Inflation expectations of households: do they influence wage-price dynamics in India?

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Abstract

This paper examines the usefulness of survey based measures of inflation expectations to predict inflation using hybrid versions of New Keynesian Phillips Curve (NKPC). While both 3-months ahead and 1-year ahead inflation expectations of households emerge statistically significant in explaining and predicting inflation in India, effectively they work as substitutes of backward looking expectations given that household expectations are found to be largely adaptive. Unlike in other countries, this paper does not find much evidence on flattening of the Phillips curve. When transmission of inflation expectations to inflation is assessed through wage dynamics, it is found that inflation expectations of households influence growth in staff costs in services sector activities, but not in manufacturing. No robust evidence is found, however, on expectations induced wage pressures influencing CPI inflation.

JEL Classification: E52; E24, E31, P24.

Keywords: Inflation Expectations; Phillips Curve; Wage-Price Dynamics.

1 Introduction

Inflation and unemployment are the two prominent sources of economic misery in an economy. High inflation expectations, by shifting the short-run Phillips curve up, can give rise to either higher inflation at unchanged rate of unemployment or higher unemployment at unchanged rate of inflation (Sinclair, 2009). A credible central bank committed to the price stability objective could anchor inflation expectations and thereby reduce economic misery on both counts. First, when inflation overshoots the target, particularly due to temporary supply shocks, the employment/output sacrifice needed for disinflating the economy would be much lower; and second, by ensuring price stability around the growth maximising rate of inflation (or the threshold inflation) it could contribute in the best possible way to sustainable high growth and employment. The magnitude of economic misery that high inflation expectations could pose, thus, depends on agents' perception about credibility of a central bank's commitment to price stability.

It is crucial for monetary policy to assess how much the headline inflation may deviate from the target because of elevated inflation expectations, and what are the near-term and medium-term ramifications for growth and employment of either forcefully resisting or accommodating risks to inflation from inflation expectations, no matter what may be driving such expectations. If inflation expectations are not anchored by credible monetary policy, even if one assumes that expectations are purely adaptive, both supply shocks and demand shocks can set off an inflation spiral. Supply shocks like temporary increase in food and fuel prices could push inflation up (and reduce output), as a result of which adaptive inflation expectations could rise, which in turn could spillover through wage-price setting responses of agents to increase inflation further. Similarly, a positive demand shock could increase inflation (and also output), but adaptive expectations would fuel an even stronger inflation spiral, backed by expansion in income[1]. Longer monetary policy waits before resisting to break the spiral, higher could be the sacrifice of output and employment in the medium-run. In turn, if monetary policy resists proactively recognizing the risk of an inflation spiral because of de-anchored inflation expectations,

[1] Expectations induced wage-price spiral requires a tight labour market condition. Along with high inflation expectations as per the household survey, one should also look at household survey results on the outlook for income and employment and actual wage/compensation growth data to assess risks to inflation from high inflation expectations (Meyer, 2011).

there could be some near-term sacrifice of output, which, however, would be comparatively less. Once expectations are anchored through credible commitment to keep inflation closer to the target, even when supply and demand shocks lead to inflation deviating from the target, return to equilibrium would be faster and also less costly. Empirical research shows that adoption of inflation targeting (with credible commitment to the target) and central bank transparency (on following a rule or providing clarity on how monetary policy will respond when anticipated and unanticipated risks to inflation materialize) reduce sensitivity of longer-term inflation expectations to shocks to inflation, implying thereby firmer anchoring of expectations (Ha, Kose, & Ohnsorge, 2019).

An inflation targeting monetary policy framework, because of its clarity on the nominal anchor, demonstrated commitment to the inflation target, and transparent communication on what a central bank may do if inflation deviates from the target as different feasible shocks materialise, helps in anchoring expectations. In other words, even when short-run shocks lead to occasional overshooting/undershooting of the inflation trajectory, inflation expectations may still remain little changed, thereby limiting risks in terms of altering the wage and price setting behaviour of agents in the economy. When inflation deviates from the target in the short-run because of a temporary shock, monetary policy credibility becomes the key factor to prevent inflation expectations from getting influenced by the shock. If expectations are well anchored around the target, policy could "look through" the price level impact. However, if expectations are not anchored and tend to firm up in response to short-run adverse shocks, then second round effects on inflation become a concern. After the global financial crisis, countries having well anchored inflation expectations seem to have also benefitted in terms of their capacity to manage adverse global spillovers, *i.e.*, even when exchange rate comes under depreciation pressure in response to sudden capital outflows in such economies, smaller exchange rate pass-through and lower inflation persistence help in faster return of inflation to the target (International Monetary Fund, 2018).

Inflation expectations, despite their importance to assess inflation dynamics in a country, however, are not directly observable, leading to use of either survey based or financial market based measures of expectations in empirical research. Survey based inflation expectations often turn out to be better predictors of actual inflation than model based

estimates or financial market data. An assessment of survey based data on inflation expectations covering both advanced and emerging economies suggests that household expectations are higher and more volatile than inflation expectations of professional forecasters. The latter are closer to inflation forecasts of central banks (Ha *et al.*, 2019). While inflation expectations are generally heterogeneous for different agents, in South Africa, for example, longer-term expectations of analysts generally remain within the inflation forecast band (of 3 to 6 per cent), whereas expectations of households, businesses and trade unions usually remain above the upper band of the inflation target, besides being more volatile (Miyajima & Yetman, 2018).

In India, 3-months ahead and 1-year ahead inflation expectations of households are collected through quarterly surveys by the Reserve Bank of India (RBI), which are widely used for the assessment of inflation outlook, *i.e.*, likely risks to the inflation trajectory from possible spillover of inflation expectations through the wage-price setting processes in the economy. What one often fails to recognise in such assessments, however, is the distinction between longer-term inflation expectations and shorter-term inflation expectations. "*…Short-term inflation expectations, in practice those for one- to two-years ahead, should vary with the business cycle and shocks to the economy. Longer term inflation expectations, usually thought of as those five years out or more, are anchored if the variations in short-term expectations do not affect their level significantly…*" (Posen, 2011). In the empirical literature that aims at examining either how well inflation expectations are anchored or whether inflation expectations can predict future inflation, accordingly, longer-term inflation expectations (of 5-years ahead that are less sensitive to short-term shocks to inflation) collected through survey of professional forecasters/consensus forecasts are often used, which usually validate inflation expectations as a key determinant of inflation, besides providing evidence on the extent of anchoring under different monetary policy regimes/in different countries (International Monetary Fund, 2018). Empirical literature nevertheless also suggests that when household inflation expectations are considered, they may outperform both lags of actual inflation and survey of professional forecasters (Doser, Nunes, Rao, & Sheremirov, 2017).

Even though longer-term household (HH) inflation expectations data are not available for India (unlike the Michigan inflation expectations survey in the US for five years), given

the extensive references to quantitative and qualitative data on inflation expectations of households in the assessment of inflation dynamics in India, this paper aims at examining the forward looking information content of both 3-months ahead and 1-year ahead inflation expectations of households from the stand point of their relevance to the wage-price dynamics. Recent empirical findings suggest that the inflation expectation channel of monetary policy works in India while the output gap channel is weak (Goyal & Parab, 2019)

Inflation expectations carry the risk of stoking a wage-price spiral. Inflation expectations induced generalised wage pressures can often be inflationary, particularly when excess demand conditions allow easy pass-through of higher wage costs to output prices. In the absence of excess demand, however, the scope for spillovers from inflation expectations to output prices through higher wages could be limited, even as lower profit margins at times may absorb some part of the higher wage costs for some time. In turn, in the presence of excess demand, easy pass-through of wage costs and higher mark ups may allow firms to offer higher wages to retain/motivate labour, leading to a situation where high prices also drive higher wages. Changes in labour productivity can at times obscure this assessment, *i.e.*, higher wages may just reflect higher productivity rather than excess demand conditions. Because of backward wage indexation, higher wages at times may also reflect lagged actual inflation. Thus, a measure of economic slack, trend labour productivity growth and inflation expectations represent the key determinants of nominal wages (International Monetary Fund, 2017). Non-availability of high frequency data on productivity and employment can complicate assessment of both current inflation dynamics and risks to the inflation outlook. When high frequency data on unemployment and productivity are not available, however, wage growth itself could be used as a useful early warning indicator of inflation. To the extent that survey based data on household inflation expectations could be a determinant of nominal wage growth, they may also be useful to predict wage and price inflation.

Set against this context, Section 2 examines the utility of survey based data on inflation expectations to explain inflation dynamics in India in a New Keynesian Phillips Curve (NKPC) framework. The shape of the Phillips curve in India is evaluated in Section 3 in the context of the global debate about challenges to the conduct of monetary policy posed

by flattening of the Phillips curve. How household inflation expectations influence the wage setting behaviour in India is analysed in section 4. Concluding observations are presented in Section 5.

2 Household Inflation Expectations in the Phillips Curve

While the theoretical debate on the subject of inflation expectations suggests extreme possibilities – the neo-classical endogenous model-consistent forward-looking rational expectations on the one hand and the Keynesian exogenous backward-looking expectations on the other – the real life expectation formation processes could be best explained by a hybrid New-Keynesian Phillips Curve (NKPC) that allows roles for both backward and forward-looking information (Hubert & Mirza, 2018; Taylor, 1982). Given that hybrid Phillips Curve specifications fit data well and also that actual inflation dynamics often exhibit persistence, the micro founded justification for hybrid NKPC comes from the assumption that a subset of firms, not all, set prices following a backward looking approach. "*… While the rational expectations revolution has allowed for great leaps in macroeconomic modelling, the surveyed empirical micro-evidence appears increasingly at odds with the full-information rational expectation assumption* (Coibion, Gorodnichenko, & Kamdar, 2018)."

While the assumption of rationality is crucial to theoretical policy frameworks, understanding of changing dynamics in an economy may generally be imperfect, and all agents that form expectations may also not know exactly the objective function of the policy maker (Bernanke, 2007). Expectation formation could be a rational learning process and "*…learning takes time, the economic scene changes continuously, information is costly and not all persons have equal opportunities for access to same information set*" (Visco, 2014) .Given that expectations are unobservable, survey based expectations provide necessary information to test the relevance of rational expectations and assess their predictive power in analysing inflation dynamics. As against the model-consistent version of expectations propounded by (Muth, 1961), directly measured expectations from survey data have been used widely for empirical validation of the role of expectations in monetary policy analysis. "… Relative to a number of popular alternative measures of inflation expectations (lagged inflation, professional surveys, Greenbook expectations, and the Cleveland Fed expectations), consumer expectations yield the most stable Phillips curve

(CPI-based) and provide the best fit during recent years. In a horse-race of inflation expectations, consumer expectations remain a strong predictor of inflation. (Olivier, 2017)." Survey based expectations, however, may often yield significantly different results from those hypothesised under rational or model-consistent expectations.

In the theoretical and empirical literature the treatment of inflation expectations in a Philips Curve framework to study inflation dynamics has changed significantly over time (Gordon, 2011). All broad approaches - the expectations augmented Philips curve, the new Keynesian Philips Curve (NKPC) and the hybrid versions of NKPC – however emphasise that inflation expectations can influence current inflation. In the Gordon triangle approach, inertia, demand and supply are the three key determinants of inflation. As per this approach, past inflation reflects generalised inflation inertia; the role of supply shocks (which could shift the short-run Philips curve) is explicitly recognised; and, output-gap can be used as a convenient proxy of demand conditions. The key point to note in this approach is that when past inflation influences current inflation that reflects generalised backward looking inertia – arising from either explicit/explicit contracts dampening the speed of changes in prices and wages, or input price changes possibly taking longer time to transmit through the supply chain to final prices – rather than backward looking inflation expectations. In NKPC, however, forward looking inflation expectations that respond rationally to policy changes play a key role in influencing inflation. Thus, unlike the Gordon approach, this approach does not recognise any role of inertia or supply shocks, the latter usually getting suppressed in the error term (Equation 1).

$$\pi_t = \alpha E_{t-k}\pi_t^e + \beta OG + \epsilon_t \qquad \ldots (1)$$

Where π_t is inflation, $E_{t-k}\pi_t^e$ is inflation expectation taken in time period $t-k$ for time period t, Y is output, and Y^* is potential output, OG is output gap defined by $\frac{Y-Y*}{Y^*} \times 100$, ϵ_t is error term satisfying properties of a white noise. As NKPC does not fit real life data well, hybrid versions of NKPC (Clarida, Gali, & Gertler, 1999) are commonly used in practice (Equation 2)[2].

[2] In empirical estimates when the output gap coefficient is insignificant, that could reflect either output gap is a poor proxy of marginal cost (because only under certain restrictions on technology and labour market structure that output gap could be a proxy of marginal cost) or incorrect measurement of output gap. In pure versions of NKPC, with no role for backward looking expectations or intrinsic inflation inertia, current

$$\pi_t = \alpha_b \pi_{t-1} + \alpha_f E_t \pi_{t+1} + \beta OG + \mu Z_t + \epsilon_t \ldots . (2)$$

Unlike the emphasis of NKPC on model consistent rational expectations, hybrid expectations are backward looking as well as forward looking, with the relative size of each (when α_b and α_f are constrained to add up to one, or even otherwise) being a country specific empirical issue. Supply side shocks (Z_t) are explicitly recognised as plausible determinants of inflation. ϵ_t is a white noise error term.

While using survey based measures of inflation expectations as proxies of forward looking expectations in the above specifications, one needs to recognise that if household expectations are not rational[3] then such data cannot be used in NKPC, but in hybrid versions of NKPC survey based data on expectations may actually work well. In Poland, empirical estimates suggested that survey based measures of inflation expectations (of consumers, financial market participants, and business enterprises) perform better than model-consistent rational expectations in forecasting inflation (Lyziak, 2016). While several empirical studies on India validate the significance of Phillips curve to explain variations in inflation - notwithstanding differences in the specification of the Phillips curve or in the choice of inflation variable - we add a new dimension to this research by applying household inflation expectations as a proxy of forward looking expectations for testing the performance of the Phillips Curve in explaining inflation dynamics in India (for a review of empirical studies on India please refer to Behera, Wahi, & Kapur, (2017)). Using consensus forecast data in NKPC (augmented with imported inflation, *i.e.*, international commodity prices) Guimaraes & Papi (2016) found both forward looking and backward looking components of expectations as key determinants of CPI inflation in India, with their respective weights coming close to half. At higher inflation levels, greater inertia (or backward looking expectations) suggested higher sacrifice ratio.

inflation is essentially discounted future marginal costs, *i.e.*, prices are set by firms on assessment of future demand and cost conditions, and if monetary policy can credibly commit to keep output gap zero in future, disinflation without sacrifice of output is possible. In real life, however, disinflation involves sacrifice of output.

[3] Sharma & Bicchal (2018) used data on wholesale price index (WPI) inflation (for the sample period Q4: 2006 to Q2: 2015) and Das (2014) used data on WPI and CPI-C (for the sample period September 2008 to December 2013) to test the rationality of household inflation expectations in India.

Importantly, commodity prices turned out to exert influence on inflation over and above what may be already captured in inflation expectations. Patra, Khundrakpam, & George, (2014) tested alternative specifications to establish the relevance of backward looking nature of Phillips curve for India to explain wholesale price inflation dynamics, but argued that inflation persistence may have four components, including inflation expectations measured by one period ahead inflation. Given the challenge of measuring inflation expectations, instead of any survey based data, they used one period ahead actual inflation, and their estimated coefficient at 0.6 was close to the value of the coefficient of intrinsic persistence (or backward looking inflation). Patra & Ray (2010) extracted model based inflation expectations to study what factors influence expectations and concluded that past inflation, food and fuel shocks, output gap and real interest rate can explain variations in inflation expectations. Model consistent rational expectations are incorporated in the framework used by Benes *et al.* (2017), under which the expectation formation process is endogenous to monetary policy credibility (*i.e.*, expectations are more backward looking when the credibility is low). Examining the Phillips curve relationship at the state level, Behera *et al.* (2017) also confirmed the significance of Phillips curve to explain inflation dynamics in India, but they assumed expectations to be adaptive in all specifications of the Philips curve. Das (2014), using lead WPI inflation as the proxy of forward looking expectations over the sample period Q2:1996 to Q4:2013, and imposing the restriction that the sum of the coefficients for forward looking and backward looking expectations is equal to one, concluded that the coefficient of backward looking expectations generally dominated forward looking expectations, implying high degree of inflation persistence and resultant lagged impact of monetary policy on inflation.

Given the available empirical support for the relevance of Phillips curve to India, we attempt to examine the explanatory power of household inflation expectations in explaining variations in CPI-C and CPI-Urban inflation in hybrid versions of the Phillips curve. The RBI survey of inflation expectations of households, conducted since 2005[4] on

[4] According to Das, Lahiri, & Zhao (2016), the RBI's first survey started in September 2005, and only qualitative information was the focus in the first two rounds, collected from four major cities. From the third round in 2006, quantitative information (3-months ahead and 1-year ahead) from twelve cities started being collected. Since the 30th round in December 2012, data are being collected from sixteen cities. Since the data would have taken some time to stabilise, it may be appropriate to use these data after 2008 for drawing relevant empirical inferences.

a quarterly basis, collects quantitative and qualitative information on inflation expectations, but the median/mean quantitative value is commonly used to assess how expectations behave relative to underlying CPI inflation. Quarterly information on 3-months ahead and 1-year ahead inflation expectations provide reasonable time series data (2008:Q1 to Q3 2018) to test the relevant hypotheses in the paper. As the survey data relate to major cities in India, for comparison purpose CPI-urban inflation (new series, for which data are available since 2012) as well as CPI-IW (for which longer time series data are available) have been used (Annex Figure 1). Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test results indicate that the variables of interest are I(1) and first difference stationary (Annex Table 1).

Output-gap measures are based on deviations of quarterly GDP from HP filter based trend GDP. When only 3-months ahead inflation expectations and output gap are used as the determinants of inflation, in all five equations (for CPI-C, CPI-Urban, CPI-IW, CPI-C non-food non-fuel, and CPI-Urban non-food non fuel) household inflation expectations emerge statistically significant (Table 1). Output gap appears statistically significant only for two measures of non-food non-fuel CPI-C and CPI-Urban inflation, and not for headline inflation. When oil price shock is included in the modified version of the Phillips curve, the explanatory power of each equation improves (Table 2). Similar results are obtained when 1-year ahead inflation expectations are used (Table 3 and 4). In this section, the aim is to test whether household inflation expectations matter to explain inflation dynamics in a Phillips curve framework in India, rather than to capture the impact all plausible determinants of inflation, including short-term shocks other than fuel.

Table 1: Phillips Curve without Oil Price Shock (1-Quarter ahead Inflation Expectations)

	CPI Urban Inflation	CPI Combined Inflation	Urban Core Inflation	CPI Combined Core Inflation	CPI –IW Inflation
L.3-Months Ahead Inflation Expectations	0.655**	0.684**	0.371***	0.347***	0.771**
	(0.170)	(0.178)	(0.088)	(0.076)	(0.225)
L1.OUTPUT GAP	0.494	0.527	0.466	0.422	0.584
	(0.479)	(0.521)	(0.273)	(0.247)	(0.573)
L2.OUTPUT GAP	0.586	0.418	0.434	0.342	0.339
	(0.505)	(0.458)	(0.244)	(0.197)	(0.634)
L3.OUTPUT GAP	0.319	0.304	0.234	0.177	0.196
	(0.385)	(0.396)	(0.243)	(0.211)	(0.488)
L4.OUTPUT GAP	0.497	0.395	0.418**	0.330*	0.346
	(0.284)	(0.290)	(0.141)	(0.118)	(0.375)
Constant	-0.701	-0.684	1.873	2.313**	-1.506
	(1.634)	(1.715)	(0.915)	(0.733)	(2.200)
Observations	22	22	22	22	22
Adjusted R^2	0.375	0.378	0.442	0.497	0.281

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 2: Phillips Curve with Oil Price Shock (1- Quarter ahead Inflation Expectations)

	CPI Urban Inflation	CPI Combined Inflation	Urban Core Inflation	CPI Combined Core Inflation	CPI (Industrial Worker) Inflation
L. 3-Months Ahead Inflation Expectations	0.691**	0.722***	0.400***	0.372***	0.793**
	(0.173)	(0.176)	(0.077)	(0.063)	(0.242)
L.OUTPUT GAP	0.406	0.434	0.394*	0.361*	0.531
	(0.342)	(0.363)	(0.183)	(0.150)	(0.509)
L2.OUTPUT GAP	0.319	0.136	0.218	0.158	0.179
	(0.538)	(0.515)	(0.235)	(0.191)	(0.698)
L3.OUTPUT GAP	0.241	0.223	0.171	0.124	0.150
	(0.281)	(0.273)	(0.156)	(0.123)	(0.448)
L4.OUTPUT GAP	0.334	0.222	0.286*	0.218	0.248
	(0.295)	(0.313)	(0.117)	(0.111)	(0.418)
Oil Price Shock	0.0855	0.0904	0.0693*	0.0589*	0.0512
	(0.055)	(0.057)	(0.024)	(0.021)	(0.072)
Constant	-1.207	-1.219	1.463	1.965**	-1.809
	(1.702)	(1.734)	(0.791)	(0.614)	(2.419)
Observations	22	22	22	22	22
Adjusted R^2	0.458	0.476	0.615	0.673	0.265

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Phillips Curve without Oil Price Shock (1-Year ahead Inflation Expectations)

	CPI Urban Inflation	CPI Combined Inflation	Urban Core Inflation	CPI Combined Core Inflation	CPI (Industrial Worker) Inflation
L4.One Year Ahead Inflation Expectation	0.524*	0.512*	0.235	0.219*	0.675*
	(0.191)	(0.200)	(0.111)	(0.092)	(0.255)
L.OUTPUT GAP	0.265	0.262	0.290	0.257	0.356
	(0.541)	(0.585)	(0.333)	(0.294)	(0.610)
L2.OUTPUT GAP	0.976	0.800	0.611	0.507	0.839
	(0.590)	(0.571)	(0.341)	(0.295)	(0.650)
L3.OUTPUT GAP	0.304	0.273	0.198	0.142	0.204
	(0.485)	(0.503)	(0.362)	(0.310)	(0.497)
L4.OUTPUT GAP	0.882*	0.781	0.608*	0.507*	0.826
	(0.370)	(0.391)	(0.215)	(0.185)	(0.442)
Constant	-0.200	0.235	2.851*	3.242**	-1.573
	(2.092)	(2.217)	(1.258)	(1.005)	(2.940)
Observations	22	22	22	22	22
Adjusted R^2	0.186	0.126	0.186	0.186	0.156

Table 4: Phillips Curve with Oil Price Shock (1-Year ahead Inflation Expectations)

	CPI Urban Inflation	CPI Combined Inflation	Urban Core Inflation	CPI Combined Core Inflation	CPI (Industrial Worker) Inflation
L4. 1-Year Ahead	0.585*	0.575*	0.282*	0.259*	0.715*
Inflation Expectations	(0.215)	(0.230)	(0.110)	(0.101)	(0.296)
L.OUTPUT GAP	0.177	0.171	0.223	0.200	0.299
	(0.481)	(0.512)	(0.301)	(0.259)	(0.579)
L2.OUTPUT GAP	0.732	0.547	0.425	0.349	0.678
	(0.568)	(0.549)	(0.287)	(0.244)	(0.668)
L3.OUTPUT GAP	0.233	0.199	0.144	0.097	0.158
	(0.455)	(0.464)	(0.337)	(0.285)	(0.480)
L4.OUTPUT GAP	0.743*	0.636	0.501*	0.417*	0.734
	(0.341)	(0.357)	(0.180)	(0.151)	(0.443)
Oil Price Shock	0.092	0.096	0.070*	0.060	0.061
	(0.056)	(0.059)	(0.033)	(0.029)	(0.068)
Constant	-1.055	-0.652	2.199	2.688*	-2.139
	(2.524)	(2.751)	(1.314)	(1.199)	(3.564)
Observations	22	22	22	22	22
Adjusted R^2	0.274	0.222	0.344	0.343	0.145

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

3 The Shape of the Phillips Curve in India

Wage and price dynamics in both advanced and emerging economies seem to have altered dramatically in the last one decade after the global financial crisis, amplifying uncertainties surrounding the role of some of the fundamental determinants of inflation – economic slack, wage costs, and inflation persistence – in explaining inflation. Weakening

impact of economic slack or flattening of the Phillips curve, declining value of the persistence parameter reflecting improved anchoring of inflation expectations, and decaying bargaining power of labour dampening wage-push pressure even when labour market conditions tighten have some puzzling dimensions, and country specific empirical facts provide varied perspectives on ways to unravel the puzzle analytically.

Forces that may be altering the influence of some of the key determinants of inflation could be - the combined influence of rising employer monopsony power and dwindling worker bargaining power, which represents a major structural shift in labour market conditions (Krueger, 2018); concentration of power in product markets (or monopoly power of firms shifting the share of national income away from labour or wages in favour of corporates or profits) and concentration of power in the labour market (or monopsony power of employers depressing wages to levels below what competitive markets would have fetched) (Bivens, Mishel, & Schmitt, 2018); and, rising role of global factors (positive supply shock stemming from growing labour and product market integration and integrated global value chains) (Carney, 2017), all of which could drive the Phillips curve to either shift downward or turn flatter. While the role of technology in depressing wages and also the share of labour income has often been highlighted, once the adverse job destruction/replacement effect of technology is adjusted for two positive effects of technology – higher productivity and creation of new tasks - the net effect may be positive (Carney, 2018).There are also strong structural disinflationary forces which are not duly recognised in conventional approaches to inflation analysis – less inclusive growth, evident from rising inequality (in terms of income, wealth and opportunities), widespread economic uncertainty, and reduction in entry barriers (the Amazon effect), which exert downward pressures on prices (El-Erian, 2019). Changing composition of labour supply (with rising participation rate of workers in the age group of 55 to 64) may be depressing the equilibrium wage rate, and also dulling the information content of unemployment as an indicator of labour market slack (Mojon & Ragot, 2019).

Despite growing evidence on flattening of the Phillips curve, central bank communication often tries to emphasise its continued relevance to inflation dynamics, backed by newer empirical arguments: "…Phillips curve is alive and kicking when inflation is measured using categories that are cyclically sensitive (*i.e.*, Cyclically Sensitive Inflation or CIS)"

(Hooper, Mishkin, & Sufi, 2019)"; "…structural conditions for pass-through from wages to prices remain in place in the euro area. Over the period from 1985 to 2018, there is a continuing link between labour cost and price inflation in the four major euro area economies and across the three main sectors (Draghi, 2019)"; and, there are "…two empirical Phillips curves – one for twisters, the other for stickers. The twisters' Phillips curve is behaving relatively similarly to the past… But the Phillips curve for stickers looks to be somewhat flatter" (Haldane, 2018). On the key issue of whether the Phillips curve is "dead, sick, or merely resting", the essence of central bank communication has been that the effects of tight labour markets on inflation might have been reduced, but not eliminated – "…I do not see it as likely that the Phillips curve is dead" (Powell, 2018).

3.1.The Indian Experience

Empirical estimates for India do not show any evidence of flattening of Phillips curve, as the estimated coefficients of output gap (4 quarters lag) in the Phillips curve equations, for both headline CPI and Core (excluding food and fuel) CPI inflation appear to have remained stable over time in the last few years (Figure 1A and 1B).

This evidence, however, is not conclusive, because estimates are highly sensitive to model specification, *i.e.*, whether the Phillips curve equation has adaptive expectations (one quarter lagged CPI headline or CPI core inflation) or forward-looking household inflation expectations (3-months ahead or 1-year ahead). As evident from estimates presented in Table 5, output-gap (4 quarter lagged) coefficients are statistically significant only when household inflation expectations are used for both CPI headline and CPI-core measures of inflation in the Phillips curve equations. In formulations with adaptive expectations, output gap coefficients are not significant.

Figure 1A: Coefficient of Output Gap (4Q lag) in Phillips curve (for headline CPI-C Inflation)

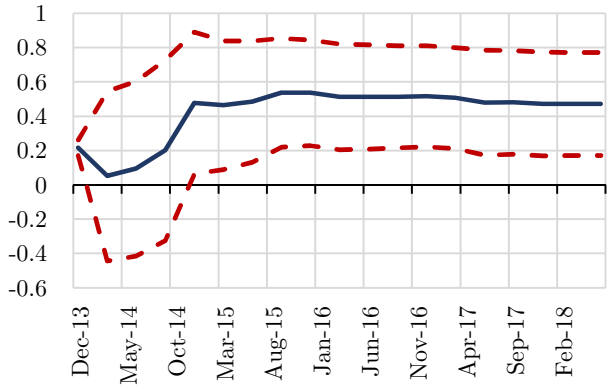
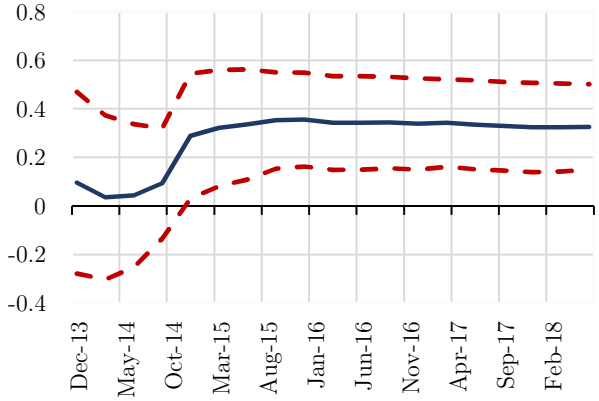


Figure 1B: Coefficient of Output Gap (4Q Lag) in Phillips Curve (for core CPI inflation)



Note: Red dotted lines are 95% confidence interval.

Table 5: Estimated Coefficients of O-Gap in Estimated Philips Curve Equations

Variable	PC with adaptive expectations (or 1Q lagged actual inflation)		PC with forward looking household inflation expectations (3-months ahead)		PC with forward looking household inflation expectations (1-months ahead)	
	Headline	Core	Headline	Core	Headline	Core
L4.Output Gap	0.005 (0.173)	0.022 (0.079)	0.472** (0.153)	0.326** (0.09)	0.379* (0.173)	0.281* (0.099)
Adaptive/household inflation expectations	0.840*** (0.114)	0.793*** (0.095)	0.828*** (0.122)	0.401*** (0.066)	0.727*** (0.133)	0.360*** (0.061)

, ** and * represent significance at 5, 1 and 0.1 per cent levels, respectively.*

The most recent communication of the Reserve Bank of India on this issue highlights the continued importance of Phillips curve to inflation dynamics - "…a positive shock to the output gap increases core and headline inflation and the peak effect occurs with a lag of

3-5 quarters, the impact being stronger and faster for core inflation than for headline inflation… the Phillips curve is relatively flat for negative output gaps, but the impact increases rapidly with positive output gaps" (RBI, 2019)[5].

4 Inflation Expectations and Wage Dynamics

One of the major arguments on the need for monetary policy to anchor inflation expectations is that the risk of a wage-price spiral can be averted. Information on household inflation expectations collected through surveys may not fully satisfy the rational expectations hypothesis, but may still contain useful information to help assess how they influence current prices by impacting wage and price setting behaviour of economic agents. In the labour market, inflation expectations of both employers (firms) and employees may determine nominal wage increases. However, given that acquiring new information could be costly, one would expect firms to be more forward looking than employees[6]. If inflation expectations of employees and employers diverge, then transmission of the former to wages may depend on the degree of unionisation, or bargaining power of labour.

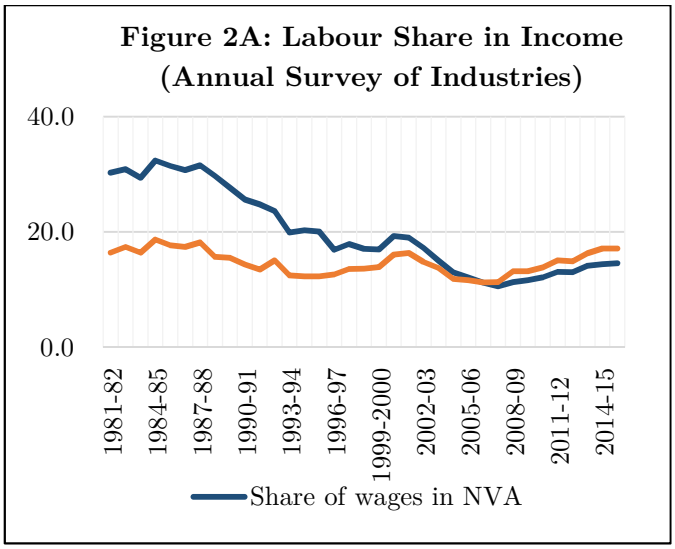
In countries that face uncertainty about availability of data on unemployment, wage growth could often be used as an early warning labour market indicator of inflation. Wage growth, however, may reflect the impact of a combination of factors – inflation expectations, slack in the labour market and labour productivity - and the transmission of inflation expectations to inflation may depend on how the latter two factors may be evolving. Moreover, in the presence of large involuntary part time employment or temporary contracts, transmission of inflation expectations could get dulled. Since the

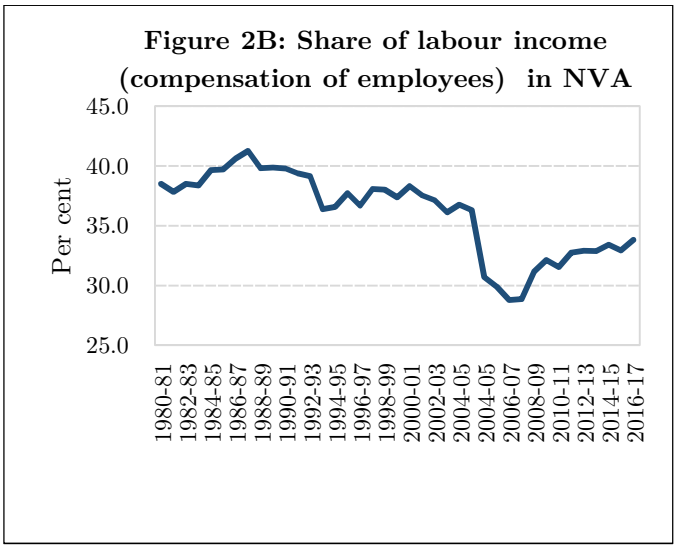
[5] Monetary Policy Report, RBI, April 2019.

[6] In India, unlike household inflation expectations (assumed as expectations of employees) which have remained persistently higher than actual inflation, inflation expectations of professional forecasters (whose analysis may matter to firms for their investment and pricing decisions) are closer to the inflation trajectory projected by the RBI and importantly, inflation expectations of firms (as per the Business Inflation Expectations Survey of IIM, Ahmedabad) are closer to actual inflation. This experience is similar to that in Poland where anchoring of forward looking expectations of financial analysts and enterprises is found to be much higher than backward-looking inflation expectations of consumers (Lyziak, 2016).

global financial crisis, subdued wage pressures and declining share of labour in total income has complicated assessment of risks to inflation from wages. In the US, the impact of tighter labour market conditions on wages has been dampened by decline in trend productivity growth and labour share in income, even as other factors such as automation, offshoring, decline in unionization and globalisation also played their role (Abdih & Danninger, 2018). In most advanced economies, nominal wage growth has been more sluggish than what is suggested by standard Phillips curve estimates, and structural changes in the bargaining power of labour and competition from foreign workers could explain part of the subdued wage growth (Arsov & Evans, 2018). Greater monopsony power of employers (as highly concentrated labour markets depress wages) and weakening bargaining power of workers have impacted wage dynamics, entailing implications for monetary policy (Krueger, 2018).

The importance of wage dynamics to inflation dynamics is evident from the high share of labour income in total income. In India, data from Annual Survey of Industries (ASI) indicate that the shares of wages (of workers) and total emoluments (of salaried employees) taken together constitute about 31.7 per cent of net value added (NVA). As against the industrial sector, for the economy as a whole, national income data suggest that labour share (compensation of employees) in net value added (NVA) is about 34 percent (Figure 2A and 2B). This would suggest that wage dynamics should matter to inflation dynamics, from the stand point of input cost as well as aggregate demand effects associated with changes in wage growth.



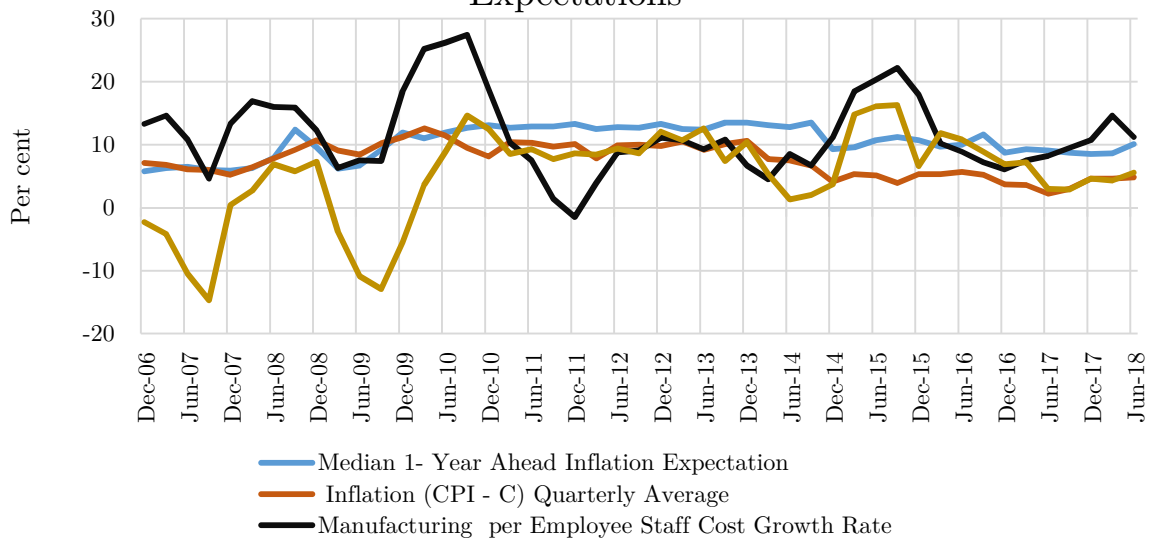


Quarterly data on inflation expectations of households in India (3-months ahead and 1-year ahead) are plotted in Figure 3 against year-on-year growth in staff costs (for manufacturing and services separately)[7] to examine whether or not, and to what extent, they co-move. The data on inflation expectations relate to select cities and accordingly staff costs are used as a proxy for urban wages. Figure 3 shows that there is some degree of occasional co-movement, which provides a case for estimating the extent to which any change in inflation expectations may influence the rate of change in staff costs[8].

[7] These data relate to non-government non-financial companies (growth in per employee staff costs) and are sourced from https://www.rbi.org.in/scripts/Pr_DataRelease.aspx?SectionID=360&DateFilter=Year and capital line database. For caveats while using this data for analysis, please see RBI's Monetary Policy Report of October 2018. Moreover, like any nominal data on wages, these data are not adjusted for changes in productivity.

[8] CPI-C back-casted data are taken from the Report of the Expert Committee to Revise and Strengthen the Monetary Policy Framework (Chairman: Dr. Urjit R Patel). Such back-casted data are not available for CPI-C (excluding food and fuel). Therefore, wherever required, CPI-IW (excluding food and fuel) has been used as a proxy measure of underlying inflation.

Figure 3: Growth in Staff Costs, Inflation, and Inflation Expectations



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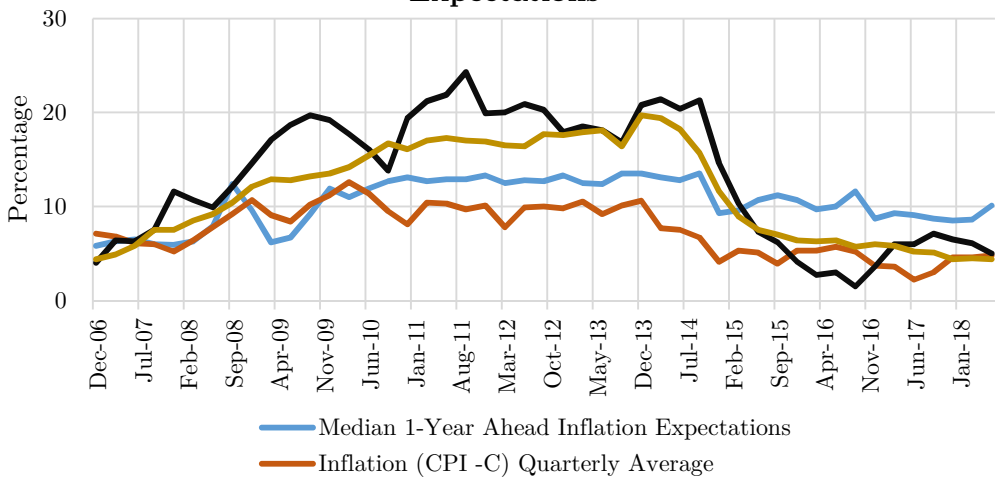
In the absence of data on inflation expectations of households in the rural areas, it is hypothesized that if rural households have similar inflation expectations as in the urban areas (given the high correlation of 0.97 between CPI-urban and CPI-rural inflation for the period January 2012 to February 2018), then inflation expectations of households (one year ahead) can also influence rural wages. Time series data on rural wages suffer from the problem of a statistical break (*i.e.*, the old series is up to October 2013 and the new series is from November 2013, but without a linking factor). Moreover, classification of labour groups has changed in both series. If one picks common comparable groups from both series, then data on "harvesting" could be used as a proxy for agricultural labourers and data on "masons" could be used as a proxy for non-agricultural labourers. Such data for the period December 2006 to September 2017 plotted in Figure 4 show that there could be some relationship between inflation expectations and rural wages, which could become clearer if estimated empirically.

Figure 4: Rural Wage Growth, Inflation, and Inflation Expectations



Before starting the empirical exercise, it is hypothesised that the wage-setting behaviour could be influenced by both past inflation (*i.e.*, backward looking) as well as inflation expectations (*i.e.*, forward looking) (Blanchard, 1986; Gali, 2011; Taylor, 1979). Accordingly, the wage setting model used in this paper is:

$$W_t = k\ P_{t-1}^{\alpha} {P^e}_{t+1}^{1-\alpha}$$

Where W_t is current wage level, P_{t-1} is previous period price level, P_{t+1}^e is expected price level, and k is a vector of other exogenous factors that affect the wage setting behaviour. Here α signifies the weightage households assign to past inflation and accordingly $1-\alpha$ is the weightage assigned to future expectations. The above equation is reduced to:

$$\frac{\dot{W}_t}{W_t} = \frac{d\ \dot{k}}{k} + \alpha\frac{\dot{P}_{t-1}}{P_{t-1}} + (1-\alpha)\frac{\dot{P^e}_{t+1}}{P_{t+1}^e}$$

The relevance of both backward looking and forward looking inflation to wage setting behaviour in India (for manufacturing staff costs, services sector staff costs, agricultural wage costs and non-agricultural rural wage costs) is examined. All variables in equations relating to harvesting and mason wage growth in Table 6 (proxies for rural wage growth) are I(1), while equations relating to manufacturing sector staff cost growth and services sector staff cost growth (proxies for urban wage growth) have a mix of I(0) and I(1). For drawing empirical inferences, therefore, the vector error correction model (VECM) is used for the former (Table 7 and 8) while an auto-regressive distributed lag (ARDL) model is used for the later (Table 9). Ordinary least square (OLS) estimates are used first in Table 6 only to check whether the restriction of sum of two coefficients adding to one works for

the Indian data. Each equation is estimated twice, *i.e.*, without imposing any restriction on the coefficients of backward looking and forward looking inflation expectations, and then imposing the restriction that these two coefficients add up to one (Table 6a and 6b). As per Wald test, the restricted version is not supported only for mason wage growth, while in terms of the sign of the coefficients, the restricted version does not work for services sector wage growth.

Table 6a: Inflation Expectations and Wage Growth (Unrestricted)

	Harvesting Wage Growth	Mason Wage Growth	Manufacturing per Employee Staff Cost Growth	Services per Employee Staff Cost Growth
Median One Year Ahead Inflation Expectations	0.795*	0.845***	-1.854*	0.307
	(0.317)	(0.172)	(0.813)	(0.678)
Inflation (CPI -C) Quarterly Average (t-1)	0.678	0.794**	1.860**	-0.412
	(0.443)	(0.242)	(0.650)	(0.599)
Dec2013-Sep2014_D	2.566*	2.346**		
	(1.086)	(0.756)		
Post_Dec_2014_D	-9.188***	-5.431***		
	(2.058)	(1.213)		
Constant	1.804	-2.399	9.039	7.926
	(3.266)	(1.683)	(7.169)	(7.549)
Observations	**46**	**46**	**41**	**41**
Adjusted R^2	**0.75**	**0.88**	**0.20**	**0.01**
Wald Test (Coefficient of median 1-year Inflation Expectations + coefficient of last period CPI–C quarterly average inflation =1)				
F	**1.97**	**13.89**	**2.62**	**2.08**
Prob > F (p-values)	**0.17**	**0.00**	**0.11**	**0.16**

Standard errors in parentheses; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6b: Inflation Expectations and Wage Growth (Restricted)

	Harvesting Wage Growth	Mason Wage Growth	Manufacturing per Employee Staff Cost Growth	Services per Employee Staff Cost Growth
Median One Year Ahead Inflation Expectations	0.731**	0.759***	0.441	2.212***
	(0.275)	(0.163)	(0.420)	(0.342)
Inflation (CPI -C) Quarterly Average (t-1)	0.269	0.241	0.559	-1.212***
	(0.275)	(0.163)	(0.420)	(0.342)
Dec2013-Sep2014_D	2.719	2.552**		
	(1.993)	(1.179)		
Post_Dec_2014_D	-11.22***	-8.177***		
	(1.958)	(1.158)		
Constant	6.174***	3.498***	2.618	-8.550***
	(0.787)	(0.466)	(1.591)	(1.297)
Observations	46	46	43	43

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Estimated coefficients would indicate that inflation expectations of households may matter for rural agricultural and non-agricultural wage setting, but not in the organised manufacturing or services sector. One presumes, in the manufacturing sector, this reflects weaker bargaining power of labour because of similar factors highlighted in the literature for other countries – globalisation and cheaper imports, automation, monopsony power of employers due to concentration of production in large firms, wakening unionisation, *etc.* In the services sector, particularly in skill intensive areas, however, one expects relatively greater bargaining power of labour, and therefore one would expect staff costs to be

sensitive to inflation expectations. These aspects are examined further using VECM and ARDL results (Table 7, 8 and 9).

The second stage of this exercise is to find out whether or not higher wages (influenced by inflation expectations) give rise to higher inflation, besides whether wages are influenced by past inflation and/or inflation expectations. This aspect was studied in detail by Kundu (2018) for India, and she found that prices influence wages, rather than wages influencing prices, implying limited risk of a wage-price spiral. These findings were based on estimates that used data on rural wages for the period November 2013 to November 2017. We use quarterly data for the period December 2006 to June 2018 in the VECM model, controlling for two dummies: Dec2013-Sep2014_D and Post_Dec_2014_D. The monthly wage series was revised in November 2013. Therefore in wage growth calculation from November 2013 to October 2014 both old and new data are used. To control for this data revision effect we have created a dummy Dec2013-Sep2014_D, which takes the value 1 if the quarter falls in between December 2013 and September 2014, else 0. From December onwards the wage growth has been calculated using new data only, and to control for this we have used a dummy Post_Dec_2014_D which is 1 if the quarter is after December 2014, else 0. It is observed that agricultural wage growth (both for harvesting and mason) influences inflation and *vice-versa*, with the presence of long-run co-integrating vectors (and the statistically significant error correction terms falling within -1 to 0 not only validate the presence of long term relationships but also indicate short-run adjustments to restore the long-run equilibrium) (Table 7 and 8). For staff costs (both manufacturing and services), ARDL results suggest that inflation expectations influence growth in services sector staff costs, but the influence on growth in manufacturing staff costs turns out to be perverse.

Table 7: Vector Error Correction Model for Harvesting Wage Growth

	(1)	(2)	(3)
	∆.Harvesting Wage Growth Rate t	∆.One Year Ahead Median Inflation Expectations	∆. CPI Inflation Quarterly Average
Error Correction Term	-0.300***	-0.0186	0.0955**
	(0.0779)	(0.0601)	(0.0466)
∆.Harvesting Wage Growth t-1	0.287**	-0.0680	-0.00557
	(0.134)	(0.103)	(0.0799)
∆. One Year Ahead Median Inflation Expectations t-1	0.142	-0.00974	0.292**
	(0.208)	(0.161)	(0.125)
∆.Inflation (CPI -C) Quarterly Average t-2	-0.561**	-0.121	0.0748
	(0.269)	(0.207)	(0.161)
Constant	-0.0282	0.0774	-0.0734
	(0.305)	(0.235)	(0.183)
Observations		44	44
Long-run Relationship			
Harvesting Wage Growth Rate=2.72^{***}×CPI Inflation Quarterly Average (t-1) +0.16× One Year Ahead Median Inflation Expectations + 5.53^{***}			

*** p<0.01, ** p<0.05, * p<0.1

Table 8: Vector Error Correction Model for Mason Wage Growth

	(1)	(2)	(3)
	∆.Mason Wage Growth Rate t	∆. One Year Ahead Median Inflation Expectations t-1	∆.Inflation Quarterly Average
Error Correction Term	-0.200***	0.0148	0.211**
	(0.0765)	(0.116)	(0.0848)
∆.Mason Wage Growth t-1	0.192*	-0.0337	0.289**
	(0.107)	(0.162)	(0.119)
∆. One Year Ahead Median Inflation Expectations t-1	-0.211	-0.140	0.0369
	(0.152)	(0.230)	(0.169)
∆.Inflation (CPI - C) Quarterly Average t-2	0.336**	0.170	0.358**
	(0.141)	(0.213)	(0.156)
Constant	-0.0539	0.0774	-0.0564
	(0.156)	(0.235)	(0.173)
Observations	44	44	44
Long Run Relationship			
Mason Wage Growth Rate=$2^{***}\times$ CPI Inflation Quarterly Average (t-1)+0.27$\times$ One Year Ahead Median Inflation Expectations t-1 + 6.18^{***}			

*** p<0.01, ** p<0.05, * p<0.1

Table 9: ARDL Model Results

	(1)	(2)
	∆.Manufacturing Staff Cost Growth Rate	∆.Services Staff Cost Growth Rate
ADJUSTMENT TERM		
Manufacturing Staff Cost Growth Rate $_{t-1}$	-0.622***	
	(0.117)	
Services Staff Cost Growth Rate $_{t-1}$		-0.709***
		(0.126)
LONG-RUN RELATIONSHIP		
Inflation (CPI -C) Quarterly Average $_{t-1}$	0.104	-0.963**
	(0.347)	(0.364)
Median 1-Year Ahead Inflation Expectations $_{t-1}$	-0.965**	1.552***
	(0.446)	(0.445)
SHORT-RUN RELATIONSHIP		
∆.Manufacturing Staff Cost Growth Rate $_{t-1}$	0.529***	
	(0.129)	
∆.Manufacturing Staff Cost Growth Rate $_{t-2}$	0.238	
	(0.143)	
∆.Manufacturing Staff Cost Growth Rate $_{t-3}$	0.384**	
	(0.146)	
∆.Inflation (CPI -C) Quarterly Average	0.0649	-0.683**
	(0.217)	(0.299)
∆.Median 1-Year Ahead Inflation Expectations	0.0485	1.100***
	(0.394)	(0.397)
∆.Services Staff Cost Growth Rate $_{t-1}$		0.326**
		(0.128)
∆.Services Staff Cost Growth Rate $_{t-2}$		0.333**
		(0.134)
Constant	13.54***	-2.080
	(3.105)	(3.192)
Observations	40	40
Adjusted R^2	0.48	0.42

Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Bound test has been made and it

confirms existence of long run relationship.

Thus, there is some empirical evidence to support the hypothesis that high inflation expectations of households influence wage dynamics in the services sector. For rural wages, convergence to long-run steady state results through adjustments in wages and inflation, and not in inflation expectations. This, however, does not stand the test of robustness, because inflation expectations data collected from cities should matter more for analysing growth in staff costs in the organised sector rather than for rural wages.

5 Conclusions

The usefulness of survey-based information collected by the RBI on inflation expectations of households is examined in this paper from the stand point of their relevance to explain inflation dynamics in India and also for forecasting inflation. While rationality is necessary for inflation expectations to be incorporated in a new Keynesian Philips Curve (NKPC), hybrid versions of NKPC often fit actual inflation data better, which also provide a more realistic framework to test the information content of any survey based measure of inflation expectations. In five different specifications of modified versions of NKPC (for CPI-C, CPI-Urban, CPI-IW, CPI-C non-food non-fuel, and CPI-Urban non-food non-fuel), it is found that household expectations emerge as a statistically significant predictor of actual inflation. As household expectations are adaptive, however, in hybrid NKPC specifications household inflation expectations effectively work more as a substitute of adaptive expectations. An empirical assessment of the slope of the Phillips curve suggests that the Phillips curve remains relevant as the time varying output gap coefficient is found to be reasonably stable. High observed inflation persistence, however, warrants sustained focus of monetary policy on anchoring inflation expectations.

The assessment of relationship between inflation expectations and wages - the key channel for transmission of inflation expectations to inflation – often requires information on other key determinants of wages, such as slack in labour market/unemployment rate, labour productivity, trend change in labour share in total income, and other factors such as automation, offshoring, unionization and globalisation. Notwithstanding the potential

impact of several factors (some unobserved/difficult to identify), any empirical evidence on inflation expectations influencing wages could be a clear risk to the inflation outlook. For India, growth in staff costs in manufacturing and services activities is used as a proxy of wage growth, given that inflation expectations data relate to cities. It is observed that inflation expectations have a statistically significant influence on growth in staff costs in the services sector, but not in manufacturing.

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Annex Table 1: Unit Root Test Results (at 10 per cent)

Variables	Augmented Dickey-Fuller	Phillips-Perron	Integration
Data in Levels			
CPI – Urban Inflation	-1.390 (0.56)	-1.067 (0.71)	I(1)
CPI-C Inflation	-0.932 (0.75)	-0.929 (0.76)	I(1)
CPI-IW Inflation	-1.305 (0.67)	-1.289 (0.63)	I(1)
$E_t \pi_{t+1}$	-2.657 (0.09)	-2.719 (0.08)	I(0)
$E_t \pi_{t+4}$	-2.470 (0.13)	-2.450 (0.13)	I(1)
Output Gap	-3.247 (0.01)	-2.673 (0.07)	I(0)
Harvesting Wage Growth Rate	-1.296 (0.63)	-1.508 (0.52)	I(1)
Mason Wage Growth Rate	-1.209 (0.67)	-1.177 (0.68)	I(1)
Manufacturing Staff Cost Growth Rate	-3.933 (0.01)	-2.880 (0.04)	I(0)
Services Staff Cost Growth Rate	-3.018 (0.03)	-2.632 (0.08)	I(0)
Data in First Differences			
CPI – Urban Inflation	-2.960 (0.05)	-6.446 (0.00)	I(0)
CPI-C Inflation)	-3.691 (0.01)	-6.443 (0.00)	I(0)
CPI-IW Inflation	-5.790 (0.00)	-5.806 (0.00)	I(0)
$E_t \pi_{t+4}$	-8.205 (0.00)	-9.890 (0.00)	I(0)
Manufacturing Staff Cost Growth Rate	-3.754 (0.00)	-5.330 (0.00)	I(0)
Services Staff Cost Growth Rate	-2.747 (0.07)	-4.100 (0.001)	I(0)

p-values in parenthesis

Annex Figure 1: Inflation Expecations of Households and different Measures of CPI Inflation