

Impact of relative price changes and asymmetric adjustments on aggregate inflation: evidence from the Philippines

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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 (ie 1994–2001) and inflation targeting (ie 2002–September 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.

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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. Friedman emphasised 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?" (Friedman (1974, p 74))

Accordingly, with an unchanged money stock, relative price adjustments are made 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 in this area (eg Vining and Elwertowski (1976), Fischer (1981), Amano and Macklem (1997)) have looked at the statistical relationship between the higher moments (ie 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 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 yield additional observations after controlling for the other factors that affect headline prices (eg oil prices, rice supply conditions, seasonality and business cycles). One

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

³ While a number of studies conducted 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, Verbrugge (1999). These authors argued that the observed correlation between inflation and its higher moments is 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.

particular factor that the paper takes into account in its analysis is the adoption of inflation targeting (IT) in the Philippines in 2002. The paper assesses the changes that may have occurred in relative price movements between the pre-IT (ie 1994–2001) and IT (ie 2002–September 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 suggests 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-IT and IT 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 IT period and the observed flattening of the Phillips curve.

The paper 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 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 (ie three-digit commodity groups)⁴ for the period January (M1) 1994–September (M9) 2019. The data set contains 94 items categorised under 11 major commodity groups (Table 1). Some of the CPI items have missing values. These items were either non-existent in the earlier part of the time series (eg mobile phones and phone cards in the early 1990s) or were not included in the CPI basket.

⁴ Disaggregated CPIs used in the study are coded with three digits (hence, the reference as three-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 three-digit CPI) in its statistical table releases, the analysis in this paper likewise treats rice, corn and other cereals as three-digit items.

CPI commodity groups (2012 = 100)

Table 1

	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.

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

1. Prices in the Philippines, on average, changed in about 75.6% of the months in the sample period (ie price increases and decreases). Between 1994 and M9 2019 (ie 308 months), there were 200 months when prices increased and 29 months when they decreased. Price increases, on average, occurred every 1.5 months while price decreases happened every 10.4 months.
2. Increases in prices were seven times more likely to occur than price decreases and almost three times more prevalent than no price change.
3. Prices stayed the same at an average rate of once every four months, or equivalently 24.4% of the entire period.
4. Price decreases, on average, accounted for a relatively small percentage at 12.7% of the total price changes (ie 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. Quite the opposite is the case for education and communication, where the frequencies of price changes are substantially lower than the others.

A significant policy shift that occurred over the 1994–M9 2019 sample period is the adoption of inflation targeting (IT) as the framework for monetary policy in the Philippines in 2002.⁵ Empirical studies (eg Guinigundo (2017)) have observed that changes occurred in the country's inflation dynamics following the adoption of IT. Inflation persistence gradually declined as the inflation process shifted from being

⁵ In January 2002, the BSP formally adopted inflation targeting as the framework for monetary policy. Based on initial assessments, the adoption of inflation targeting helped the country sustain a favourable inflation performance over the medium term (Guinigundo (2005)).

backward-looking to more forward-looking. 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.

To assess the potential impact of IT on price changes, we divide our sample period into 1994–2001 and 2002–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 (ie price increases and decreases) during the IT period (73.2%) relative to the pre-IT period (79.8%). The frequency of price increases declined significantly in the IT period (63.8%) compared to the 1994–2001 period (70.8%). Moreover, the proportion of price decreases and no price changes increased in the 2002–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 IT period relative to the pre-IT period. Most of the items in the food and non-alcoholic beverages commodity group (eg rice, other cereals, fish and seafood, milk, cheese and eggs) had a 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 cause 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. Meanwhile, 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 IT period relative to the pre-IT period.

The duration of the gaps between price increases was, on average, 1.4 months over the 1994–2001 period. This lengthened to 1.6 months in the 2002–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–M9 2019 period.

The observed decline in the frequency of price changes and the lengthening of the duration between price adjustments correspond to a period of lower average inflation in the economy. Inflation declined from an average of 7.6% between 1994 and 2001 to 3.8% in the 2002–M9 2019 period. The rates of price change for the different commodity groups likewise declined in the later period.

Frequency and duration of price changes: 1994–M9 2019, 1994–2001 and 2002–M9 2019, CPI commodity groups

2012 = 100

Table 2

	1994–M9 2019			1994–2001 (Pre-IT)			2002–M9 2019 (IT)		
	Increase	Decrease	No change	Increase	Decrease	No change	Increase	Decrease	No change
Total no of months	308			95			213		
<i>Frequency of price change (in no of months)</i>									
All items	200	29	7473	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 and other fuels	235	46	27	75	10	9	160	35	18
Furnishings, household 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 and services	262	10	37	82	4	9	170	8	35
<i>Share to total number of periods (in per cent)</i>									
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 and other fuels	76.3	14.9	8.8	79.4	11.0	9.6	75.1	16.2	8.5
Furnishings, household 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 and services	85.1	3.1	12.0	86.3	4.2	9.5	79.8	3.7	16.3

*Duration of gap 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	10.7	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 and other fuels	1.3	9.4	15.8	1.3	7.9	13.6	1.3	9.1	20.7
Furnishings, household 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
Education	5.4	44.3	1.3	4.6	20.6	1.4	5.1	50.7	1.3
Restaurants, miscellaneous goods and services	1.3	33.0	6.3	1.2	39.6	8.6	1.3	42.6	5.8

Details may not add up to total due to rounding.

Sources: Philippine Statistics Authority; authors' calculations.

3. Relative price change distribution and aggregate inflation

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 by the estimation and analysis of the corresponding (changing) shape of the distribution over time in terms of the second and third moments (ie standard deviation and skewness).

To estimate the frequency and magnitude of price changes for each j th three-digit level disaggregated (CPI) item, we use the following equations:^{6,7}

$$\text{Frequency of price changes: } F_j = \frac{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{NUM}_{ijt}}{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{DEN}_{ijt}} \quad (1)$$

$$\text{Frequency of price increases: } F_j^+ = \frac{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{NUMUP}_{ijt}}{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{DEN}_{ijt}} \quad (2)^8$$

$$\text{Average price increase in per cent } \bar{\Delta}_j^+ = \frac{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{NUMUP}_{ijt} (\ln P_{ijt} - \ln P_{ij,t-1})}{\sum_{i=1}^{n_j} \sum_{t=2}^t \text{NUMUP}_{ijt}} \quad (3)$$

where the price available at t is given as $\text{DEN}_{ijt} = 1$ if P_{ijt} and $P_{ij,t-1}$ are observed in t ; 0 otherwise. Price change at t is defined to be: $\text{NUM}_{ijt} = 1$ if $P_{ijt} \neq P_{ij,t-1}$; 0 otherwise.

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

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

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

The distribution of price changes was 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.

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.

⁶ These equations and corresponding descriptions are from Abenoja and Basilio (2018).

⁷ 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.

⁸ 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).

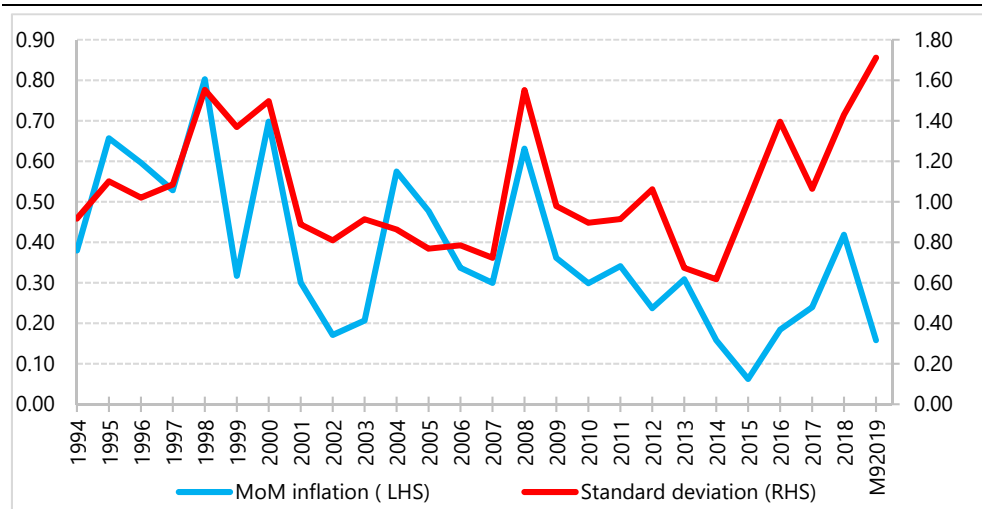
First observation: The variability of relative price changes is closely associated with movements in short-run aggregate inflation.

In Figure 1, 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 1 reveals that high variability of relative price changes in the Philippines points 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 (ie 1998, 2000, 2018) were attributed to supply side shocks. Still reeling from the impact of the 1997 Asian 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 prices and ample food supply largely contributed to the decline in the rate of inflation. An important observation that appears in Figure 1 is the low level of relative price variability between 2001 and 2007 despite high inflation rates in 2004–06 due to supply side shocks. A possible explanation for this is that the supply shocks that occurred during this period triggered second-round effects (ie increases 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% VAT to their consumers. The following year, in 2006, the national government increased the VAT rate for goods and services from 10% to 12%. These developments contributed to a permanent increase in the prices of most of the goods and services in the economy.

Inflation rate and standard deviation of relative prices

Month-on-month, in per cent

Figure 1



Sources: Philippine Statistics Authority; authors' calculations.

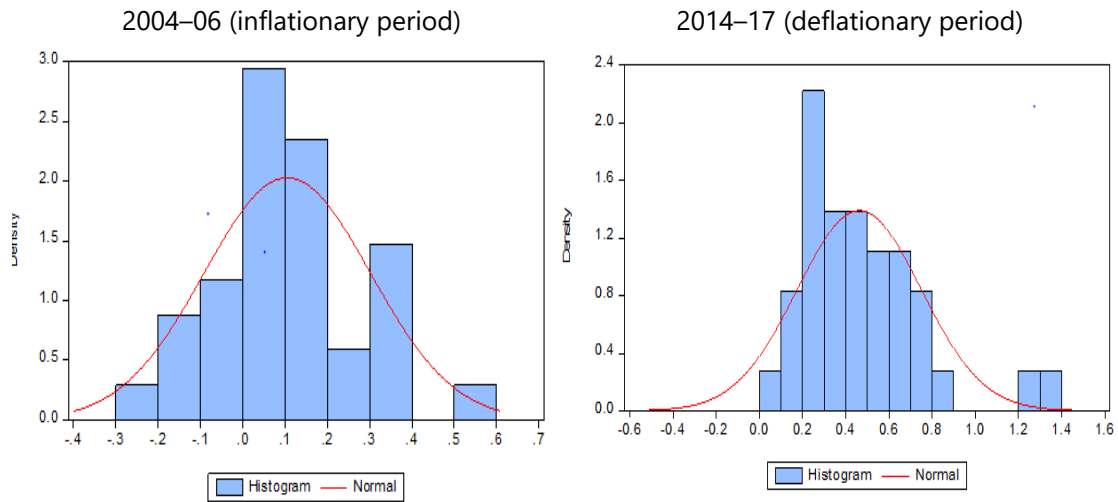
Figure 1 also reflects the observed decline in the volatility of inflation following the adoption of IT. Inflation volatility declined from an average of 2.5% in the 1994–2001 period to 2.0% in the period 2002–M9 2019. With the exception of 2008 and 2016, relative price variability remained relatively low over the 2002–18 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)).

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 changes. Moreover, a positively skewed distribution of relative price changes signifies 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–M9 2019 period relative to the 1994–2001 period.

We look at two particular periods in our data to see whether the skewness of the distribution of relative price changes provides information on the direction of aggregate inflation. The first period is 2004–06 (inflationary period) and the second is from the latter part of 2014 to early 2017 (deflationary episode). In Figure 2, 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.

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. In the Philippines, price pressures have always been attributed to supply side shocks, particularly to food, oil and energy items.

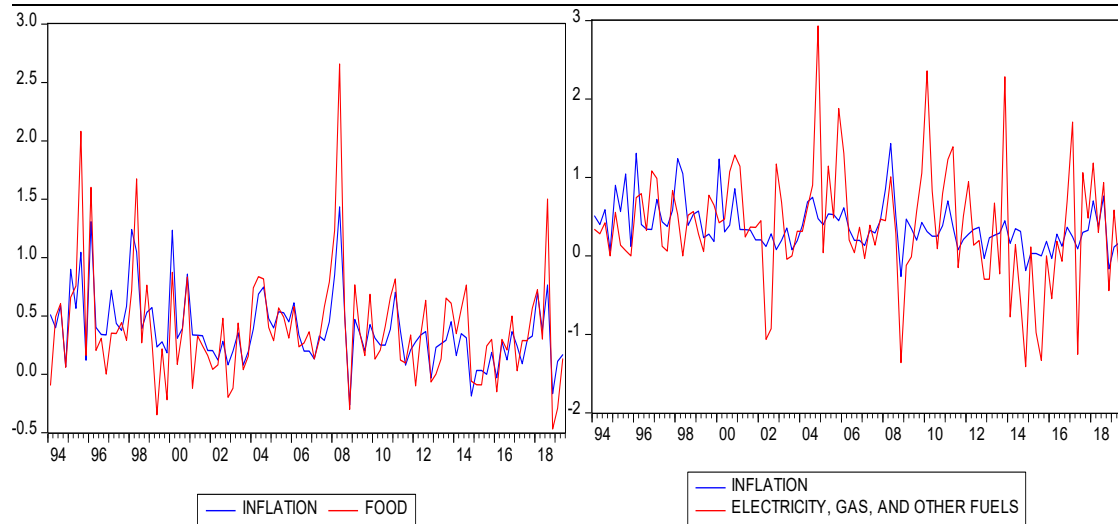


Sources: Philippine Statistics Authority; authors' calculations.

Figure 3 plots inflation against the price changes in food, oil and energy.⁹ The graphs show that, during periods of inflation (deflation), price changes in the food, oil and energy items are larger (smaller) than average inflation. This signifies that price changes in these commodities pull up (down) the general level of prices in the economy.

Inflation and relative price changes in selected commodities

Figure 3



Sources: Philippine Statistics Authority; authors' calculations.

⁹ 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

We looked at the asymmetry of the distribution of the price changes in the Philippines to see how it relates to the positive relationship observed for inflation and the relative price variability and skewness of price changes. 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 September 2019. The output of the estimation produces the index for measuring the asymmetry of the distribution of disaggregated price changes/inflation for each month. Figure 4 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 month-on-month difference in the CPI level for the same cross section of CPI items.

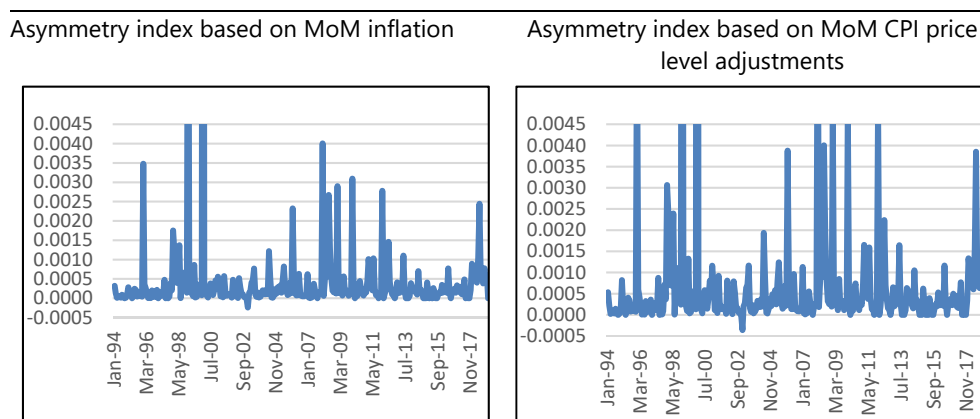
Estimates of the asymmetry index based on distributions of inflation data and CPI price level changes show consistency of results. For example, both charts in Figure 4 generally have the same peaks. Periods with large tails usually coincided with one-off periods where specific CPI items exhibited irregular spikes in inflation. This was the case for the peaks in January 1996 (due to the implementation of the expanded Value Added Tax (E-VAT) law (Jurado (2017))), January 1999 (period of higher food prices related to the occurrence of El Niño/La Niña and a period of depreciating currency during the Asian 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 VAT 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 Niño 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 cutoff 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 cutoff 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 (ie positive inflation) over time, despite downward adjustments for some items for given periods.

Estimated asymmetry indices, January 1994–September 2019

2012 = 100

Figure 4



Sources: Philippine Statistics Authority; authors' calculations.

4.1 Inflation and price asymmetry: some regressions

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

$$\pi_t = \alpha (4) \pi_{t-1} + \theta_\sigma \sigma_t + \theta_\kappa \kappa_t + \theta_{Asym} Asym_t + \sum_{vi} \theta_i exo_{t,i} + \varepsilon_t$$

where

- π_t = short-run inflation (month-on-month CPI change, in per cent)
- 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 affects aggregate inflation (eg seasonality, output gap, oil prices, rice prices)
- ε_t = period t error term for the regression
- $\theta_\pi, \theta_\sigma, \theta_\kappa, \theta_{Asym}, \theta_i$ are the respective coefficients of the explanatory variables.

Results show that both measures of asymmetry have significant effects on short-run inflation (Table 3). This observation holds even if the moments of the distribution (ie standard deviation and skewness variables) and other exogenous variables (eg oil and rice prices) are added into the regression. Such a 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 their effect on inflation.

Regression results using alternative measures of asymmetry				Table 3
Dependent variable: inflation				
	(1)	(2)	(3)	(4)
Constant	0.2317 (0.0272)	0.2307 (0.0250)	0.1171 (0.3498)	0.1251 (0.0311)
Lagged inflation	0.2344 (0.0458)	0.2315 (0.0424)	0.2282 (0.0420)	0.2358 (0.0412)
Asym_Adj ¹	67.2726 (5.5462)		53.2560 (6.7343)	60.7434 (5.6416)
Asym_Inf ²		23.8389 (1.5961)		
Standard deviation			0.0666 (0.0218)	0.0166 (0.0194)
Skewness			0.0310 (0.0050)	0.0292 (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
DW ³	1.7829	1.6870	1.8091	1.8822

Standard errors are in parentheses. Number of observations: 307.

¹ Asym_Adj pertains to the asymmetry index that is measured based on the distributions of CPI level changes. ² Asym_Inf is based on CPI inflation or percentage changes. ³ DW = Durbin-Watson test.

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.

Regressions of aggregate inflation lead to an analysis of the Phillips curve when adding some output or employment variables into the equation. Table 4 presents the regression results of equation (4) with output gap and unemployment as additional explanatory variables. The output gap is not positive or statistically significant, even as various proxy variables (real GDP growth) or transformations (ie in levels, per cent or logs) are used. The coefficient of unemployment is significant but of the wrong sign (positive). We note that while these results may not be consistent with those observed for advanced economies (eg the United States in Ball and Mankiw (1995) or Canada in Amano and Macklem (1997)), the empirical results are consistent with the Philippine experience. In the 1980s and 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.

The lessening sensitivity of prices to real economic activity (ie flattening of the Phillips curve) in the Philippines has been attributed to the adoption of IT (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 it 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.¹⁰ 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 rose.

In Table 4, 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 items 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 appears 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.

¹⁰ Starting in the 1980s and until the 2000s, the Philippines undertook key trade reforms and policies geared towards liberalising and improving the domestic economy's competitiveness. Between the 1980s and early 1990s, the Philippines pursued trade reform programmes 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.

Philips curve equations

Table 4

Dependent variable: inflation					
	(1)	(2)	(3)	(4)	(5)
Constant	-0.1460 (0.0830)	0.1460 (0.0388)	-0.2161 (0.0804)	-0.1355 (0.0739)	0.1448 (0.0346)
Lagged inflation	0.3186 (0.0531)	0.2160 (0.0426)	0.3020 (0.0518)	0.2424 (0.0500)	0.2286 (0.0415)
Output gap	-7.18E-07 (1.27e-06)	-2.25E-06 (1.34e-06)			-1.50E-06 (1.17e-06)
Unemployment	0.0310 (0.0101)		0.0338 (0.0098)	0.0311 (0.0092)	
Asym_Adj ¹	160.3721 (20.1422)	52.8072 (6.7550)	146.8666 (20.0018)	147.1478 (18.2080)	60.3677 (5.6419)
Standard deviation	0.0121 (0.0230)	0.0646 (0.0219)	0.0583 (0.0273)	-0.0002 (0.2093)	0.0156 (0.0193)
Skewness	0.0276 (0.0045)	0.0316 (0.0051)	0.0457 (0.0076)	0.0276 (0.0041)	0.0295 (0.0045)
Standard deviation x Skewness			-0.0112 (0.0034)		
Log difference of world oil price				0.3176 (0.4039)	0.7676 (0.4346)
Log difference of domestic rice price				7.2227 (1.1603)	7.4640 (1.2442)
Adj R ²	0.5069	0.4606	0.5279	0.5955	0.5943
DW ²	1.9637	1.7952	2.0008	2.0672	1.8751
No of observations	192	304	195	192	257

Standard errors are in parentheses.

¹ Asym_Adj pertains to Asymmetry index as measured based on the distributions of CPI level changes. ² DW = Durbin-Watson test.

4.2 Subsample splitting and possible structural changes between the pre-IT (1994–2001) and IT (2002–19) periods

Comparing between two periods (ie pre-OPEC, 1949–69 and OPEC, 1970–89), 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 at measuring supply shocks over time (Ball and Mankiw (1995)).

As in Section 2 of this paper, we split the sample period into the pre-IT (1994–2001) and IT (2002–19) 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 5). Lagged inflation, for instance, is not significant for the pre-IT period (columns 1 and 3) but becomes significant during the IT 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 IT period. Inference shows an absence of evidence on the role of expectations or persistence during the pre-IT 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-IT period) to negative (IT period).

The asymmetry index is significant for both periods, while seeing an increase in the magnitude of its effects (coefficient) during the IT 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 draw conclusions about the role of standard deviation (ie dispersion of inflation in a cross section of 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-IT period (column 3) but not significant for the IT period (column 4). The larger dispersions during the pre-IT period (when compared to the IT period) could partly explain its greater role in explaining aggregate inflation during that period.

Similar to the regression results presented in Tables 4 and 5, the skewness is significant and shows some stability in both the significance and the 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-IT period but became significant during the IT period. Rice prices were more volatile during the pre-IT years, which partly explains the observed lower significance during this period. Overall, there is subsample stability of coefficients for asymmetry, skewness and lagged inflation. As stated 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”.

Subsample stability and possible structural changes
(pre-IT and IT periods)

Table 5

	Regressions with oil and rice prices			
	Pre-IT (1994–2001) (1)	IT (2002–M9 2019) (2)	Pre-IT (1994–2001) (3) ¹	IT (2002–M9 2019) (4) ¹
Constant	0.2554 (0.0900)	0.0893 (0.0309)	0.2352 (0.0780)	0.0736 (0.0384)
Lagged inflation	0.0736 (0.0825)	0.2691 (0.0485)	0.0505 (0.0719)	0.3455 (0.0511)
Output gap			4.45E-07 (3.88e-06)	–4.81E-07 (1.24e-06)
Asym_Adj ²	53.5526 (10.8063)	148.4848 (18.2205)	38.1913 (10.5398)	161.5308 (19.9755)
Standard deviation	0.0069 (0.0482)	0.0059 (0.0205)	0.0951 (0.0426)	0.0075 (0.0223)
Skewness	0.0574 (0.0187)	0.0274 (0.0040)	0.0546 (0.0139)	0.0272 (0.0044)
Log difference of world oil price	1.9991 (1.4446)	0.3759 (0.3992)		
Log difference of domestic rice price	4.1156 (5.4819)	7.1419 (1.1516)		
Adj R ²	0.6839	0.5680	0.5177	0.4809
DW ³	1.6804	2.0515	1.9299	1.9729
No of observations	47	209	94	209

Standard errors are in parentheses.

¹ An alternative Phillips curve regression (ie columns 3 and 4) was tested with unemployment as a substitute for the output gap. The unemployment variable was significant but only during the IT period. ² Asym_Adj pertains to Asymmetry index as measured based on the distributions of CPI level changes. ³ DW = Durbin-Watson test.

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 characterised 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 on 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 IT on relative price movements showed that, between the pre-IT and IT periods, the frequency of price changes declined. Additionally, the duration of the gap between price adjustments increased from 1.4 months in the pre-IT period to 1.6 months in the IT 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-IT and IT periods indicated that the asymmetry and skewness of the distribution of price changes affect aggregate inflation in the Philippines.

Going forward, further work in this area still needs to be done. For example, the reasons behind the asymmetry in price adjustments (ie motivation for menu costs) could be further explored. It would also be interesting to use a more disaggregated data set, ie the five-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.

The observations from this paper contribute to a better understanding of inflation dynamics in the Philippines, which is important for monetary policy. The finding that relative price changes can be inflationary in the short run could complicate the conduct of monetary policy. While monetary policy can influence inflation, it cannot really affect relative price changes. Monetary policy likewise needs to take into account the asymmetries in price adjustments which could also cause inflationary pressures in the short run. These are important considerations that policymakers need to keep in mind.

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