changes over time *t*
κ_t	=	skewness of the distribution of disaggregated price changes for each period *t*
$Asym_t$	=	indicator variable for asymmetry (in index points), for each period *t*
$exo_{t,i}$	=	the other *i*th exogenous variable that significantly aggregate inflation (e.g. seasonality, output gap, oil prices, rice prices)
ε_t	=	period *t* error term for the regression
θ_π, θ_σ, θ_κ, θ_{Asym}, θ_i	=	are the respective coefficients of the explanatory variables

Results show that both measures of asymmetry have significant effects on short-run inflation (Table 4). This observation holds even if the moments of the distribution (i.e., standard deviation and skewness variables) and other exogenous variables (e.g. oil and rice prices) are added in the regression. Such result confirms the standard theoretical basis for Equation 4 which considers the addition of the moment variables and other exogenous variables as regressors for short-run inflation.

Skewness, which measures the symmetry of the whole distribution and not just the tails, was found to be significant when included in the regressions (columns 3 and 4). The standard deviation of the distribution of disaggregated price changes was significant in the regression, even with the inclusion of the rice price variable (column 4). However, the standard deviation was not significant when the regression adds oil prices (column 4). This was not surprising considering that the large volatilities or dispersions across a cross-section of CPI inflation occurred at the same time as that of (or even as a result of) higher global oil prices. There is an expected degree of correlation between variables for standard deviation and global oil prices. This also explains why world oil prices tend to lack statistical significance in its effect on inflation.

The adjusted R-squared ranges between 0.3515 and 0.5932. This is fairly comparable with the results in Ball and Mankiw (1995). Durbin-Watson tests indicate the rejection of serial correlation.

TABLE 4
Regression results using alternative measures of asymmetry

Dependent Variable: Inflation				
	(1)	(2)	(3)	(4)
Constant	0.2317	0.2307	0.1171	0.1251
	(0.0272)	(0.0250)	(0.3498)	(0.0311)
Lagged Inflation	0.2344	0.2315	0.2282	0.2358
	(0.0458)	(0.0424)	(0.0420)	(0.0412)
Asym_Adj*	67.2726		53.2560	60.7434
	(5.5462)		(6.7343)	(5.6416)
Asym_Inf*		23.8389		
		(1.5961)		
Standard Deviation			0.0666	0.0166
			(0.0218)	(0.0194)
Skewness			0.0310	0.0292
			(0.0050)	(0.0045)
Crude oil price				0.7261
				(0.4339)
Rice prices				7.5041
				(1.2454)
Adj. R-squared	0.3515	0.4450	0.4576	0.5932
D.W.	1.7829	1.6870	1.8091	1.8822

*** Asym_Adj pertains to the asymmetry index that is measured based on the distributions of CPI level changes while Asym_Inf is based on CPI inflation or percentage changes.*
N.B. Standard errors are in the parenthesis. Number of observations is 307

Regressions of aggregate inflation lead to an analysis of the Phillips curve when adding some output or employment variables in the equation. Table 5 presents the regression results of equation 4 with output gap and unemployment as additional explanatory variables. The output gap is not positive and it is not statistically significant, even as various proxy variables (real GDP growth) or transformations (i.e., in levels, percent or logs) are used. The coefficient of unemployment is significant but it is of the wrong sign (positive). We note that while these results may not be consistent with what are observed for advanced economies (e.g. for the US in Ball and Mankiw, 1995 and for Canada in Amano and Macklem, 1997), the empirical results are consistent with the Philippine experience. In the 1980s until the late 1990s, the Philippines registered low growth rates and high average inflation. However, starting in the late 2000s, the country started to achieve higher growth rates that were accompanied by generally lower and more stable inflation.

TABLE 5
Regression results using alternative measures of asymmetry

Dependent Variable: Inflation					
	(1)	(2)	(3)	(4)	(5)
Constant	-0.1460	0.1460	-0.2161	-0.1355	0.1448
	(0.0830)	(0.0388)	(0.0804)	(0.0739)	(0.0346)
Lagged Inflation	0.3186	0.2160	0.3020	0.2424	0.2286
	(0.0531)	(0.0426)	(0.0518)	(0.0500)	(0.0415)
Output Gap	-7.18E-07	-2.25E-06			-1.50E-06
	(1.27e-06)	(1.34e-06)			(1.17e-06)
Unemployment	0.0310		0.0338	0.0311	
	(0.0101)		(0.0098)	(0.0092)	
Asym_Adj*	160.3721	52.8072	146.8666	147.1478	60.3677
	(20.1422)	(6.7550)	(20.0018)	(18.2080)	(5.6419)
Standard Deviation	0.0121	0.0646	0.0583	-0.0002	0.0156
	(0.0230)	(0.0219)	(0.0273)	(0.2093)	(0.0193)
Skewness	0.0276	0.0316	0.0457	0.0276	0.0295
	(0.0045)	(0.0051)	(0.0076)	(0.0041)	(0.0045)
Standard Deviation			-0.0112		
x Skewness			0.0034		
Log Difference				0.3176	0.7676
of World Oil Price				(0.4039)	(0.4346)
Log Difference				7.2227	7.4640
of Domestic Rice Price				(1.1603)	(1.2442)

** Asym_Adj pertains to Asymmetry index as measured based on the distributions of CPI level changes while Asym_Inf is based on CPI inflation or percentage changes.*
n.b. Standard errors are in parenthesis.

The lessening sensitivity of prices to real economic activity (i.e., flattening of the Phillips curve) in the Philippine has been attributed to the adoption of inflation targeting (Guinigundo, 2017). Nonetheless, the IMF (2006) pointed out that while improved monetary policy credibility can account for a large part of the decline in the sensitivity of prices, more than half of the decline is accounted for by other factors, including global factors. In the case of the Philippines, increased trade openness is cited as an important factor that led to lower frequency of price changes and the lengthening of the duration between price adjustments in the economy. [9] Prices responded sluggishly to domestic demand pressures given increased trade and investment flows. Strong international competition constrained firms and businesses from increasing prices even when demand rises.

[9] Starting in the 1980s until the 2000s, the Philippine undertook key trade reforms and policies geared towards liberalization and improving the domestic economy's competitiveness. Between 1980s and early 1990s, the Philippines pursued trade reform programs that substantially reduced import tariffs. The country also acceded to the AFTA-CEPT (1993) and GATT-WTO (1995). In the 2000s, the Philippines pursued trade facilitation through regional and bilateral free trade agreements.

In Table 5, lagged inflation is positively significant across all the regressions, indicating the degree of persistence of past inflation performance. Meanwhile, the asymmetry variable is consistently observed to have a positive and significant effect across all regressions. The asymmetry variable, as a transformation of (or the differential between) the mass of the tails of the distribution of price changes, is by construction an indicator of the outliers in a cross-section of price changes of the disaggregated CPI items. This outlier effect is one of the possible information content of the asymmetry index that is generally independent of skewness and standard deviation.

Consistent with the results of the regressions, the standard deviation of the relative-price changes loses statistical significance when world oil price is included in the model as an exogenous variable. Similar to the interpretation of Amano and Macklem (1997), the information contained in oil prices of the distribution appear to be redundant. It duplicates the independent effects of the dispersion of disaggregated price changes on aggregate price conditions.

Without world oil prices in the Phillips curve regressions (columns 1, 2 and 3), the coefficient of standard deviation is positive and significant. This finding is consistent with the results of the menu cost framework in Ball and Mankiw (1994, 1995). In contrast to the results of standard Phillips curve-menu cost models, the effects of the interaction of skewness and standard deviation on aggregate inflation is found to be statistically insignificant. This lack of significance is the reason for dropping the interaction variable in the other regressions. The interaction variable relatively provides no new information under the described setup.

4.2 Subsample splitting and the structural changes between pre-inflation targeting (1994-2001) and inflation targeting (2002-2019) periods

Comparing between two periods (i.e. pre-OPEC, 1949 – 1969 and OPEC, 1970 – 1989), Ball and Mankiw (1995) observed the general stability of coefficients derived from the regression of aggregate inflation against asymmetry, skewness and standard deviation. The subsample regressions excluded food and energy variables as these were not statistically significant. Rather than these traditional measures of supply shocks, the asymmetry index turned out to be better measures of supply shocks over time (Ball and Mankiw, 1995).

As in Section 2 of this paper, we split the sample period into the pre-inflation targeting (1994-2001) and the inflation targeting (2002 – present) periods. The former is a much shorter subsample than the latter.

Corresponding changes in the magnitude and significance of the coefficients can be observed from the regression results for each subsample (Table 6). Lagged inflation, for instance, is not significant for the pre-inflation targeting period (columns 1 and 3) but becomes significant during the inflation targeting period (columns 2 and 4). Using lags as proxy for expected inflation (Amano and Macklem, 1997), this finding reflects the important role of inflation expectations during the inflation targeting period. Inference shows absence of evidence on the role of expectations or persistence during the pre-inflation targeting period, given the lack of significance of the coefficients of lagged inflation. The output gap

variable shows similar degrees of insignificance for both subsamples. Furthermore, its coefficients changed sign from positive (pre-inflation targeting period) to negative (inflation targeting period).

The asymmetry index is significant for both pre-inflation targeting and inflation targeting periods, while seeing an increase in the magnitude of its effects (coefficient) during the inflation targeting period. The coefficients of the asymmetry index in columns (2) and (4) are about three to four times the size of its coefficients in columns (1) and (3), respectively. Meanwhile, it is difficult to make conclusions about the role of standard deviation (i.e., dispersion of inflation in a cross-section the disaggregated CPI items) as its coefficients are generally not significant (for columns 1 and 2). In a Phillips curve setting (columns 3 and 4), the standard deviation was significant for the pre-inflation targeting period (column 3) but was not significant for the inflation targeting period (column 4). The larger dispersions during the pre-inflation targeting period (when compared to the inflation targeting period) could partly explain its greater role in explaining aggregate inflation during the said period.

Similar to the regression results presented in Tables 5 and 6, the skewness is significant and shows some stability in both the significance and magnitude of its coefficients. World oil prices (in logs) were not significant in the various regressions (columns 1 and 2). Meanwhile, domestic rice prices were not significant during the pre-inflation targeting but became significant during the inflation targeting period. Rice prices were more volatile during the pre-inflation targeting years which partly explains the observed less significance during this period. Overall, there is subsample stability of coefficients for the asymmetry, skewness and lagged inflation. As in Ball and Mankiw (1995), the role of traditional indicators of supply shock (food and energy) in the regressions of aggregate inflation may relatively "matter only because they induce asymmetry in the distribution of price changes."

Table 6
Subsample stability and possible structural changes
(pre-inflation targeting and inflation targeting periods)

Regressions with Oil and Rice Prices				
	Pre-inflation targeting (1994 – 2001) (1)	Inflation targeting (2002 – M9 2019) (2)	Pre-inflation targeting (1994 – 2001) (3)*	Inflation targeting (2002 – M9 2019) (4)*
Constant	0.2554	0.0893	0.2352	0.0736
	(0.0900)	(0.0309)	(0.0780)	(0.0384)
Lagged Inflation	0.0736	0.2691	0.0505	0.3455
	(0.0825)	(0.0485)	(0.0719)	(0.0511)
Output Gap			4.45E-07	-4.81E-07
			(3.88e-06)	(1.24e-06)
Asym_Adj*	53.5526	148.4848	38.1913	161.5308
	(10.8063)	(18.2205)	(10.5398)	(19.9755)
Standard	0.0069	(0.0059)	0.0951	0.0075
Deviation	(0.0482)	(0.0205)	(0.0426)	(0.0223)
Skewness	0.0574	0.0274	0.0546	0.0272
	(0.0187)	(0.0040)	(0.0139)	(0.0044)
Log Difference	1.9991	0.3759		
of World Oil Price	(1.4446)	(0.3992)		
Log Difference	4.1156	7.1419		
of Domestic Rice Price	(5.4819)	1.1516		
Adj. R^2	0.6839	0.5680	0.5177	0.4809
D.W.	1.6804	2.0515	1.9299	1.9729
No. of obs	47	209	94	209

** An alternative Phillips curve regression (i.e., columns 3 and 4) was tested with unemployment as a substitute for real GDP gap. The unemployment variable was significant but only during the inflation targeting period.*

** Asym_Adj pertains to Asymmetry index as measured based on the distributions of CPI level changes.*

N.B. Standard errors are in the parenthesis.

5. Concluding thoughts

In summary, this paper looked into the link between the distribution of relative price changes and short-run inflation in the Philippines. Disaggregated price data was used to determine whether the higher moments of the distribution of price changes provide information on the adjustments and persistence of aggregate domestic price conditions.

The analysis in this paper yielded important observations for prices in the Philippines. Some of these are in keeping with empirical observations in other countries. First, there is a close association between the variability of relative price changes and short-run inflation in the Philippines. Episodes of high inflation were characterized by higher levels of price change variability. To a lesser extent, higher price dispersion was also associated with a deflationary period. Second, the skewness of the distribution of price changes was observed to be

positively related to the movements in inflation. During periods of rising inflation, a positively skewed distribution signifies that some commodities are experiencing larger price changes relative to the others and these are putting upward pressure to the general level of prices. Third, the tails or shocks to prices of different goods and services can be isolated. Evidence from the Phillips curve regressions shows that these can have significant effects on overall inflation under certain conditions. Fourth, the higher moments of the price distribution can provide some explanation on the observed decline in the sensitivity of short-run inflation to demand pressures.

The assessment of the impact of inflation targeting on relative price movements showed that, between the pre-inflation targeting and inflation targeting periods, the frequency of price changes declined. Additionally, the duration between price adjustments increased from 1.4 months in the pre-inflation targeting period to 1.6 months in the inflation targeting period. These findings partly explain the decline in average inflation and low price volatility that the country experienced over the past 17 years. In a regression analysis, splitting the sample between the pre-inflation and inflation targeting periods in the Philippines indicated that the asymmetry and skewness of the distribution of price changes affect aggregate inflation in the Philippines.

From a policy standpoint, the finding that relative price changes can be inflationary in the short-run could complicate the conduct of monetary policy. Monetary policy cannot really affect relative price changes given that these are determined by developments in the real sector of the economy. Moreover, there are asymmetries in price adjustments which could also cause inflationary pressures in the short-run. These are insights that policymakers need to take into consideration in the conduct of monetary policy.

This paper provides an initial attempt to better understand inflation dynamics in the Philippines using disaggregated CPI data and analysing relative price changes. Going forward, further work in this area still needs to be done. For example, the reasons behind the asymmetry in price adjustments (i.e., motivation for menu costs) could be further explored. It would also be interesting to use a more disaggregated dataset, i.e. the 5-digit CPI items in order to further account for the heterogeneity and dispersion of price changes within markets (of the same product/sector) and across different markets.

References

Abenoja, ZR and J Basilio (2018): "Disaggregated CPI facts about Philippine inflation and some use of microdata for macronalysis", Paper presented at the 2018 Philippine Statistical Association, Inc. (PSAI) Annual Conference, 20 September.

Amano, RA and RT Macklem (1997): "Menu costs, relative prices, and inflation: evidence for Canada", Bank of Canada Working Paper, pp. 97-14.

Ball, L and G Mankiw (1994): "Asymmetric price adjustment and economic fluctuations", *The Economic Journal*, vol. 104, pp. 247 – 261, March.

——— (1995): "Relative-price changes as aggregate supply shocks", *Quarterly Journal of Economics*, vol. 110, pp. 161-193.

——— (1999): "Interpreting the correlation between inflation and the skewness of relative prices: a comment", *Review of Economics and Statistics*, vol. 81, pp. 197-198.

Blejer, MI (1983): "On the anatomy of inflation: the variability of relative commodity prices in Argentina", *Journal of Money, Credit and Banking*, vol. 15, pp. 469-482.

Bryan, MF and SG Cecchetti (1999b): "Inflation and the distribution of price changes: rejoinder", *Review of Economics and Statistics*, vol. 81, pp. 203-204.

Fischer, S (1981): "Relative shocks, relative price variability, and inflation", *Brookings Papers on Economic Activity*, vol. 1981-2, pp. 381-431.

——— (1982): "Relative price variability and inflation in the United States and Germany", *European Economic Review*, vol. 18, pp. 171- 196.

Friedman, M (1975): "Perspectives on inflation", *Newsweek*, June 24, p. 73.

Guinigundo, DC (2005): "Inflation targeting: the Philippine experience", in V. Valdepeñas Jr. (ed.), *The Bangko Sentral ng Pilipinas and the Philippine Economy*, Manila, Philippines: Bangko Sentral ng Pilipinas, pp. 346–391.

——— (2017): "Implementing a flexible inflation targeting in the Philippines", in V. Valdepeñas Jr. (ed.), *Philippine Central Banking: A Strategic Journey to Stability*, Manila, Philippines, Bangko Sentral ng Pilipinas.

Jurado, FJ (2017): "Proposed reforms on value-added tax", *NTRC Tax Research Journal*, vol XXIX.3, May-June.

Lucas, R (1973): "Some international evidence on output-inflation tradeoffs", *American Economic Review*, June, 63, pp. 326 – 334.

Mills, FC (1927): Behaviour of prices, New York: National Bureau of Economic Research.

Verbrugge, RJ (1999): "Cross-sectional inflation asymmetries and core inflation: a comment on Bryan and Cecchetti", *Review of Economics and Statistics*, vol. 81, pp. 199-202.

Vining, D and T Elwertowski (1976): "The relationship between relative prices and the general price level", *American Economic Review*, vol. 66, no 4, pp. 699-708.

Annex 1
Philippine Consumer Price Index for All Income Households by Commodity Group (2012=100)

1. Food and Non-Alcoholic Beverages	
Rice	Milk, cheese and eggs
Corn	Oils and fats
Bread and cereals	Fruits
Other cereals, flour, cereal preparation, bread, pasta and other bakery products	Vegetables
	Sugar, jam, honey, chocolate and confectionery
Meat	Food products n.e.c.
Fish and Seafood	Coffee, tea and cocoa
	Mineral water, soft drinks, fruit and vegetable juices
2. Alcoholic Beverages, Tobacco, and Other Vegetable-Based Tobacco Products	
Spirits	
Wine	
Beer	
Tobacco	
Other vegetable-based tobacco products	
3. Clothing and Footwear	
Clothing materials	Shoes and other footwear
Garments	Repair and hire of footwear
Other articles of clothing and clothing accessories	
Cleaning, repair and hire of clothing	
4. Housing, Water, Electricity, Gas and Other Fuels	
Actual rentals paid by tenants	Electricity
Materials for the maintenance and repair of the dwelling	Gas
	Liquid fuels
Services for the maintenance and repair of the dwelling	Solid fuels
Water supply	
5. Furnishings, Household Equipment and Routine Household Maintenance	
Furniture and furnishings	Glassware, tableware and household utensils
Carpets and other floor coverings	Major tools and equipment
Household textiles	Small tools and miscellaneous accessories
Major household appliances whether electric or not	Non-durable household goods
	Domestic services and household services
Small electric household appliances	
Repair of household appliances	

6. Health	
Pharmaceutical Products	Dental services
Other Medical Products	Paramedical services
Therapeutic appliances and equipment	Hospital services (in-patient services)
Medical services	

7. Transport	
Motorcycle	Other Services With Respect Of Personal Transport Equipment
Bicycle And Tricycle	Passenger Transport By Railway
Spare Parts And Accessories For Personal Transport Equipment	Passenger Transport By Road
Fuel And Lubricants For Personal Transport Equipment	Passenger Transport By Air
Maintenance And Repair Of Personal Transport Equipment	Passenger Transport By Sea And Inland Waterway

8. Communication	**9.**
Postal services	Telephone and telefax services
Telephone and telefax equipment	

9. Recreation and Culture	
Equipment for the reception, recording and reproduction of sound and pictures	Pets and related products
Photographic and cinematographic equipment and optical instruments	Recreational and sporting services
Information processing equipment	Cultural services
Recording media	Games of chance
Repair of audio-visual, photographic and information processing equipment	Books
Musical instruments and major durables for indoor recreation	Newspapers and periodicals
Games, toys and hobbies	Miscellaneous printed matter
Equipment for sport, camping and open-air recreation	Stationery and drawing materials
Gardens, plants and flowers	

10. Education	
Pre-primary education services	First stage of tertiary education services
Primary education services	Second stage of tertiary education services
Secondary education services	Education services not definable by level
Post-secondary non-tertiary education services	

11. Restaurants and Miscellaneous Goods and Services	
Restaurants, cafes, and the like	Jewelry, clocks, and watches
Hairdressing salons and personal grooming establishments	Other personal effects
Electric appliances for personal care	Other services, n.e.c.
Other appliances, articles and products for personal care	

Source: Philippine Statistics Authority

Annex 2
3-Digit CPI Items with missing data as per the period indicated

CPI Item	Weights	Period of Missing Data	
Other Vegetable-Based Tobacco Products	0.0008	Jan-94	Dec-11
Repair and hire of footwear	0.0015	Jan-94	Dec-05
Liquid fuels	0.1341	Jan-94	Dec-11
Carpets and other floor coverings	0.0038	Jan-94	Dec-05
Repair of household appliances	0.0057	Jan-94	Dec-05
Major tools and equipment	0.0025	Jan-94	Dec-05
Therapeutic appliances and equipment	0.0375	Jan-94	Dec-99
Paramedical services	0.0528	Jan-94	Dec-05
Motorcycle	0.6430	Jan-94	Dec-11
Bicycle and tricycle	0.1193	Jan-94	Dec-11
Maintenance and repair of personal transport equipment	0.1889	Jan-94	Dec-99
Other services with respect of personal transport equipment	0.0313	Jan-94	Dec-99
Passenger transport by railway	0.0676	Jan-94	Dec-99
Telephone and telefax services	2.5375	Jan-94	Dec-99
Photographic and cinematographic equipment and optical instruments	0.0149	Jan-94	Dec-05
Information processing equipment	0.3200	Jan-94	Dec-99
Repair of audio-visual, photographic and information processing equipment	0.0007	Jan-94	Dec-05
Musical instruments and major durables for indoor recreation	0.0113	Jan-94	Dec-05
Games, toys and hobbies	0.0521	Jan-94	Dec-05
Equipment for sport, camping and open-air recreation	0.0029	Jan-94	Dec-99
Gardens, plants and flowers	0.0140	Jan-94	Dec-05
Pets and related products	0.0538	Jan-94	Dec-05
Miscellaneous printed matter	0.0039	Jan-94	Dec-05
Pre-primary education services	0.1659	Jan-94	Dec-99
Primary education services	0.5360	Jan-94	Dec-99
Secondary education services	0.6401	Jan-94	Dec-05
Post-secondary non-tertiary education services	0.0650	Jan-94	Dec-99
Second stage of tertiary education services	0.2344	Jan-94	Dec-05
Education services not definable by level	0.0208	Jan-94	Dec-99
Electric appliances for personal care	0.0026	Jan-94	Dec-05
Jewellery, clocks and watches	0.0762	Jan-94	Dec-99
Other services, n.e.c.	0.1641	Jan-94	Dec-11

Source: Philippine Statistics Authority

Annex 3
The Data and Distribution of price adjustments

The main object of the current study is the dataset of disaggregated (consumer) price indices (CPI) at the 3-digit level. Such indices are published by the Philippine Statistical Authority (PSA) and consists of 94 items product types. This CPI data is extracted from PSA's CPI database that is available in its OPEN database platform. Data on weights (using the latest available base year of 2012) are separately downloaded since PSA. Once extraction is made, the database is processed as follows.

- Arrangement the raw CPI data to segregate Philippine (PH) CPI, National Capital Region (NCR) CPI and Areas outside NCR (AONCR) CPI from one another. CPI and corresponding Inflation based on PH CPI is what is referred to aggregate CPI and aggregate inflation, respectively.

- Each geographical unit above (namely, PH, NCR and AONCR) contains subsets of CPI that are coded with single digits (containing the 11 main subgroups of the headline CPI) and at a disaggregated level, with 3-digits (containing about 94 items).

- Out of the raw data, the main subgroups (1-digit CPI items) are sorted and separated from the 3-digit CPI items. The resulting 3-digit CPI items-only database form time series of the 94 CPI items.

  Each product type (3-digit CPI item) is heterogeneous (differs from the other products) and is generally based on (indexation of) a set of prices collected from various or dispersed sources (e.g. the stores or other vendors). The former (cross-section heterogeneity) pertains to the so-called "intermarket" differences in prices while the latter (dispersion of the source of store prices) refers to "intramarket" differences.

There are many factors that make the CPI subgroups differ from one another, e.g. weights (in the average consumer basket), degrees of import content, government control over the pricing structure in a specific industry, menu costs, market structures and supply shock patterns (i.e. seasonality, cyclicality and synchronization with the business cycles and unpredictability).

Annex 4
Descriptive statistics of the price change distributions
1994- M9 2019

Year	Mean	Standard deviation	Skewness	Kurtosis
1994	0.38	0.917	2.103	19.703
1995	0.66	1.101	2.978	23.833
1996	0.60	1.020	1.353	10.407
1997	0.53	1.085	0.857	11.022
1998	0.80	1.552	2.170	15.318
1999	0.32	1.369	1.760	18.346
2000	0.70	1.497	2.119	14.907
2001	0.30	0.888	1.249	13.521
2002	0.17	0.809	1.198	13.867
2003	0.21	0.914	0.457	14.098
2004	0.57	0.863	3.357	17.328
2005	0.48	0.768	2.698	13.362
2006	0.34	0.785	0.763	25.275
2007	0.30	0.723	2.344	31.903
2008	0.63	1.551	-2.179	22.921
2009	0.36	0.978	2.929	20.630
2010	0.30	0.896	1.766	28.364
2011	0.34	0.914	1.815	17.125
2012	0.24	1.062	0.548	23.173
2013	0.31	0.674	3.387	20.236
2014	0.16	0.617	-0.189	19.441
2015	0.06	1.003	4.185	27.493
2016	0.18	1.395	-0.696	40.120
2017	0.24	1.064	1.669	26.272
2018	0.42	1.430	3.584	24.978
M9 2019	0.16	2.020	0.159	49.312

Source: Philippine Statistics Authority; Authors' calculations

Annex 5
Procedure for the Estimation of the Asymmetry Indices

1. Assume a distribution of the price shocks (CPI changes in index points or as a percentage change, i.e. inflation) and apply to the data (fit the data into this distribution[10)] to be able to estimate the required parameters.

    - In the current case, a t-Location Scale Distribution is assumed.

2. Set a cut-off X, based on which the Asymmetry Index will be calculated for every period. This cut-off serves as the absolute value of the thresholds for determining the tails of the distribution. The upper tail consists of positive values that are higher than the positive cut-off (i.e., +X) while the lower tail consists of negative values that are lower than the negative cut-off (i.e., X).

    - For the MoM inflation data, "5 percent" was the cut-off (similar cut-off used in Ball and Mankiw, 1995)
    - For the MoM CPI price change/adjustment, "4 index points" was the cut-off

3. Inspect the histogram, as well as the probability density function and/or the cumulative distribution function (empirical CDF), to ensure that the results in the estimation of asymmetry would be consistent with graphical observations or intuition.[11]

4. Estimate the tail (mass or area of the tail) of the estimated probably density function (distribution function).

    - upper tail = relative price change greater than the positive cut-off (+X)
    - lower tail = relative price change lower than the negative cut-off (-X)
    - Given the fitted density or cumulative distribution estimates in Part I (based on an assumed distribution, such as the t-Location scale, log Gaussian, etc.), estimate tails for the given cut-offs as well as the differences between the left and right tails.[12]

[10] Ball and Mankiw (1995) employed skew-normal distribution.

[11] Here, a step from Ball and Mankiw (1995) was skipped. The step originally includes a relative price change variable that is based on the deviation of industry price change minus the mean price change. In the current research, such step is taken to be part of the robustness checks. Furthermore, Ball and Mankiw (1995) also applies industry weights to calculate monthly skewness and asymmetry indices. In the current paper, the weights applied to the variables as part of the empirical exercises that robustness checks.

[12] There are other ways to measure the tails (area under the tail of the curve), assuming other types of distributions. For example, we can measure the areas of the tail-rectangles in a histogram. We can also use a nonparametric method, e.g. via Kernel smoothing-Matlab function "ksdensity.m", to estimate areas of the tails.

5. Estimate the mass of the tails and apply the following formula to estimate the asymmetry:

AsymX = mass in the upper tail minus the mass in the lower tail as expressed in the following equation:

$$AsymX_t = \sum_{i=1}^{N} P_{i,t} LTail(X)_{i,t} - \sum_{i=1}^{N} P_i RTail(X)_{i,t} \quad \text{(Equation 5)}$$

where for each time period t and for all N disaggregated CPI items:

Pi,t is the price of disaggregated CPI item i

X is the constant cut-off, in absolute value, for determining the threshold for the left and right tails of the distribution of price changes

LTail(X)i,t is an indicator variable that has a value of 1 if the corresponding price change (in levels or in percent) of a CPI item i is lower than negative X.

*RTail(X)i,*t is an indicator variable that has a value of 1 if the corresponding price change (in levels or in percent) of a CPI item i is lower than positive X.

BANGKO SENTRAL NG PILIPINAS
BSP Working Paper Series

Scope: The Bangko Sentral ng Pilipinas (BSP) Working Paper Series constitutes studies relevant to central banking, which are conducted by BSP researchers and occasionally, in collaboration with external contributors. The topics may include monetary policy framework and operations, bank supervision, financial markets, macro-financial risks, payments and settlements system, digitalization, big data management and analytics for central banks, central bank communication, central bank governance and legal frameworks, among others.

Peer-reviewed: The BSP working papers are reviewed by the Editorial Committee, led by the Deputy Governor of the Monetary and Economics Sector. Completed working papers are published for the purpose of soliciting comments and discussion for further refinements. The views and opinions expressed are those of the author(s) and do not necessarily reflect those of the BSP.

Submissions: Authors may submit their manuscripts to the following addresses below:

- BSP.Working.Paper@bsp.gov.ph with the subject line that reads BSP Working Paper Series
- The Managing Editor, BSP Working Paper Series, Center for Monetary and Financial Policy, Room 402, 4/F, 5-Storey Building, BSP Main Complex, Malate, Manila

Editorial Guidelines:

- The title page of the manuscript must include the following: title, author's name, abstract describing the main arguments and conclusions of the article, affiliation, corresponding author, 3 - 5 keywords, JEL classification
- Manuscripts must be written in English and in MS Word format, text-aligned with 1.5 line spacing, 1" margins, font Segoe UI, font size 11.
- All graphs, tables, and footnotes must be in font Segoe UI, font size 9.
- Tables must contain only essential data and hence, must be kept to a minimum. Each figure and table must be given an Arabic numeral, followed by a heading.
- All diagrams, charts, and graphs must be referred to as figures and consecutively numbered.
- All figures and tables must be cited in the text.
- Headings and sub-headings must be clearly marked.
- References must be consistent with in-text citations.
- Manuscripts must adopt the Harvard referencing system or APA referencing system.

Authors must include in their submission all graphs and tables in Excel format. They must also ensure that their manuscripts are consistently referenced and free from typographical and presentation errors. The Editorial Committee and the Editorial Staff will not undertake any retyping of manuscripts before publication.

Website: http://www.bsp.gov.ph/publications/regular_wps.asp

List of BSP Working Paper Series

- Available at http://www.bsp.gov.ph/publications/regular_wps.asp

No	Author	Title	Date
2020-03	Veronica B. Bayangos, Rafael Augusto D. Cachuela and Fatima Lourdes E. Del Prado	Impact of Extreme Weather Episodes on the Philippine Banking Sector: Evidence Using Branch-Level Supervisory Data	June 2020
2020-02	Joselito R. Basilio and Faith Christian Q. Cacnio	Relative price changes, asymmetric adjustments and aggregate inflation: Evidence from the Philippines	June 2020
2020-01	Eloisa T. Glindro, Hazel C. Parcon-Santos, Faith Christian Q. Cacnio, Marites B. Oliva, and Laura L. Ignacio.	COVID-19 Exit Strategies: How Do We Proceed?	May 2020
2019-04	Charday V. Batac, Eduard Joseph D. Robleza I, Jan Christopher G. Ocampo, and Cherrie F. Ramos	BSPeak: A Text Analysis of BSP's Communications	November 2019
2019-03	Ramon Moreno, Hazel Parcon-Santos, and John Michael Rennie Hallig	A Preliminary Assessment of Drivers of Philippine FX Market Liquidity	October 2019
2019-02	Veronica B. Bayangos and Jeremy L. De Jesus	Have Domestic Prudential Policies Been Effective: Insights from Bank-Level Property Loan Data	March 2019
2019-01	Cherry Wyle G. Layaoen and Vernalin Grace F. Domantay	Do Capital Regulations Influence Banks' Holding of "Excess Capital"	March 2019
2018-01	Hazel C. Parcon-Santos	Foreign Exchange Interventions, Capital Outflows, and Financial Vulnerabilities in Selected Asian Emerging Economies	November 2018
2018-01	Roberto S. Mariano, Suleyman Ozmucur, Veronica B. Bayangos, Faith Christian Q. Cacnio, and Marites B. Oliva	Review of the Potential Output and Output Gap Estimation Models of the Bangko Sentral ng Pilipinas	October 2018
2017-01	Veronica B. Bayangos	Capital Flow Measures and Domestic Macro Prudential Policy in Asian Emerging Economies: Have These Been Effective?	June 2017
2016-02	Eufrocinio M. Bernabe, Jr., Hazel C. Parcon-Santos and John Michael Rennie G. Hallig	Spillovers in ASEAN-5 Equity Markets	July 2016
2016-01	Veronica B. Bayangos, Lilia V. Elloso, John Michael Rennie G. Hallig, Jodeth Niña R. Yeung and April Michelle D. Salamatin	The Impact of Foreign Exchange Liberalization Reforms on the Philippine Economy: An Initial Assessment	March 2016

No	Author	Title	Date
2015-01	Laura L. Ignacio, Hazel C. Parcon-Santos, Teresita B. Deveza, Maria Fatima C. Paule-de Leon, and Jean Christine A. Armas	Reformulating Effective Exchange Rates: Does the Exchange Rate Matter For Trade?	June 2015
2013-01	Francisco G. Dakila, Jr., Veronica B. Bayangos and Laura L. Ignacio	Identifying Sectoral Vulnerabilities and Strengths for the Philippines: A Financial Social Accounting Matrix Approach	July 2013
2012-02	Hazel C. Parcon-Santos and Eufrocinio M. Bernabe, Jr.	The Macroeconomic Effects of Basel III Implementation in the Philippines: A Preliminary Assessment	October 2012
2012-01	Veronica B. Bayangos	Going With Remittances: the Case of the Philippines	July 2012
2010-02	Eloisa T. Glindro and Vic K. Delloro	Identifying and measuring Asset Price Bubbles in the Philippines	June 2010
2010-01	Veronica B. Bayangos and Irene T. Estigoy	A Geometric Price Index for the Philippines: A Preliminary Assessment	March 2010
2009-01	Paul D. McNelis, Eloisa T. Glindro, Ferdinand S. Co, and Francisco G. Dakila, Jr.	Macroeconomic Model for Policy Analysis and Insight (a Dynamic Stochastic General Equilibrium Model for the BSP)	December 2009
2008-02	Agnes M. Yap and Cristeta B. Bagsic	Adjustments in the Face of Peso Volatility: Perspective from the Past and Policy Directions	September 2008
2008-01	Haydee L. Ramon	Forecasting the Volatility of Philippine Inflation Using GARCH Models	September 2008
2007-02	Francisco G. Dakila, Jr. and Racquel A. Claveria	Identifying the Determinants of Overseas Filipinos' Remittances: Which Exchange Rate Measure is Most Relevant?	January 2008
2007-01	Paul D. McNelis and Cristeta B. Bagsic	Output Gap Estimation for Inflation Forecasting: The Case of the Philippines	August 2007
2006-02	Cristela Goce-Dakila and Francisco G. Dakila, Jr.	Modeling the Impact of Overseas Filipino Workers Remittances on the Philippine Economy: An Inter-Regional and Economy-Wide Approach	September 2006
2006-01	Cristeta B. Bagsic and Eloisa T. Glindro	Bangko Sentral ng Pilipinas Modernization: A Policy Perpective PDF	August 2006

BSP International Research Conference Volume

Available at http://www.bsp.gov.ph/publications/regular_irc.asp

- BSP International Research Conference on "Revisiting Macro-Financial Linkages: Looking Back and Looking Ahead", 20-21 September 2016
- BSP International Research Conference on "The Evolving Role and Limits of Monetary Policy: New Perspectives for Emerging Market Economies", 28-29 October 2014
- BSP International Research Conference on "Contemporary Challenges to Monetary Policy", 28-29 February 2012
- 2010 Central Bank Macroeconomic Modeling Workshop, 19-20 October 2010
- BSP International Research Conference on Remittances, 30-31 March 2009
- Joint BSP-BIS High-Level Conference on Transparency and Communication in Monetary Policy, 01 February 2008