Wage Phillips Curve of a Large Emerging Economy: Role of Structural Heterogeneity

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Abstract

The paper finds the role of dynamic structural heterogeneity in establishing the empirical existence and convexity of the wage Phillips curve for large emerging economies. Using Indian state-level data, we find a negative and convex relationship between earnings growth and unemployment after controlling for structural labour market factors that vary over time and across states. The fixed effects regression model suggests that a higher speed of formalization makes the wage-Phillips curve flatter, controlling for changes in the composition of labour supply and skilling.

Keywords: Unemployment, Wage growth, Wage Phillips curve, Emerging Economies
JEL classification: E24 E26 J30 E52

1. Introduction

The existence and convexity of the wage Phillips curve remain debated for advanced economies (e.g., Kirpson & Staehr, 2024; Donayre & Panovska, 2016; Ball & Mazumder, 2011; Stiglitz, 1997). However, literature is limited for large emerging countries (Aginta, 2023; Patra et al., 2021; Behera et al., 2018). Structural differences between advanced and emerging economies necessitate separate attention when estimating the Phillips curve. Emerging market economies (EMEs) experience greater variations in structural features, such as labor force participation, skilling, and formalization, compared to advanced economies (ILO & OECD, 2023; Elgin et al., 2021). New Keynesian literature with labour market frictions suggests that these structural features affect the Phillips curve slope (Siena & Zago, 2022; Di Pace & Hertweck, 2019). The ability to influence wages corresponding to labour market slack or boom depends on structural factors (Siena & Zago, 2022; Byrne & Zekaite, 2020). Rissman (1993) found a stable Phillips curve only after controlling for sectoral labour shifts. Burya et al. (2023) show the wage Phillips curve is weaker (flatter) in regions with more market powers to firm, highlighting the role of institutional characteristics.

This paper argues that for emerging economies undergoing structural changes in the labour market, the Phillips curve needs to be augmented with dynamic structural parameters that vary across time and space. We demonstrate the existence and convexity of the wage Phillips curve for India, a large emerging economy, after incorporating labour market features. By controlling for labour supply composition and skilling, we find that a higher degree of formalization flattens the wage-Phillips curve. An increase in unpaid family workers shifts the Phillips curve backward, while an increase in skilling pushes it outward. These findings emphasize that the monetary policy of emerging economies needs to account for the rate of structural changes.

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[a] The views expressed in the article represents the views of the authors and not those of the institution to which they belong.

2. Data

Unlike most studies using national time-series data (e.g., Aginta, 2023; Behera et al., 2018; Kumar & Orrenius, 2016), we leverage state-level panel data to estimate nonlinear wage Phillips curve specifications. This paper focuses on India, with its diverse economic and labor market conditions across states (PLFS, 2023-24; HCES, 2022-23). We use data from the Periodic Labour Force Survey (PLFS), available from 2017-Q3 to 2024-Q2, surveying over 100,000 individuals quarterly. We use earnings and working status information based on Current Weekly Status (CWS) to obtain average weekly earnings by state and quarter. The paper also uses educational attainment and enterprise information to create state-level measures of skilling (proportion of graduates in the labor force) and formality (proportion of workers in non-agricultural formal sector firms). Additionally, we calculate the proportion of unpaid family workers in the workforce. State-level inflation expectations data are collected from the Inflation Expectations Survey of Households by the Reserve Bank of India (see Appendix 1).

3. Methodology

We use clustered robust linear regression (clustered at the state level) to estimate the Wage Phillips curve for 24 quarters (2018-Q3 to 2024-Q2) across 26 states. Our baseline model (Equation 1) is an expectations-augmented wage Phillips curve estimation. The year-over-year growth of nominal average earnings for state 's' and time 't' ($\Delta w_{s,t}$) is regressed on the unemployment rate ($u_{s,t}$) and 3-month-ahead inflation expectations ($\pi^e_{s,t}$) to account for the effect of inflation, as earnings growth is measured in nominal terms. The model also controls for time-invariant state-level characteristics (α_s), time fixed effects (τ_t) to account for common macroeconomic shocks, and lagged wage growth ($\Delta w_{s,t-1}$) to address persistence (Kumar & Orrenius, 2016).

Baseline Model:

$$\Delta w_{s,t} = \beta u_{s,t} + \gamma \pi^e_{s,t} + \alpha_s + \tau_t + \mu \Delta w_{s,t-1} + e_{s,t} \tag{1}$$

We incorporate the year-on-year change in time-varying structural labour market characteristics $\left(\Delta X_{s,t}\right)$ and their interaction with the unemployment rate as additional covariates in an augmented wage Phillips curve model (Equation 2). Three such characteristics (X) are considered: the proportion of unpaid family worker (ufw), above graduate workers (ag) and formal sector workers (fs). A statistically significant δ signifies a shift in the wage Phillips curve due to changes in $\Delta X_{s,t}$. Further we consider interaction effect of unemployment rate ($u_{s,t}$) with the Y-on-Y change in the rate of formalisation in the economy (Δfs). A statistically significant positive coefficient ρ means that if $\Delta fs_{s,t}$ is positive, the wage Philips curve will be flatter, given β (i.e., coefficient of $u_{s,t}$) is expected to be negative. This relation is reverse in case of negative and significant ρ.

Augmented Model:

$$\Delta w_{s,t} = \beta u_{s,t} + \gamma \pi^e_{s,t} + \alpha_s + \tau_t + \Delta X_{s,t}\delta + \rho \Delta fs_{s,t} u_{s,t} + \mu \Delta w_{s,t-1} + \varepsilon_{s,t}$$

(2)

To test the convexity of the Wage-Phillips curve, we estimate two non-linear models (Equation 3 and 4). The first uses the reciprocal of the unemployment rate. The second model uses a spline of the unemployment rate with a median knot. If the first spline's coefficient is greater in absolute value than the second's, it signifies convexity.

Non-linear Augmented Model 1:

$$\Delta w_{s,t} = \zeta\left(\frac{1}{u_{s,t}}\right) + \beta u_{s,t} + \gamma \pi^{e}_{s,t} + \alpha_s + \tau_t + \Delta X_{s,t}\delta + \rho \Delta f s_{s,t}\frac{1}{u_{s,t}} + \mu \Delta w_{s,t-1} + \varepsilon_{s,t}\,. \quad (3)$$

Non-linear Augmented Model 2

$$\Delta w_{s,t} = \beta_1 u_{1s,t} + \beta_2 u_{2s,t} + \gamma \pi^{e}_{s,t} + \alpha_s + \tau_t + \Delta X_{s,t}\delta + \rho \Delta f s_{s,t} u_{s,t} + \mu \Delta w_{s,t-1} + \varepsilon_{s,t}. \quad (4)$$

4. Results

Table 1 presents the regression results. Model 1 which considers a basic wage Phillips curve relationship does not show statistically significant association between ($u_{s,t}$) and ($\Delta\, w_{s,t}$). However, Model 2, which controls for structural labour market parameters, finds β statistically significant and negative. This shows that the impact of unemployment on wage inflation become significant if controlled for labour market conditions. Model 3 indicates that faster labour market formalization flattens the Phillips curve, as the interaction between ($u_{s,t}$) and ($\Delta\, f s_{s,t}$) is significant and positive. This suggests that higher unemployment rates lead to a smaller reduction in earnings growth with faster workforce formalization. This finding supports existing literature on the effectiveness of monetary and fiscal policy with greater formalization (Ghate et al., 2024; Di Pace & Hertweck, 2019). An increase in the rate of skilling pushes the earnings growth up for a given $u_{s,t}$. On the flip side, earnings growth is dampened given the higher growth of the share of unpaid family workers.

Models 4 and 5 estimate the non-linear specifications of the wage Phillips curve and show statistical significance of the relevant parameters. The reciprocal of $u_{s,t}$ has a positive coefficient implying a convex relationship between $u_{s,t}$ and $\Delta w_{s,t}$ (Model 4). Also, the spline terms (β_1, β_2) are found to be negative and statistically significant in Model 5, and $|\beta_2| < |\beta_1|$ indicating convexity of the wage Philips curve. Moreover, the faster rate of formality makes the convex wage Phillips relation flatter. This finding corroborates the theoretical underpinning of the convex Phillips curve as the downward wage rigidity increases with higher formalisation (Kumar & Orrenius, 2016).

Table 1 Wage Phillips Curve Estimation Results

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
$u_{s,t}$	-0.04	-0.52***	-0.56***	-0.28	

$\frac{1}{u_{s,t}}$				8.24**	
$u_{1s,t}$					-0.71*
$u_{2s,t}$					-0.49**
$\Delta ufw_{s,t}$		-0.90***	-0.93***	-0.87***	-0.93***
$\Delta ag_{s,t}$		1.13***	1.10***	1.04***	1.10***
$\Delta fs_{s,t}$		0.42	-0.07	0.89***	-0.06
$\Delta fs_{s,t} * u_{s,t}$			0.08*		0.08*
$\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right)$				-1.29**	
$\pi^{e}{}_{s,t}$[2]	-0.1	-0.35	-0.26	-0.16	-0.27
R-square	0.19	0.41	0.42	0.44	0.42
RMSE	11.42	9.78	9.72	9.61	9.73

Note 1: *** p-value≤ .01, ** p-value ≤ .05, * p-value ≤ 0.1.

Note 2: The interactions of skill levels and unpaid family labour with unemployment are statistically insignificant. However, the interaction of formalization with unemployment remains significant, even when all three interactions are included in one model. This holds true for the nonlinear model as well. For brevity, these results are not included in Table 1 or the main text.

To address potential endogeneity in the Wage-Phillips curve estimations, we conduct a System-GMM estimation for Models 1–4 from Table 1. The results (Table 3, Appendix 2) support a downward-sloping convex Wage-Phillips curve after accounting for time-varying structural characteristics. However, the interaction between the change in the share of formal workers and the unemployment rate is not statistically significant. Our sample has fewer cross-sectional units (N = 26), leading to a high number of instruments compared to observations in the

[2] With time-fixed effects, inflation expectation coefficients are insignificant due to strong cross-sectional dependence (confirmed by the CD test). For robustness, we re-estimated models using real per-worker earnings growth (earnings per worker growth minus three-month-ahead inflation expectations) as the dependent variable, excluding three-month-ahead inflation expectations. The significance of other coefficients remained largely unchanged

System-GMM estimations (Roodman, 2009). Thus, we consider the System-GMM estimates as preliminary exercise to address reverse causality. Instead, we validate our findings through a different approach below.

5. Robustness

This paper posits that the rate of formality is crucial when estimating the wage Phillips curve due to the dynamic and diverse labour market characteristics of large emerging economies. As a robustness check, we leverage the 'large' aspect of the emerging economy by exploiting subnational variations in economic prosperity. Given the varying levels of industrialization across Indian states (defined as the proportion of the workers employed in industrial sector at 2017-Q3), we introduce a dummy, IS, for above median industrialised.[3] We then use the convex wage Phillips curve specification (Model 4) to assess whether the impact of formalisation on flattening the wage Phillips curve diminishes in more industrialized states. Table 2 provides the evidences in favour of that hypothesis as the coefficient of triple interaction term, $\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right) * IS$, is statistically significant and positive while the coefficient of $\frac{1}{u_{s,t}}$ is positive and $\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right)$ is negative.

Table 2 Robustness Analysis

Variables	Model 4.1	Model 4.2
$u_{s,t}$	-0.26	-0.26
$\frac{1}{u_{s,t}}$	8.63**	8.63**
$\Delta ufw_{s,t}$	-0.83**	-0.83***
$\Delta ag_{s,t}$	1.07***	1.06***
$\Delta fs_{s,t}$	0.81***	0.78***
$\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right)$	1.66***	-1.63***

[3] We tested the share of industry in states' GVA as a proxy for industrialization, but the results were insignificant. Since we focus on per worker earning growth, the share of the labour force in industry is more relevant. High capital intensity in some industries can skew output share, making it less reflective of the actual workforce linked to industrialization

$\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right) * IS$	1.01*	0.94**
$\Delta fs_{s,t} * IS$		0.04
R-square	0.44	0.44
RMSE	9.58	9.59

Note: *** p-value≤ .01, ** p-value ≤ .05, * p-value ≤ 0.1. The convex Phillips curve with time and state-fixed effects are estimated. The models include three months ahead inflation expectation as it was in the baseline model 4 in Table 1.

6. Conclusion

The paper presents evidence supporting the convexity of the wage Phillips curve for India, a large emerging economy. We argue that for the economies like India, it is crucial to augment the Phillips curve with dynamic structural features such as labour supply composition, skilling, and formality. In both linear and convex model specifications, we find that a faster rate of labour market formalization flattens the wage Phillips curve. That complicates central banks' tasks to stabilize macroeconomic conditions, requiring a nuanced monetary policy approach. Future research may further explore fiscal and monetary policy based on this study's findings. A more robust dynamic panel analysis to establish a causal link is also left for future research.

Appendix 1:

The city median inflation expectations are used for states' inflation expectations. For states without a city in the 19-city IESH data set, the nearest city's data is used. For example, Andhra Pradesh and Telangana use Hyderabad's data.

Appendix 2:

Table 3 System-GMM Estimations

Variables	Model 1	Model 2	Model 3	Model 4
$u_{s,t}$	-0.46	-0.65*	0.75**	-0.57*
$\frac{1}{u_{s,t}}$				8.19*
$\Delta ufw_{s,t}$		-0.97***	-1.11***	-1.05***

$\Delta ag_{s,t}$		1.20***	0.80***	0.99***
$\Delta fs_{s,t}$			-0.17	0.68*
$\Delta fs_{s,t} * u_{s,t}$			$0.10^{\#}$	
$\Delta fs_{s,t} * \left(\frac{1}{u_{s,t}}\right)$				-0.95
$\pi^{e}{}_{s,t}$	0.12	-0.40	-0.20	0.29
No. of Instruments	87	108	150	172

Note 1: *** p-value $\leq .01$, ** p-value $\leq .05$, * p-value ≤ 0.1 # p-value ≤ 0.15. All the models are estimated using System GMM estimation adjusted for small sample of cross-sectional units and including time fixed effects. Number of Observations for all models is 598.

Note 2: Lag-limit for instruments – 4 to T

Note 3: Arellano-Bond Auto-correlation test: Rejected for first order and cannot be rejected for second order for all models.

Note 4: Sargan Test: Rejected and Hansen Test: cannot be rejected for all models.

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