



Policy Note: PN2401

An Alternative Representation of CPI Inflation of Bangladesh: Diffusion Index (DI) Approach

Rupok Chad Das*
Alok Roy

July 2024

Economic Modeling and Forecasting Wing
Research Department
Bangladesh Bank

** The authors of this policy note are Deputy Director and Joint Director respectively in the Research Department of Bangladesh Bank. The authors would like to express humble gratitude to Dr. Sayera Younus, Executive Director (Research), Bangladesh Bank for her kind instruction, guidance, and insight. However, any remaining errors are solely of the authors. Views expressed in this policy note are the authors own, and do not reflect the views of the institution they work. Queries and questions are welcome and can be sent to rupok.chad@bb.org.bd, alok.roy@bb.org.bd.*

Table of Contents

1	Introduction	1
2	Diffusion Index: Calculation, Scenarios & Their Implications	3
3	CPI Diffusion Index of Bangladesh	4
4	Limitations & Some Technical Notes	7
5	Conclusion	7
	References	8
	Annexure A	9
	Annexure B	10

List of Figures

1	CPI Inflation and Diffusion Indices (m-o-m)	4
2	CPI Inflation and Diffusion Indices (y-o-y) with Old Base	6
B1	Movement of Index and the Inflation Rates: Headline, Food & Non-food	10

List of Tables

1	Different Scenarios & Implications	3
2	Values of CPI Diffusion Index & Inflation (m-o-m)	5
3	Category-wise Weights of the CPI Components	5
A1	Diffusion Index (m-o-m) of the CPI Components	9

An Alternative Representation of CPI Inflation of Bangladesh: Diffusion Index (DI) Approach

Rupok Chad Das

Alok Roy

Abstract

The intention of this policy note is to calculate the Diffusion Index (DI) of CPI inflation for the economy of Bangladesh, which will facilitate a deeper understanding of the overall direction or pattern of inflationary dynamics. This DI can be a very convenient tool as it can point towards the trend of change, craft comparison based on time and/or sub-group, analyze, and, most importantly act as an early warning indicator. From the technical front, proportionate increase and decrease in the CPI products, excluding the generic category and sub category these belong to, has been calculated using traditional growth formula using the data prepared by Bangladesh Bureau of Statistics (BBS). Addressing the rebasing of CPI basket, this article focuses on the DI from April'23 to onwards. Except the month of August'23, the subsequent months (September'23 to March'24) have shown a linear and positive relationship between value of DI and rate of CPI inflation. In terms of policy perspective, the relationship between DI and inflation may help to dissect product or category-wise inflation dynamics more precisely which can, in turn, help the policymakers to work out necessary course of action for the problematic products or categories.

1. Introduction

The economy of Bangladesh is one of the fastest growing economies of the world and is now being considered as a role model in terms of growth and development. In the premise of the growth impetus, the economy of Bangladesh is currently undergoing some form of unease circumstances in some areas and the recent persistent and rising trend in inflation is perhaps the most disturbing one. Other than the Covid-19 pandemic, geopolitical crisis between the Russia and Ukraine war is believed to affect the stability of the Bangladesh economy badly especially from the external fronts. Even though the global economy has almost recovered from the pandemic related shocks and the supply disruptions have seen normalization to a great extent, the economy of Bangladesh continues its' suffering from continual and high trend of inflation. Depreciation of domestic currency against US\$, periodic damage of foods grains production are contributing for the domestic inflationary pressure in Bangladesh.

Policymakers are resorting to as much ways as available to understand inflation dynamics. In line with this, Bangladesh Bank has recently adopted some of the international best practices to forecast the CPI inflation and started using the outcomes for better preparation of the policy stance intended to stabilize inflation. Of the other south Asian countries, India and Sri Lanka

are using DI for better understanding of the inflation dynamics. DI, although don't conform to that of the sophisticated models, proves quite handy to comprehend the trend of the inflation especially in recent data points.

This article is designed to formulate a very elementary DI of CPI inflation for the economy of Bangladesh, which will facilitate understanding the overall direction and pattern of inflation dynamics, especially in recent data points. Although its theoretical basis is very simple, the findings were impressive enough to depict inflation dynamics. The technical analysis involves calculating the proportional increase and decrease in the CPI products. The calculation excludes the generic category and its subcategories, and the traditional growth formula is used in this analysis. DIs with the prior CPI basket were shown; however, while discussing them, this article emphasised current CPI DIs.

The concept of DI originated from the fact that business cycles in aggregate are in most of the cases invariably preceded by a notable regular cycle in the proportion of individual activities undergoing expansion. Although not in the current form, the concept of developing an index from the cyclical pattern of leading and coincident indicators was originally developed at the National Bureau of Economic Research (NBER) in 1950s. This crude concept was further shaped by the economists to develop different versions and usage of DIs ([Broida, 1955](#) & [Moore, 1961](#)). DI traces out the common tendency within a group of variables that share common or unique features by taking directions of change during identical intervals in the components of economic aggregates. DI is assumed to be closely correlated with the rates of change in the corresponding aggregates. The most common usage of DI is in the share market to signal whether the market is bullish or bearish in nature. Furthermore, while examining the product, price, sales, and production aggregates, DIs can be a very convenient tool for observing any cyclical diffusion.

However, in case of weighted aggregates, DI provides information on the direction of change (the portion of an entity that intends for a positive or negative a change), but not on the intensity of change (the amount of that change) which depends on the weight of the components included in the process. In our economic system, economic movements spread from one economic process to another, and these movements cumulate over time. DI is a measure showing how this spreading and cumulation goes on over time. Due to the fact that most high-frequency variables share some common features, DI is handy enough to be used for forecasting macroeconomic aggregates like CPI inflation as it can depict the direction of the path of inflation ([Stock & Watson, 2022](#)). Because of the simplicity of the index, policymakers are using it to illustrate certain high-frequency macroeconomic variables, like inflation. The rest of this article is organised as follows. In the following [section 2](#), measurement equation of DI and implications for inflation dynamics under different possible scenarios are discussed. [Section 3](#) presents the

DI for CPI inflation of Bangladesh. [Section 4](#) highlights some limitation and technical notes about the version of DI presented in this article. Finally, [section 5](#) concludes with some policy implications.

2. Diffusion Index: Calculation, Scenarios & Their Implications

The fundamental notion of DI is to indicate the direction of change in an overall index, which may encompass numerous weighted individual components and sub-categories. There exist many variations of DI, all of which adhere to this basic premise. However, this article adopts a rudimentary and convenient version of the DI computation, which can be defined as follows:

$$\text{Diffusion Index}(DI) = \frac{(N_i - N_d)}{N_T} \times 100 \quad (1)$$

where,

N_i = Number of Increasing Components

N_d = Number of Decreasing Components

N_T = Number of Total Components

A unidirectional relationship between the DI and the rate of inflation is generally anticipated. This implies that the rate of inflation is assumed to be greater during periods when the values of DI indices are high, and vice versa. Nevertheless, there might be certain instances that deviate from this norm. The following [Table 1](#) summarizes the different scenarios that may happen.

Table 1: Different Scenarios & Implications

Scenarios	DI & Rate of Inflation	Implications
Scenario I	Higher DI & Higher inflation	Unidirectional relation between variables of interest
Scenario II	Lower DI & Lower inflation	Unidirectional relation between variables of interest
Scenario III	Higher DI but Lower inflation	Opposite direction between variables of interest, and this happens when the products whose prices have gone up possess a comparatively lower weight in total within the CPI basket
Scenario IV	Lower DI but Higher inflation	Opposite direction between variables of interest, and this happens when the products whose prices have fallen possess a comparatively lower weight in total within the CPI basket.

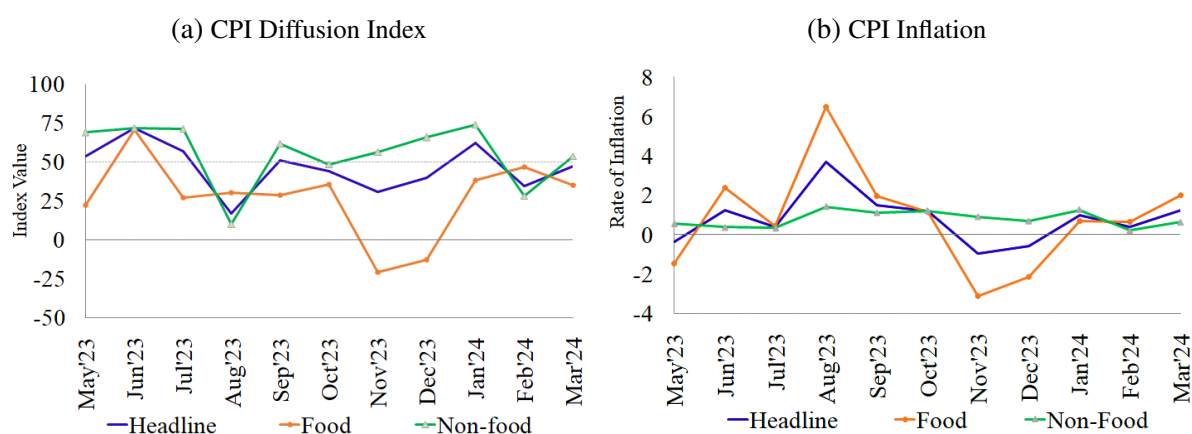
Source: Authors' Calculation

3. CPI Diffusion Index of Bangladesh

In this article, the diffusion index has been calculated from the components of the CPI basket that are provided by the Bangladesh Bureau of Statistics (BBS). At present, based on the Classification of Individual Consumption by Purpose (COICOP) of the United Nations Department of Economic and Social Affairs, BBS produces the Consumer Prices Index (CPI) of Bangladesh's economy, considering 2021-22 as base and weights are derived from the Household Income and Expenditure Survey (HIES) 2016-17 of BBS. Starting from April 2023, BBS is providing Consumer Price Index (CPI) statistics using the current base period and classification.

This article specifically examines the dynamics and relationship between DI and CPI inflation, based on the current CPI basket and base. DIs are computed for the headline CPI, as well as the food and non-food CPI, when the aforementioned relationship is examined. It may be mentioned that, due to the rebasing and classification issues of the current CPI basket, year-on-year (y-o-y) DI calculation was rendered impracticable as past observations with the same base and CPI products were unavailable. Consequently, the scope of this article is restricted to the explanation of the month-on-month (m-o-m) DI and CPI inflation. However, [Figure 2](#) illustrates y-o-y DIs for the old CPI base for the purpose of providing information. It is important to note that the dynamics of the m-o-m diffusion index may be more pertinent when DI is regarded as one of the early warning indicators.

Figure 1: CPI Inflation and Diffusion Indices (m-o-m)



Source: BBS, Authors' Calculation

To calculate the DI, firstly, m-o-m price increases and decreases in the products have been calculated using the traditional growth formula to find the net change in the number of CPI products that have experienced positive or negative growth during the period under consideration. Secondly, after finding the number of increased and decreased components, DIs were constructed using [Equation \(1\)](#). Apart from this, the generic and sub-categories have been

excluded during the calculation, only the price changes of individual products are taken into consideration¹. The relationship between CPI inflation and DI is illustrated in Figure 1 using the indices calculated from the aforementioned steps and the index values are summarised in Table 2. Some specific values created during the steps of DI calculation (number of increased, decreased, and stable CPI components in each month and corresponding DI) are provided in Table A1 of Annexure A. In this article, DI is defined in a manner that indicates a broader expansion or spread of price increases when the value exceeds 50, and a broader decline in prices across items when the reading is below 50. In other words, a DI value greater than 50 indicates that the number of CPI products experiencing price increases is greater than the number of CPI products with stable or decreased prices, and a value lower than 50 denotes the opposite.

Table 2: Values of CPI Diffusion Index & Inflation (m-o-m)

DI & Inflation	May'23	Jun'23	Jul'23	Aug'23	Sep'23	Oct'23	Nov'23	Dec'23	Jan'24	Feb'24	Mar'24
Headline DI	53.4	71.5	56.5	16.8	50.8	44.2	30.9	39.8	62	34.3	47.4
Headline Inflation	-0.35	1.26	0.39	3.69	1.51	1.19	-0.95	-0.59	1.01	0.41	1.26
Food DI	22.2	70.6	27	30.2	28.6	35.7	-20.6	-12.7	38.1	46.8	34.9
Food Inflation	-1.47	2.39	0.44	6.51	1.99	1.17	-3.11	-2.14	0.70	0.66	2.03
Non-food DI	68.8	71.9	71.1	10.2	61.7	48.4	56.3	65.6	73.8	28.1	53.5
Non-food Inflation	0.56	0.37	0.34	1.41	1.10	1.21	0.91	0.69	1.26	0.22	0.63

Source: BBS, Authors' Calculation

Table 3: Category-wise Weights of the CPI Components

Category	Weights	May'23	Jun'23	Jul'23	Aug'23	Sep'23	Oct'23	Nov'23	Dec'23	Jan'24	Feb'24	Mar'24
Headline	WIC _H	59.3	67.46	52.53	56.55	68.35	67.63	56.66	58.12	86.13	77.01	59.07
	WDC _H	23.91	2.93	11.82	29.29	22.28	31.13	37.53	41.34	13.37	22.29	12.8
	WSC _H	16.79	29.61	35.64	14.16	9.37	1.23	5.8	0.54	0.5	0.7	28.13
	Difference	35.39	64.54	40.71	27.26	46.07	36.5	19.13	16.78	72.76	54.72	46.27
	Total	100	100	100	100	100	100	100	100	100	100	100
Food	WIC _F	18.72	37.18	23.07	26.87	25.22	19.36	20.24	11.2	36.41	36.23	33.74
	WDC _F	23.91	2.93	10.75	17.98	19.13	24.87	24.62	33.66	8.45	8.55	10.1
	WSC _F	2.23	4.75	11.04	0	0.51	0.63	0	0	0	0.07	1.02
	Difference	-5.2	34.25	12.33	8.89	6.09	-5.51	-4.38	-22.46	27.96	27.68	23.64
	Total	44.86	44.86	44.86	44.86	44.86	44.86	44.86	44.86	44.86	44.86	44.86
Non-Food	WIC _{NF}	40.58	30.28	29.46	29.67	43.14	48.27	36.43	46.92	49.72	40.77	25.33
	WDC _{NF}	0	0	1.07	11.31	3.15	6.27	12.91	7.68	4.92	13.73	2.7
	WSC _{NF}	14.56	24.86	24.61	14.16	8.85	0.61	5.8	0.54	0.5	0.63	27.11
	Difference	40.58	30.28	28.39	18.37	39.99	42	23.51	39.24	44.8	27.04	22.63
	Total	55.14	55.14	55.14	55.14	55.14	55.14	55.14	55.14	55.14	55.14	55.14

WIC= Summation of the weights of the Increasing Components of CPI Basket;

WDC= Summation of the weights of the Decreasing Components of CPI Basket;

WSC= Summation of the weights of the Stable Components of CPI Basket;

H =Headline Index; F =Food Index; NF = Non-Food Index; Difference=WIC-WDC, Total= WIC+WDC+WSC

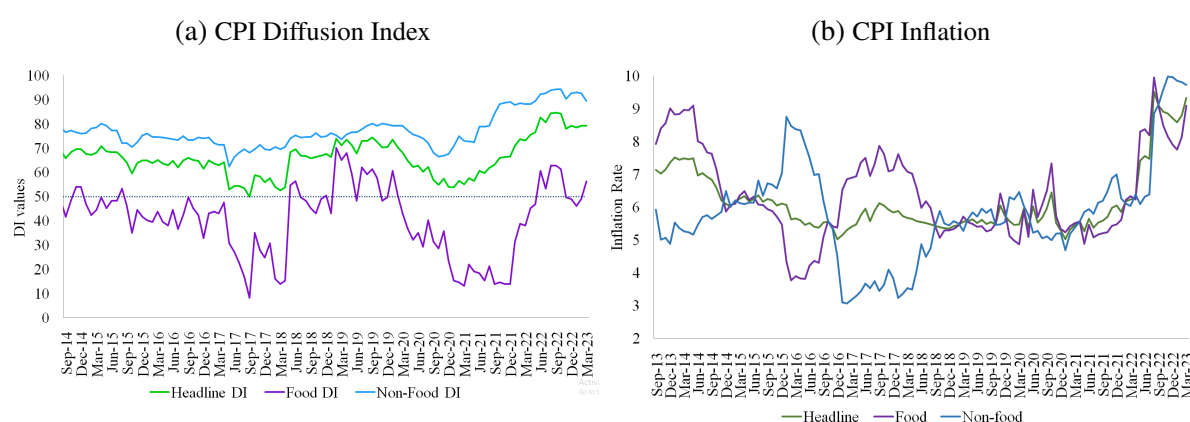
Source: BBS, Authors' Calculation

¹Sub-category refers to the category within which a particular product belongs, and generic category refers to the category within which sub-categories belong. Only the national indices for each of the products in the CPI basket have been considered for DI calculation.

The headline DIs during May-September'23 (except August'23) are above 50, which resembles positive m-o-m headline inflation during that period. During October'23 to December'23, headline DIs are below 50, and this period corresponds to negative m-o-m headline inflation. The values of DI for food indices are lower for most of the months except June'23, indicating that only fewer food items have witnessed price rises during the period under review. DI values for non-food items are high (above 50) and thus signify that a high number of non-food items have seen price rises in this period, which corresponds to higher non-food m-o-m inflation.

The computational principle of DI articulates that the index and inflation rate ought to move in similar direction, however, exceptions may arise due to the varying weights of the CPI components. The movement of DI and the inflation rate is found to follow a similar direction with one exception in August'23. The movements of the DIs of headline, food, and non-food with the respective inflation rates are illustrated in [Figure B1 of Annexure B](#). Higher headline inflation even if the DI value is low, was observed in the month of August'23. The number of headline CPI items experiencing lower prices compared to the previous month turned out to be significantly greater (143 items out of 382 items) in August'23, which was only 22 items in July'23 ([Table 3](#)). The number of stable headline CPI items also dropped significantly to 32 items in August'23. As a result, the headline DI became lower (16.75) in August'23. This lower DI value has not been communicated in the inflation scenario. The reason for this is that the number of CPI items that have experienced reduced prices has comparatively smaller weights (29.29) than the number of items that have experienced higher price (55.56). The category-wise weights relevant with DI calculation are listed in [Table A1](#). Despite the fact that the number of non-food CPI experiencing price drops in August'23 was larger and consequently provided lower DI, the non-food inflation was higher due to the same reason explained above. The fact that CPI items with larger weights have a greater impact on inflation rates can be captured easily by the DI.

Figure 2: CPI Inflation and Diffusion Indices (y-o-y) with Old Base



Source: BBS, Authors' Calculation

4. Limitations & Some Technical Notes

As previously stated, the m-o-m DI may be more useful in analysing the dynamics of inflation. Given that the monthly CPI is susceptible to seasonality, it would be more reasonable to derive DI from data that has been corrected for seasonality. However, the short data span of the CPI with the existing base and classification limits the scope of seasonal adjustment. Despite the fact that there is a longer data range available for seasonal adjustment using the old CPI base and classification, it would be extremely uncommon to extract sensible forward-looking guidance from the obsolete CPI classification. In addition, the short data range also restricts this article to analyse y-o-y based DI of current CPI series.

The first step in any DI calculation for weighted aggregates like CPI is to identify change in product price over a specified period. This article defines the change in prices by considering every difference in price as a dispersion. There are a variety of ways to redefine the dispersion in product prices. If a product's price changes by less than a specific threshold (say, 1 percent), it may be considered unchanged. Furthermore, one may incorporate the standard deviation of a price series while setting a specific threshold. Due to the limited availability of data, this article was unable to analyse any thresholds.

5. Conclusion

Inflation dynamics for Bangladesh's economy have been quite volatile in recent times due to supply disruptions and altered trade dynamics fueled by the aftermath of the geopolitical crisis emanating from the Russia-Ukraine war. Effective and comprehensive design of remedial policy measures for the containment of inflation within the expected range demands a better understanding of the dynamics of inflation from various viewpoints. The CPI diffusion index introduced in this article is found to have a clear and meaningful relationship with the CPI inflation rate. The associated information relating DI also provides additional insights about the inflation dynamics. Policymakers may examine the CPI diffusion index to identify any distortions and understand the reasons for volatility. Apart from the definition introduced in this article, other versions of DI can be constructed to dissect the changes in CPI inflation. Furthermore, there are scopes for using the diffusion index for forecasting purposes as well. Bangladesh Bank may monitor the CPI diffusion index on a regular basis to understand inflation dynamics, which can in turn help policymakers to formulate inflation related policies better.

References

- i. Broida, A. L. (1955). Diffusion indexes. *The American Statistician*, 9(3), 7–16.
<https://doi.org/10.2307/2681458>
- ii. Moore, G. H. (ed.). (1961). Diffusion indexes, rates of change, and forecasting. In *Business Cycle Indicators: Vol. 1*, Princeton University Press. [National Bureau of Economic Research]. <https://www.nber.org/chapters/c0729>
- iii. Stock, J. H., & Watson, M. W. (2002). Macroeconomic Forecasting Using Diffusion Indexes. *Journal of Business & Economic Statistics*, 20(2), 147–162.
<https://doi.org/10.1198/073500102317351921>

Annexure A: Headline, Food & Non-food Diffusion Index

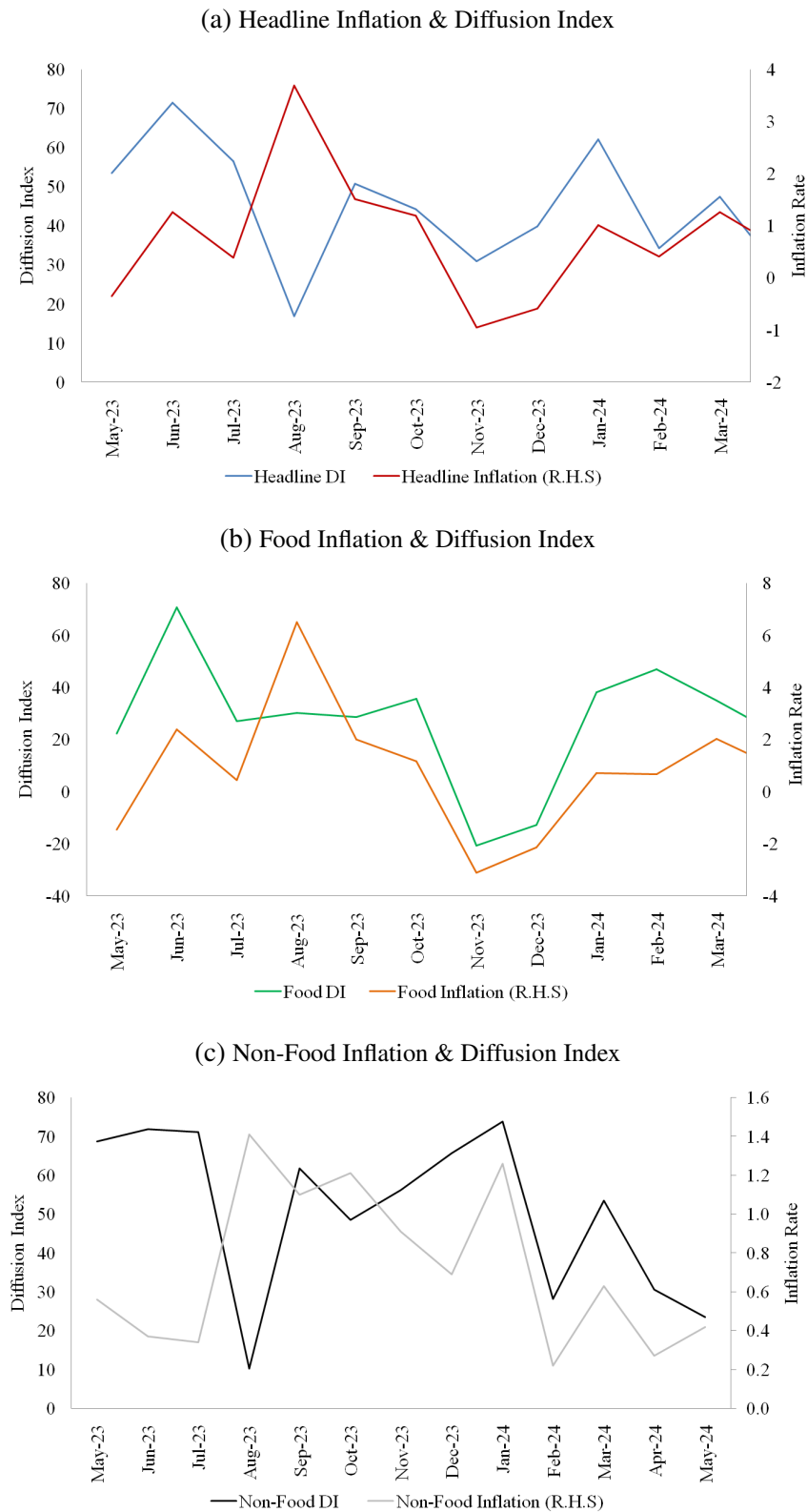
Table A1: Diffusion Index (m-o-m) of the CPI Components

Category	Number of Products & DI	May'23	Jun'23	Jul'23	Aug'23	Sep'23	Oct'23	Nov'23	Dec'23	Jan'24	Feb'24	Mar'24
Headline	Increase	245	278	238	207	275	272	240	266	309	252	228
	Decrease	41	5	22	143	81	103	122	114	72	121	47
	Stable	96	99	122	32	26	7	20	2	1	9	107
	Total	382	382	382	382	382	382	382	382	382	382	382
	Increase as %	0.64	0.73	0.62	0.54	0.72	0.71	0.63	0.70	0.81	0.66	0.60
	Decrease as %	0.11	0.01	0.06	0.37	0.21	0.27	0.32	0.30	0.19	0.32	0.12
	Difference	0.53	0.71	0.57	0.17	0.51	0.44	0.31	0.40	0.62	0.34	0.47
	DI for headline CPI	53.4	71.47	56.54	16.75	50.79	44.24	30.89	39.79	62.04	34.29	47.38
Food	Increase	69	94	52	82	80	84	50	55	87	92	82
	Decrease	41	5	18	44	44	39	76	71	39	33	38
	Stable	16	27	56	0	2	3	0	0	0	1	6
	Total	126	126	126	126	126	126	126	126	126	126	126
	Increase as %	0.55	0.75	0.41	0.65	0.63	0.67	0.40	0.44	0.69	0.73	0.65
	Decrease as %	0.33	0.04	0.14	0.35	0.35	0.31	0.6	0.56	0.31	0.26	0.3
	Difference	0.22	0.71	0.27	0.30	0.29	0.36	-0.21	-0.13	0.38	0.47	0.35
	DI of food CPI	22.22	70.63	26.98	30.16	28.57	35.71	-20.6	-12.7	38.1	46.83	34.92
Non-Food	Increase	176	184	186	125	195	188	190	211	222	160	146
	Decrease	0	0	4	99	37	64	46	43	33	88	9
	Stable	80	72	66	32	24	4	20	2	1	8	101
	Total	256	256	256	256	256	256	256	256	256	256	256
	Increase as %	0.69	0.72	0.73	0.49	0.76	0.73	0.74	0.82	0.87	0.63	0.57
	Decrease as %	0	0	0.02	0.39	0.14	0.25	0.18	0.17	0.13	0.34	0.04
	Difference	0.69	0.72	0.71	0.10	0.62	0.48	0.56	0.66	0.74	0.28	0.54
	DI for non-food CPI	68.75	71.88	71.09	10.16	61.72	48.44	56.25	65.63	73.83	28.13	53.52

Source: BBS, Authors' Calculation

Annexure B: Movement of Diffusion Index and the Inflation Rates: Headline, Food & Non-food

Figure B1: Movement of Index and the Inflation Rates: Headline, Food & Non-food



Source: BBS, Authors' Calculation