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A Traditional Nominal Wage Phillips Curve: Theory and Evidence

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By combining simple contracting schemes with firms' optimisation, we provide theoretical underpinnings to the traditional nominal wage Phillips curve. The parameters of our Phillips curve have a structural interpretation. We extend the model to include the effect of the labour share, a factor that is absent in the new Keynesian model. Empirically we find that the unemployment parameter of the traditional model is significant, and that of the forward-looking model is wrongly signed. Furthermore, evidence suggests that inflation targeting was accompanied by the flattening of the curve, increased anchoring of inflation expectations and a decline in worker power.

I *Introduction*

In baseline macro-models the inflation rate of the nominal wage usually plays a background role in the determination of price inflation dynamics. Gordon (2011) argues that the absence of wage inertia and the fact that the labour share changes over time weaken the link between price inflation and nominal wage inflation. This permits a separate modelling of the price inflation rate independently of nominal wage inflation. However, the presence or absence of wage inertia is an empirical issue that cannot be ascertained *a priori*. In addition, Gordon (1997) argues that models with a separate price and wage growth equation do not perform as well as the triangle model. This assertion is disputed by Fair (2008), who finds that a system that specifies separate price and nominal wage equations performs better than Gordon's triangle Phillips curve in forecasting inflation. This means that the wage equation contains information about the dynamics of the price level.

From the standpoint of macroeconomic modelling, heterodox scholars, especially the post-Keynesians, have consistently emphasised the centrality of income distribution in the determination of both price and wage formation (*e.g.*, Rochon & Setterfield, 2012; Nishi, 2015). In the post-Keynesian school income distribution, measured by labour share, is a standard variable that is used to describe the various structural regimes which characterise the aggregate demand side of the economy (*e.g.*, Taylor, 1985; Bhaduri & Marglin, 1990; Lavoie & Stockhammer, 2012). Consequently, as in Flaschel *et al*. (2001) and Asada *et al*. (2006), there is motivation for the explicit and separate consideration of the nominal wage and price Phillips curves in macro-models, so that the dynamics of the labour share can be determined.

Within new Keynesian theory, Galí (2011) provides a micro-founded nominal wage Phillips curve, building on the approach of Erceg *et al*. (2000). Galí (2011) motivates the nominal wage Phillips curve on the basis that the coexistence of price and nominal wage rigidities has important implications for the design of optimal monetary policies. For example, Erceg

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et al. (2000) and Canzoneri *et al*. (2004) find that strict nominal wage inflation targeting dominates strict price inflation targeting when both price and nominal wage rigidities are present. To quote Canzoneri *et al*. (2004, p. 28), 'wage inflation targeting seems very attractive. It is easy to explain, and presumably to implement, and its good performance vis á vis price inflation-targeting and hybrid rules seems to be robust across a variety of models'. In addition, Galí's contribution in the formulation of the new Keynesian nominal wage Phillips curve opens the possibility of an extension of the canonical new Keynesian model to consider the role of income distribution.

Very little research has been conducted to assess the empirical strength of the new Keynesian nominal wage Phillips curve, as compared with the price Phillips curve. We think that the criticisms of the new Keynesian price Phillips curve are likely to carry over to its nominal wage counterpart. For example, Rudd and Whelan (2005, 2007) and Fair (2008) do not find significant empirical forward-looking behaviour in the expectations formation process for the price Phillips curve. Second, Gordon (2011) finds that the new Keynesian Phillips curve produces very poor dynamic forecasts of the price inflation rate while the backward-looking Phillips curve does a very good job in this regard. Both these and other criticisms leave the traditional Phillips curve, with its poor theoretical foundations, as a framework that best describes the dynamics of the price inflation process.

In this paper we close this gap in the literature by providing some theoretical foundations for the traditional nominal wage Phillips curve. Using simple contract-setting schemes, we show that a traditional nominal wage Phillips curve can be derived so that its parameters have a structural interpretation in much the same way as Galí's (2011) new Keynesian nominal wage Phillips curve. A key difference between our baseline nominal wage Phillips curve and its new Keynesian counterpart is that ours does not contain the forward-looking term of nominal wage inflation. This Phillips curve is therefore similar in form to a limiting case of the one proposed by Galí with indexation, with only backward-looking expectations. With some further extension, our Phillips curve can incorporate a labour share term similar to that found by Blanchard and Katz (1999), which they attribute to Sargan (1964). We believe that the nominal wage Phillips curve that we derive in this paper provides a credible alternative to the new Keynesian version.

The paper is structured as follows. Section II presents the theoretical derivation of the traditional nominal wage Phillips curve. Section III provides the empirical evidence for such a curve. Section IV explores whether the policy transition towards inflation targeting has affected the structural parameters of the model. Section V concludes with directions for future research.

II Theoretical Framework

(i) Nominal Wage-Setting

Assume an economy that is populated by two groups of workers: for the first group their wage is equal to its market-clearing level for their labour, and for the second group their wage is set through contracts. Therefore, the average nominal wage in this economy is:

$$W_t = (1-\nu_w)W_t^* + \nu_w W_t^c, \tag{1}$$

where W_t is the average wage level, W_t^* is the market-clearing wage for the first group, W_t^c is the contract wage for the second group and $0 < \nu_w < 1$ is the fraction of workers who receive the contract wage. The contract wage of the second group of workers is determined by the previous wage level as a reference point, projected forward using the expected inflation rate and trend productivity growth, as follows:

$$W_t^c = \left(1+\pi_{t-1}^e\right)(1+g^n)W_{t-1}, \tag{2}$$

where π_t^e is the expected rate of inflation that is applied on the contracted nominal wage and g^n is the trend growth rate of labour productivity, which we assume is constant. Note that Equation (2) is similar to the automatic indexation of wage inflation to price inflation that is also used by Galí (2011). The only difference is that Galí indexes wage inflation to a moving average of price inflation, whereas in our case the contract wage is driven by expected price inflation. Equation (1) can be written as follows:

$$W_t = (1-\nu_w)W_t^* + \nu_w\left(1+\pi_{t-1}^e\right)(1+g^n)W_{t-1}. \tag{3}$$

Dividing both sides by W_{t-1}, we can express Equation (3) in terms of the nominal wage inflation rate:

$$\left(1+\tilde{\pi}_t^w\right) = (1-\nu_w)\left(1+\tilde{\pi}_t^w\right)\left(\frac{W_t^*}{W_t}\right) + \nu_w\left(1+\pi_{t-1}^e\right)(1+g^n), \tag{4}$$

where $\tilde{\pi}_t^w$ is the nominal wage inflation rate. Dividing both sides by $(1+g^n)$ we obtain the following:

$$\left(\frac{1+\tilde{\pi}_t^w}{1+g^n}\right) = (1-\nu_w)\left(\frac{1+\tilde{\pi}_t^w}{1+g^n}\right)\left(\frac{W_t^*}{W_t}\right) + \nu_w\left(1+\pi_{t-1}^e\right). \tag{5}$$

Now note that at the steady state $\left(\frac{1+\tilde{\pi}_0^w}{1+g^n}\right) = (1+\pi_0)$, where $\tilde{\pi}_0^w$ is the steady state nominal wage inflation rate and π_0 is the steady state price inflation rate. Further note that the natural log of $\left(\frac{1+\tilde{\pi}_t^w}{1+g^n}\right)$ is approximately $\tilde{\pi}_t^w - g^n$, which we denote by π_t^w. This is nominal unit labour cost inflation. Therefore, linearising Equation (5) around the steady state, we obtain:

$$\pi_t^w = (1-\nu_w)\pi_t^w + (1-\nu_w)\left(\hat{w}_t^* - \hat{w}_t\right) + \nu_w \pi_{t-1}^e. \tag{6}$$

By making π_t^w the subject of the formula we obtain:

$$\pi_t^w = \pi_{t-1}^e + \lambda_w\left(\hat{w}_t^* - \hat{w}_t\right). \tag{7}$$

where $\lambda_w = \left(\frac{1-\nu_w}{\nu_w}\right)$ measures the degree of nominal wage flexibility. From Equation (7) we note that nominal wage inflation is due to the inflation rate of the contract wage and the gap between the nominal wage and its market-clearing level. Note that we can write the average nominal wage as $W_t = (1+\mu_t)W_t^*$, where μ_t is the average mark-up rate. Therefore, we can also restate Equation (7) in terms of the mark-up rate as follows:

$$\pi_t^w = \pi_{t-1}^e - \lambda_w\left(\mu_t^w - \mu^w\right). \tag{8}$$

Equation (8) is similar to Galí's (2011) wage equation, which is expressed in terms of the mark-up rate. We are now in the position to introduce the unemployment rate.

(ii) Technology

In order to introduce the unemployment rate, Galí (2011) considers the behaviour of the marginal supplier of labour. In our case, we consider the behaviour of firms that are confronted by workers who are paid the average nominal wage. Therefore, to introduce the unemployment rate in Equation (8) we think of the economy as composed of N_t employed workers, each earning an average nominal wage W_t. This view of the economy is consistent with Equation (1) because it implies that $W_t N_t = W_t^* N_t^* + W_t^c \tilde{N}_t$, where N_t^* is the number of workers who earn the market-clearing wage and $\tilde{N}_t$ is the number of workers who earn the contract wage This in turn implies that $\nu_w = \frac{\tilde{N}_t}{N_t}$. We next assume that firms use the following aggregate production function:

$$Y_t = N_t^{1-\alpha}, \tag{9}$$

where N_t is the level of employment. The optimal employment condition for firms who are confronted by workers who are paid the average wage is:

$$\frac{W_t}{P_t} = (1-\alpha)N_t^{-\alpha}. \tag{10}$$

Now, note that if $W_t = W_t^*$, then firms would employ all labour in this economy, as W_t^* is the market clearing nominal wage in Equation (1). Therefore, at full employment, that is, at the point where the labour market clears, Equation (10) becomes:

$$\frac{W_t^*}{P_t} = (1-\alpha)L_t^{-\alpha}, \tag{11}$$

where L_t is the labour force. Divide Equation (10) by Equation (11) to obtain:

$$\frac{W_t}{W_t^*} = \left(\frac{N_t}{L_t}\right)^{-\alpha}. \tag{12}$$

We log-linearise Equation (12) to obtain the following equation:

$$w_t - w_t^* = -\alpha(n_t - l_t), \tag{13}$$

where n_t is the natural log of employment and l_t is the natural log of the labour force. Since $(n_t - l_t)$ is the natural log of the employment rate, we have $(n_t - l_t) \approx -u_t$, where u_t is the unemployment rate. Expressing Equation (13) in terms of the average wage mark-up and the unemployment rate, and taking deviations from the steady state we obtain:

$$\mu_t^w - \mu^w = \alpha(u_t - u_0), \tag{14}$$

where $u_0 = \frac{\mu^w}{\alpha}$. Therefore, as in Galí (2011), the equilibrium unemployment rate is determined by the equilibrium mark-up rate. Equation (14) provides a straightforward way to introduce the unemployment rate in Equation (8), thereby leading to the wage Phillips curve.

(iii) The Baseline Traditional Wage Phillips Curve

Replacing $\mu_t^w - \mu^w$ from Equation (8) using Equation (14), we obtain the following equation:

$$\pi_t^w = \pi_{t-1}^e - \lambda_w \alpha(u_t - u_0) \tag{15}$$

This is the baseline traditional nominal wage Phillips curve. Note that its slope depends on proportion λ_w, which in turn depends on the fraction of workers whose wages are set at the market-clearing level. The higher the share of workers whose wages are set at the market clearing level, the larger is the slope of the nominal wage Phillips curve. Also, the slope of the nominal wage Phillips curve depends on the technology parameter (the elasticity of output with respect to labour), which is $(1-\alpha)$. The larger is output elasticity with respect to labour, the smaller is the slope of the nominal wage Phillips curve.

A few words are in order regarding the differences and similarities between Equation (15) and its new Keynesian counterpart found in Galí (2011). The two key differences are, first, that Equation (15) does not contain forward-looking nominal wage inflation on the righthand side, as is the case in the baseline new Keynesian model; and second, instead of the Frisch elasticity of labour supply, our Phillips curve has the elasticity of output with respect to labour. Nevertheless, our Phillips curve is similar in form to the new Keynesian version, in so far as the latter is purely backward-looking. In other words, Equation (15) can be viewed as a special case of the new Keynesian model where the discount factor is zero.

(iv) The Sargan–Blanchard–Katz Effect

We now introduce in the nominal wage Phillips curve the effect of the labour share similar to the wage Phillips curve in Blanchard and Katz (1999), which they attribute to Sargan (1964). The labour share appears in this Phillips curve through a postulation that the reservation wage depends on the lagged nominal wage and productivity in a manner that makes the unemployment rate stationary, or rather in a manner that leaves the labour share stationary. To include the labour share effects in our wage Phillips curve, we modify the manner in which the contract wage is set.

In addition to expected inflation and projected productivity growth, workers also use their bargaining strength in negotiating their contract wages. Suppose that the bargaining strength is measured by the level of the labour share relative to its steady state level so that, if workers' bargaining strength rises, the labour share rises above the steady state. Let the steady state labour share be denoted by S^*. We therefore modify the contracting equation as follows:

$$W_t^c = \kappa_w \left(1 + \pi_{t-1}^e\right)(1 + g^n)\left(\frac{S_{t-1}}{S^*}\right)^{1-\omega} W_{t-1}. \tag{16}$$

The parameter $\omega \gtreqless 1$ represents the impact of bargaining strength on the contracted nominal wage. In particular, ω represents the degree of wage demand moderation when the labour share is above its steady state level. Therefore, if $\omega < 1$, workers tend to moderate their wage demands less when the labour share is above its steady state level. This is likely the case where wage bargaining is dominated by militant trade unions. However, if $\omega > 1$ workers moderate their wage demands more when the labour share is higher than its steady state level. This modification of the contract wage leads to the following modification of Equation (5):

$$\left(\frac{1 + \tilde{\pi}_t^w}{1 + g^n}\right) = (1 - \nu_w)\left(\frac{1 + \tilde{\pi}_t^w}{1 + g^n}\right)\left(\frac{W_t^*}{W_t}\right) + \nu_w\left(1 + \pi_{t-1}^e\right)\left(\frac{S_{t-1}}{S^*}\right)^{1-\omega} \tag{17}$$

Log-linearising Equation (17) around the steady state and expressing it in terms of the wage mark-up gap we obtain:

$$\pi_t^w = \pi_{t-1}^e + (1-\omega)(s_{t-1} - s^*) - \lambda_w\left(\mu_t^w - \mu^w\right) \tag{18}$$

On the basis of Equation (18), we can modify Equation (15) so that we obtain:

$$\pi_t^w = \pi_{t-1}^e + (1-\omega)(s_{t-1}-s^*) - \lambda_w \alpha (u_t - u^*) \quad (19)$$

Therefore, if the bargaining process is not dominated by sufficiently moderate trade unions the labour share will have a positive impact on nominal wage inflation. The implication is that the local dynamics of the labour share will be unstable.

III Empirical Evidence

We use quarterly data drawn from the FRED database, and in some cases augmented with data from national statistics offices. For both the price and nominal unit labour cost inflation rates we use annualised log differences. Figure 1 illustrates the relationship between the nominal unit labour cost inflation rate and the unemployment rate. For most of the economies in our sample we observe a broadly negative relationship between these two variables, confirming the Phillips curve relationship. Another observation is that nominal unit labour cost inflation is more volatile than the unemployment rate, which means that while the unemployment rate may explain the low-frequency variations in the nominal unit labour cost inflation rate, there are other factors that explain the high-frequency fluctuations.

The baseline Equation (15) does not allow the full identification of the parameters. Galí (2011) calibrates the Frisch elasticity of labour supply; in our case we have to calibrate the elasticity of output with respect to labour. To do this, we note from Equation (10) that:

$$\frac{W_t N_t}{P_t Y_t} = (1-\alpha) \quad (20)$$

Therefore, $(1-\alpha)$ is the labour share. We then use the average of the labour share from the data to calibrate the value for α, which we also use to calibrate s^*. Table 1 lists the estimates for α for each economy.

Regarding inflation expectations π_t^e we also follow Galí in using a moving average measure, in our case we use the eight-order moving average of the price inflation rate. Table 2 reports results for the basic nominal wage Phillips curve in Equation (15). The results show that $\lambda_w = 1.46$ for Australia, with a non-accelerating inflation rate of unemployment (NAIRU) of 5 per cent, which implies nominal wage rigidity of $\nu_w = 0.41$. This estimate of the NAIRU is closer to the estimate in Gruen *et al*. (1999) for the period 1965–97, and the estimate is consistent with the more recent one found by Chua and Robinson (2018) which is 5.5 per cent. For the European Union (EU) we find that $\lambda_w = 0.41$, which implies a substantial nominal wage rigidity of $\nu_w = 0.71$, with a NAIRU of 8 per cent. In the case of the US, we find that $\lambda_w = 1.66$, with a NAIRU of 5 per cent, which implies nominal wage rigidity of $\nu_w = 0.38$. The NAIRU estimate is consistent with the one in Galí (2011), who also finds it to be 5 per cent.

There is very little research on emerging market nominal wage Phillips curves. In the case of Mexico we have that $\lambda_w = 3.54$, which implies that nominal wage rigidity is $\nu_w = 0.22$, with a NAIRU of 3 per cent. In Turkey, nominal wage rigidity is $\nu_w = 0.42$, with a NAIRU of 12 per cent. In South Africa the coefficient λ_w is not significant and the estimated NAIRU is 30 per cent. As the following results will show, this suggests that the baseline formulation that we estimate in Table 1 does not fit the South African and Japanese data.

The baseline nominal wage Phillips curve in Equation (15) does not prescribe the expectations formation process. Therefore, it provides flexibility in econometrically choosing the best expectations formation process to fit the data. Therefore, we consider an alternative expectations formation process than a simple moving average process. Blanchard (2016) states that inflation expectations have become more anchored, leading to the change in the Phillips curve from its accelerationist version to the old version first postulated by Phillips in the 1960 s. A similar finding is expressed by Ball and Mazumder (2019). To incorporate the idea of anchored inflation expectations, suppose that inflation expectations are given by $\pi_t^e = \gamma \overline{\pi}_t^{(8)} + (1-\gamma)\pi^*$, where $\overline{\pi}_t^{(8)}$ is the eight-quarter moving average rate of inflation and π^* is the average rate of inflation. Table 3 reports the results with this type of expectations formation process.

The results show an improvement in the fit of the model, with a higher R^2. We have that $\lambda_w = 1.27$ for Australia, with a NAIRU of 5 per cent, which implies nominal wage rigidity of $\nu_w = 0.44$. The anchoring of inflation to a constant average is 0.32. For the US, nominal wage rigidity slightly increases to 0.40 and the NAIRU remains 5 per cent. The anchoring of inflation to a constant average is very weak at 0.08. Note that this result is consistent with the one found by Blanchard (2016), who finds that inflation is

FIGURE 1
Nominal Unit Labour Cost Inflation and the Unemployment Rate [Colour figure can be viewed at wileyonlinelibrary.com]

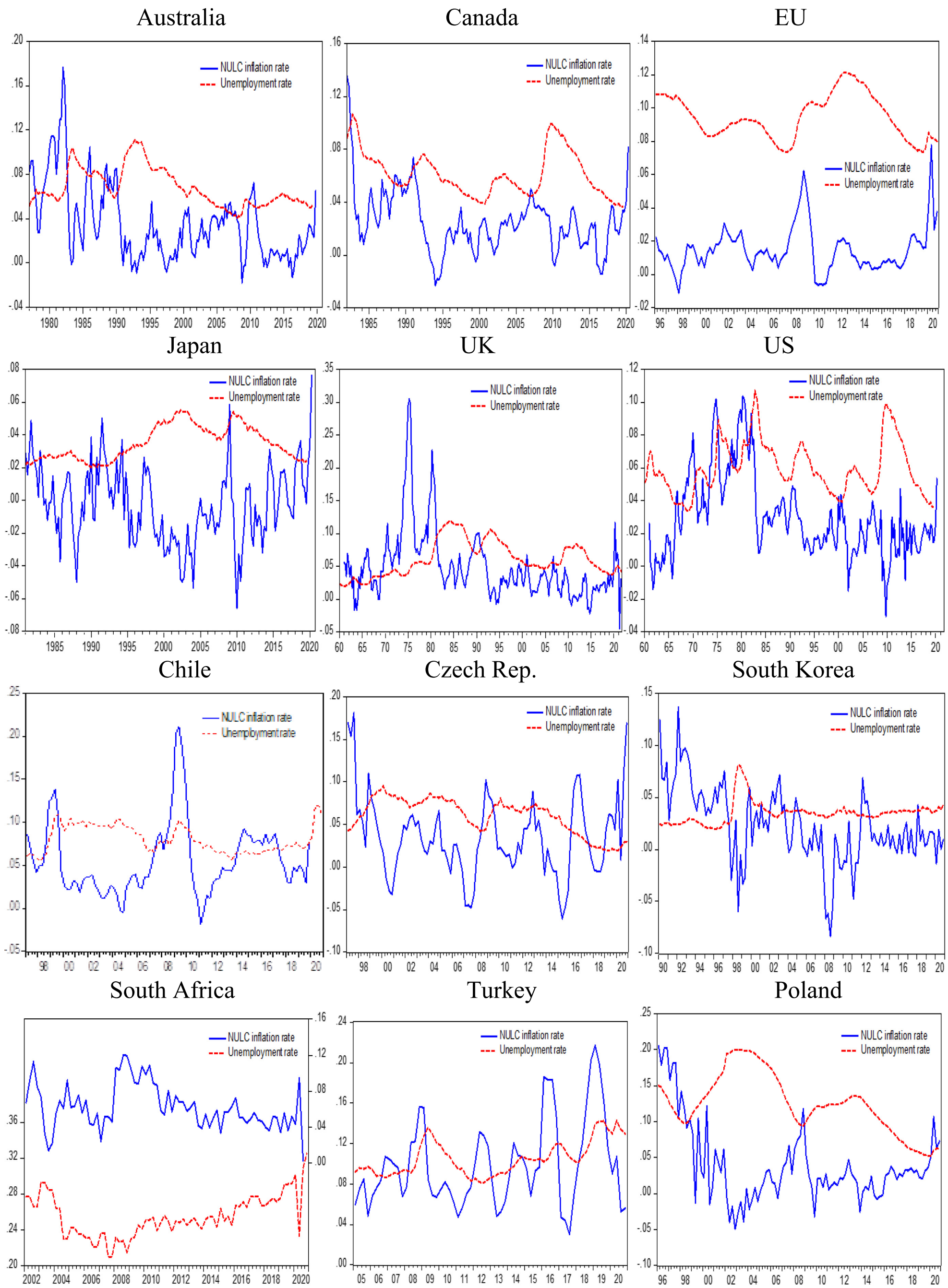

TABLE 1
Estimated Elasticity of Output with Respect to Labour

	α
Advanced economies	
Australia (1966Q3–2019Q2)	0.50*
	(0.00)
Canada (1961Q1–2019Q3)	0.49*
	(0.00)
European Union (1995Q1–2020Q4)	0.53*
	(0.00)
Japan (1994Q1–2020Q4)	0.50*
	(0.00)
New Zealand (1991Q1–2019Q2)	0.55*
	(0.00)
UK (1960Q1–2019Q2)	0.49*
	(0.01)
USA (1960Q1–2019Q3)	0.37*
	(0.00)
Emerging economies	
Chile (1997Q1–2019Q4)	0.83*
	(0.00)
Czech Republic (1996Q1–2020Q4)	0.59*
	(0.00)
Mexico (2009Q1–2019Q4)	0.63*
	(0.00)
Poland (1995Q1–2020Q4)	0.61*
	(0.00)
South Africa (1994Q1–2020Q4)	0.49*
	(0.01)
South Korea (1990Q1–2020Q4)	0.52*
	(0.00)
Turkey (2005Q1–2020Q4)	0.72*
	(0.01)

Note: Standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

TABLE 2
Basic Wage Phillips Curve (Eq. 16)

	λ_w	u^*	R^2
Advanced economies			
Australia (1978:1–2019:2)	1.46*	0.05*	0.35
	(0.47)	(0.01)	
Canada (1982:1–2019:3)	1.06*	0.05*	0.29
	(0.46)	(0.01)	
European Union	0.41*	0.08*	0.27
(1996:1–2019:4)	(0.19)	(0.01)	
Japan (1981:1–2019:3)	0.49	−0.01	0.29
	(0.42)	(0.04)	
New Zealand	0.92*	0.05*	0.08
(1990:1–2019:2)	(0.19)	(0.01)	
UK (1960:1–2021:4)	1.12*	0.06*	0.43
	(0.36)	(0.00)	
USA (1962:1–2019:3)	1.66*	0.05*	0.66
	(0.29)	(0.00)	
Emerging markets			
Chile (1997:1–2019:4)	0.76**	0.11*	0.38
	(0.38)	(0.02)	
Czech Republic	1.18*	0.07*	0.26
(1997:1–2020:2)	(0.52)	(0.01)	
Mexico (2009:1–2019:4)	3.54*	0.03*	0.15
	(1.42)	(0.01)	
Poland (1996:1–2020:4)	0.89*	0.10*	0.64
	(0.20)	(0.01)	
South Africa (2002:1–2020:2)	0.30	0.30*	0.11
	(0.28)	(0.06)	
South Korea (1990:1–2021:3)	2.00*	0.02*	0.39
	(0.56)	(0.01)	
Turkey (2005:3–2020:4)	1.36*	0.12*	0.16
	(0.56)	(0.01)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

largely anchored on the four-quarter moving average of past inflation rates. Note that the results for Japan have improved, with λ_w now exhibiting statistical significance, in contrast to the baseline version estimated in Table 2.

For emerging markets, we have for Mexico that $\lambda_w = 4.28$, which implies that nominal wage rigidity is now $\nu_w = 0.19$, with a NAIRU of now 4 per cent. In Turkey, nominal wage rigidity is $\nu_w = 0.41$, with a NAIRU of 11 per cent. In South Africa the coefficient λ_w is now significant at 0.61 with an estimated NAIRU is 24 per cent, despite the inclusion of data in the 1990 s. By estimating the equation from 2000 onwards, the results change substantially because of improved data quality on the unemployment rate. The implied nominal wage rigidity is $\nu_w = 0.62$. Also note that the results for South Africa now exhibit statistical significance, in contrast to the baseline version estimated in Table 2.

A few countries exhibit an anomalous size of the anchoring parameter γ. For an example for Chile the parameter is 1.61 and for Turkey it is 1.06. Yet, this parameter is supposed to be between 0 and 1. This could indicate that the inflation expectations formation process is not specified adequately, so that other variations of inflation expectations could be explored in these cases. For Mexico, the sign of γ is not correct, but the parameter is not statistically significant, and the rest of the parameters are correctly signed and significant.

Table 3
Wage Phillips Curve with Anchored Expectations

	λ_w	u^*	γ	R^2
Advanced economies				
Australia (1978: 1–2019:2)	1.27*	0.05*	0.68*	0.44
	(0.37)	(0.01)	(0.14)	
Canada (1982: 1–2019:3)	0.55*	0.04*	0.67*	0.37
	(0.26)	(0.02)	(0.19)	
European Union (1996: 1–2019:4)	0.56*	0.08*	0.79*	0.19
	(0.25)	(0.01)	(0.31)	
Japan (1981: 1–2019:3)	1.56*	0.01	0.41*	0.38
	(0.38)	(0.01)	(0.13)	
New Zealand (1990: 1–2019:2)	0.75*	0.02	0.51*	0.15
	(0.25)	(0.03)	(0.25)	
UK (1960:1–2021:4)	1.03*	0.06*	0.82	0.46
	(0.40)	(0.01)	(0.20)	
USA (1962: 1–2019:3)	1.51*	0.05*	0.92*	0.67
	(0.35)	(0.00)	(0.10)	
Emerging markets				
Chile (1997: 1–2019:4)	0.80**	0.11*	1.61*	0.47
	(0.40)	(0.01)	(0.69)	
Czech Republic (1997: 1–2020:2)	1.17*	0.07*	0.98*	0.26
	(0.54)	(0.01)	(0.29)	
Mexico (2009: 1–2019:4)	4.28*	0.04*	−1.10	0.21
	(1.38)	(0.00)	(0.95)	
Poland (1996: 1–2020:4)	0.80*	0.11*	0.73*	0.73
	(0.17)	(0.01)	(0.07)	
South Africa (1994:1–2020:2)	0.61*	0.24*	0.46*	0.28
	(0.24)	(0.02)	(0.17)	
South Korea (1990: 1–2021:3)	2.10*	0.02*	0.86*	0.40
	(0.51)	(0.01)	(0.16)	
Turkey (2005: 3–2020:4)	1.42*	0.11*	1.06**	0.16
	(0.61)	(0.01)	(0.54)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

Table 4
Phillips Curve with Sargan–Blanchard–Katz Effect

	λ_w	u^*	ω	R^2
Advanced economies				
Australia (1978: 1–2019:2)	1.18*	0.05*	1.18*	0.39
	(0.47)	(0.01)	(0.12)	
Canada (1982: 1–2019:3)	0.82**	0.05*	1.16*	0.32
	(0.43)	(0.01)	(0.11)	
European Union (1996:1–2019:4)	0.41*	0.08*	0.93*	0.27
	(0.16)	(0.01)	(0.14)	
Japan (1981: 1–2019:3)	1.71*	0.03*	0.72*	0.43
	(0.48)	(0.00)	(0.14)	
New Zealand (1990:1–2019:2)	1.29*	0.06*	0.87*	0.10
	(0.35)	(0.00)	(0.10)	
UK (1960:1–2021:4)	1.61*	0.06*	1.12*	0.45
	(0.44)	(0.00)	(0.12)	
USA (1962: 1–2019:3)	1.65*	0.05*	1.02*	0.66
	(0.29)	(0.00)	(0.05)	
Emerging markets				
Chile (1997: 1–2019:4)	0.98*	0.11*	0.96*	0.44
	(0.36)	(0.01)	(0.04)	
Czech Republic (1997:1–2020:2)	1.63**	0.06*	1.25*	0.31
	(0.83)	(0.01)	(0.26)	
Mexico (2009: 1–2019:4)	3.55*	0.03*	1.02*	0.20
	(1.64)	(0.01)	(0.06)	
Poland (1996: 1–2020:4)	0.93*	0.11*	1.36*	0.76
	(0.11)	(0.01)	(0.05)	
South Africa (2002:1–2020:2)	0.37	0.29*	1.20*	0.26
	(0.24)	(0.04)	(0.08)	
South Korea (1990:1–2021:3)	1.92*	0.02*	0.98*	0.39
	(0.65)	(0.01)	(0.02)	
Turkey (2005: 3–2020:4)	1.69*	0.11*	0.77*	0.19
	(0.79)	(0.01)	(0.12)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

Table 4 reports results for Equation (19), which is the nominal wage Phillips curve that features the Sargan–Blanchard–Katz term. We observe that there are instances where $\omega > 1$ which, according to the theory, implies that wage bargaining is characterised by moderation. Among the advanced economies this is the case in Australia, Canada, the UK and US. Blanchard and Katz (1999) find that the labour share exhibits strong error-correction in European countries – we find this not to be the case in our estimation. Instead, we find that the labour share positively affects nominal wage inflation. Nevertheless, for the US, Blanchard and Katz find that the labour share has a coefficient that is close to zero. This corresponds to our finding that $\omega = 1.02$, which implies that $(1-\omega) = -0.02$, which is very small.

Now coming to the estimates of nominal wage rigidity, we note that there is no significant change in nominal wage rigidity and the NAIRU. In Australia nominal wage rigidity is now 0.46, with a NAIRU of 5 per cent remaining unchanged. For Canada, nominal wage rigidity is 0.55, with the NAIRU estimate of 5 per cent. The NAIRU for Japan is 3 per cent, with nominal wage rigidity of 0.37. For the US, nominal wage rigidity remains 0.38, and the NAIRU remains unchanged at 5 per cent. This means that augmenting the nominal wage Phillips curve with the labour share improves the description of the

TABLE 5
Phillips Curve with Anchored Expectations and the Sargan–Blanchard–Katz Effect

	λ_w	u^*	γ	ω	R^2
Advanced economies					
Australia (1978:1–2019:2)	1.35*	0.05*	0.60*	0.92*	0.44
	(0.41)	(0.01)	(0.15)	(0.15)	
Canada (1982:1–2019:3)	0.54*	0.04	0.69*	1.02*	0.37
	(0.27)	(0.02)	(0.25)	(0.16)	
European Union (1996:1–2019:4)	0.40*	0.07*	0.90*	0.93*	0.28
	(0.20)	(0.01)	(0.30)	(0.14)	
Japan (1981:1–2019:3)	2.25*	0.02*	0.52	0.88*	0.38
	(0.66)	(0.01)	(0.41)	(0.12)	
New Zealand (1990:1–2019:2)	1.14*	0.03*	0.50*	0.86*	0.18
	(0.37)	(0.01)	(0.24)	(0.08)	
UK (1960:1–2021:4)	1.32*	0.06*	0.88*	0.91*	0.46
	(0.53)	(0.01)	(0.23)	(0.11)	
USA (1962:1–2019:3)	1.48*	0.05*	0.89*	0.98*	0.67
	(0.35)	(0.00)	(0.11)	(0.05)	
Emerging markets					
Chile (1997:1–2019:4)	0.83**	0.12*	1.58*	0.96*	0.50
	(0.46)	(0.04)	(0.68)	(0.05)	
Czech Republic (1997:1–2020:2)	0.35	0.08*	1.09*	0.56*	0.34
	(0.59)	(0.04)	(0.19)	(0.20)	
Mexico (2009:1–2019:4)	5.11*	0.04*	−1.30	1.00*	0.29
	(1.64)	(0.00)	(0.94)	(0.08)	
Poland (1996:1–2020:4)	0.88*	0.10*	0.90*	1.28*	0.76
	(0.14)	(0.01)	(0.06)	(0.09)	
South Africa (2002:1–2020:2)	0.56*	0.22*	0.57*	1.14*	0.34
	(0.26)	(0.02)	(0.21)	(0.08)	
South Korea (1990:1–2021:3)	2.06*	0.01	0.66*	0.96*	0.41
	(0.51)	(0.01)	(0.29)	(0.04)	
Turkey (2005:3–2020:4)	1.31*	0.10*	0.69	0.77*	0.20
	(0.63)	(0.01)	(0.48)	(0.11)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

dynamics of the nominal wage in all the countries.

Lastly, Table 5 combines both expectations anchoring and the Sargan–Blanchard–Katz effect in the nominal wage Phillips curve. We see for these results that such a combination is admitted by the data, without much change in the structural parameters such as the degree of nominal wage rigidity. For example, for the US, nominal wage rigidity is now estimated to be 0.40, with the NAIRU still at 5 per cent. Similarly, for Australia nominal wage rigidity is 0.43 and the NAIRU is 5 per cent. For the EU nominal wage rigidity is 0.71, with the NAIRU of 7 per cent.

For most countries in our sample, it is clear that $\omega < 1$, meaning that the bargaining process is not characterised by wage moderation when the labour share exceeds its steady state level. The above results confirm that the traditional nominal wage Phillips curve that we have derived fits the data, in the sense that its parameters are statistically significant and correctly signed. We now turn to the issue of whether the change in the monetary policy regime towards inflation targeting has affected the parameters of the model.

IV Has Inflation Targeting Flattened the Nominal Wage Phillips Curve?

The overriding goal of inflation targeting as a policy framework is to stabilise inflation expectations at a low level. One of the consequences of achieving this goal is that once inflation expectations are credibly anchored at a low and stable level, workers and employers would find it easy to enter into longer term contracts without fear that, in the interim, price changes would not be such as to destabilise the relative purchasing power of their incomes. We now test if inflation targeting has reduced λ_w. In doing so, we go some way to test one of the hypotheses forward by Kuttner and Robinson (2010) in their conclusion that perhaps the flattening of the Phillips curve could be due to the improved monetary policy implementation which could lead to infrequent price resetting.

The analysis is limited by the availability of data for some countries. For example, Chile announced its adoption of inflation targeting in 1990 and the data we use to estimate the nominal wage Phillips curve start in 1997. Therefore, we only consider those countries that have some data before their adoption of inflation targeting to check if there has been some significant change in the parameters when only data after the adoption of inflation targeting are used for estimation. For the US in particular, we follow Famiglietti and Garriga (2021) and use 1996 as the year of inflation targeting, albeit implicit, because the US explicitly adopted inflation targeting in 2012.

We compare the 'full sample' results that are reported in Table 5 with results that are obtained from estimating the Phillips curve using data after the adoption of inflation targeting. Table 6 shows that for Australia, the estimation starts in 1993, we have λ_w declining from 1.35 to 0.72 after the adoption of inflation targeting. This means that the fraction of workers who enter into contracts has increased from 43 per cent to 58 per cent. For the US the regression starts in 1997, we have that λ_w has declined from 1.48 to 1.13, which means that the fraction of workers who enter into contracts increased from 40 per cent to 47 per cent. For Poland the regression starts in 2000; we observe that λ_w has declined from 0.88 to 0.77, implying that the fraction of workers who enter into contracts has increased from 53 per cent to 56 per cent.

The results for South Africa and the Czech Republic are different. Instead of λ_w decreasing, it has increased. Table 6 shows that for South Africa λ_w has increased from 0.56 to 0.93, implying that the fraction of workers who enter into contracts has declined from 64 per cent to 52 per cent. For the Czech Republic we have that λ_w has increased from 0.35, which was not significant to 1.77, implying that the fraction of workers who enter into contracts has also declined from 74 per cent to 37 per cent.

The above results are not extensive because many countries have not been tested. However,

Table 6
Phillips Curve with Anchored Expectations and Sargan–Blanchard–Katz Effect

	λ_w	u^*	γ	ω	R^2
Advanced economies					
Australia (1993–2019)	0.72**	0.055*	0.15	1.04*	0.13
	(0.37)	(0.01)	(0.23)	(0.20)	
UK (1993–2019)	0.88*	0.065*	0.22	1.05*	0.10
	(0.42)	(0.01)	(0.33)	(0.07)	
US (1997–2019)	1.13*	0.05*	0.35**	1.12*	0.33
	(0.25)	(0.00)	(0.18)	(0.05)	
Emerging markets					
Czech Republic (2005–20)	1.77**	0.06*	0.83	1.08*	0.24
	(1.02)	(0.01)	(0.89)	(0.35)	
Poland (2000–20)	0.77*	0.10*	0.56*	1.12*	0.33
	(0.13)	(0.01)	(0.19)	(0.10)	
South Africa (2002–20)	0.93**	0.28*	0.51*	1.12*	0.33
	(0.51)	(0.01)	(0.19)	(0.11)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

the tentative evidence is that inflation targeting appears to have unambiguously contributed towards the flattening of the Phillips curve in advanced economies, a phenomenon also observed by Blanchard (2016). This result is consistent with the finding by Galí and Gambetti (2020) who confirm the existence of a growing disconnect between nominal wage inflation and the unemployment rate from the new Keynesian perspective. In addition, such a finding is in line with that of Costain *et al.* (2022), who report that the decline in the slope of the Phillips curve is largely driven by state-dependent wage stickiness. For emerging markets, the impact of inflation targeting on the shape of the Phillips curve is not as straightforward. In some cases, inflation targeting appears to have flattened the Phillips curve, while in some cases the slope of the Phillips curve appears to have increased.

In addition to the slope of the Phillips curve, the parameter ω appears to have increased across many economies. This could be due to a decline in labour militancy, where wage moderation now characterises many of the bargaining processes in driving nominal wage setting. This may also mean that the bargaining power of workers has declined relative to that of employers during the inflation targeting period. This result is in line with the view expressed by Stansbury and Summers (2020), who find that since the 1980 s the union wage premium has declined in the US.

Another parameter that has declined is γ. The evidence suggests that inflation expectations are anchored more to a constant inflation target than the moving average measure. In the case of Australia and the UK, this parameter is not significant. This result supports the finding by Blanchard (2016) and Ball and Mazumder (2019), who argue that the accelerationist Phillips curve has given way to a Phillips curve in which inflation expectations have been steadily anchored. It appears that inflation expectations have been steadily anchored to a constant level, leading to a Phillips curve in which the level of inflation, rather than its change, is increasingly related to the unemployment rate.

V *Comparison with Forward-Looking Wage Phillips Curve*

It is useful to empirically compare the above Phillips curve to Galí's (2011) versions. This exercise is also motivated by the fact that π_t^e could as well be forward-looking in as much as it can be backward-looking or a hybrid. We have also noted that our Phillips curve, in so far as it is purely backward-looking, can be thought of as similar to the limiting case of Gali's formulation, although the content of the parameters is different. We also check how this limiting case compares with the above results. Galí's basic nominal wage Phillips curve is of the form:

$$\pi_t^w = \beta E_t \pi_{t+1}^w - \lambda_w \varphi(u_t - u_0), \tag{21}$$

where β is the discount factor and φ is the Frisch elasticity of labour supply. Extended to incorporate wage indexation to past prices, the Phillips curve becomes:

$$\pi_t^w = \gamma\overline{\pi}_{t-1} + \beta\left(E_t\pi_{t+1}^w - \gamma\overline{\pi}_t\right) - \lambda_w\varphi(u_t - u_0). \tag{22}$$

where $\overline{\pi}_t$ is some measure of past price inflation. Table 7 reports the results (the sample sizes are as above). Starting with the basic case, which is Equation (21), across a number of economies, the parameter λ_w is not significant. Where it was positive and significant, it now carries a wrong sign and is not significant. Only Australia exhibits the correct sign at 10 per cent level of significance. Moving on to the case with price indexation, which is Equation (22), we notice that λ_w is now significant at conventional levels, but it still carries a wrong sign in a number of countries, except for Poland and South Korea, where it carries a correct sign and is significant. We also note that the indexation parameter γ carries a wrong sign in several countries. and in others, for example, Mexico and Turkey, it exceeds 1. Although these latter problems can also be found in Table 5, in Table 7 they are worse in that they affect more countries.

The problem of the wrong sign on the forcing variable in forward-looking models also affects the new Keynesian price Phillips curve estimations, as noted by Rudd and Whelan (2007), Malikane (2014) and Abbas *et al.* (2016). Based on the results in Table 7 we conclude that the forward-looking version of the nominal wage Phillips curve is rejected by the data in that the crucial forcing variable, the unemployment rate, carries a wrong sign in many cases, and in some economies it is not significant. Only

TABLE 7
Estimation of the Forward-Looking Wage Phillips Curve

	Basic Wage Phillips Curve				Wage Phillips Curve with Indexation				
	β	$\lambda_w(\varphi=1)$	u^*	R^2	β	λ_w	u^*	γ	R^2
Advanced economies									
Australia	0.99*	0.09**	0.07*	0.78	0.98*	0.09	0.07*	−0.22	0.76
	(0.05)	(0.05)	(0.02)		(0.05)	(0.06)	(0.02)	(0.27)	
Canada	1.03*	−0.08**	0.07*	0.76	1.04*	−0.10*	0.07*	−0.13	0.76
	(0.04)	(0.05)	(0.02)		(0.05)	(0.05)	(0.02)	(0.25)	
European Union	1.05*	−0.10	0.10	0.51	1.07*	−0.07	0.10*	0.57	0.50
	(0.08)	(0.08)	(0.01)		(0.13)	(0.09)	(0.01)	(0.55)	
Japan	0.89*	0.20	0.03*	0.44	0.77*	0.18	0.02	0.81*	0.49
	(0.10)	(0.15)	(0.01)		(0.11)	(0.13)	(0.02)	(0.24)	
New Zealand	0.89*	−0.05	0.03	0.31	0.52*	−0.02*	0.06	0.42*	0.39
	(0.09)	(0.08)	(0.07)		(0.00)	(0.06)	(0.00)	(0.18)	
UK	0.87*	0.03	0.12	0.87	0.86*	0.03	0.11	0.11	0.54
	(0.09)	(0.08)	(0.13)		(0.09)	(0.11)	(0.19)	(0.56)	
USA	1.00*	−0.05	0.07*	0.82	1.00*	−0.02	0.08**	0.60*	0.83
	(0.03)	(0.05)	(0.02)		(0.03)	(0.04)	(0.04)	(0.19)	
Emerging economies									
Chile	1.03*	−0.27*	0.09*	0.81	1.01*	−0.26**	0.09*	−0.27	0.80
	(0.04)	(0.13)	(0.01)		(0.04)	(0.15)	(0.01)	(0.35)	
Czech Republic	0.89*	−0.23	0.05*	0.51	0.83*	−0.25**	0.06*	0.59*	0.51
	(0.09)	(0.15)	(0.02)		(0.09)	(0.14)	(0.01)	(0.21)	
Mexico	0.96*	0.23	0.04*	0.84	0.75*	1.56*	0.06*	−2.12*	0.78
	(0.10)	(0.32)	(0.02)		(0.18)	(0.66)	(0.01)	(0.99)	
Poland	0.94*	0.03	0.14**	0.44	0.46*	0.19*	0.12*	0.88*	0.64
	(0.08)	(0.05)	(0.08)		(0.14)	(0.07)	(0.01)	(0.11)	
South Africa	0.83*	−0.10	0.13	0.27	0.97*	−0.21	0.24*	−0.22	0.13
	(0.11)	(0.14)	(0.20)		(0.12)	(0.17)	(0.05)	(0.20)	
South Korea	0.89*	0.23	0.05*	0.52	0.86*	0.37*	0.04*	0.64*	0.52
	(0.07)	(0.18)	(0.01)		(0.08)	(0.18)	(0.00)	(0.21)	
Turkey	0.90*	−0.66*	0.09*	0.64	1.01*	−0.27*	0.11*	1.01*	0.67
	(0.05)	(0.15)	(0.01)		(0.06)	(0.12)	(0.01)	(0.28)	

Note: GMM estimation. Instruments: 4 lags of nominal unit labour cost inflation, price inflation, unemployment rate. Standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

Poland and South Korea admit the forward-looking nominal wage Phillips curve. Lastly, we consider the limiting case, which is similar to our Phillips curve, where $\beta = 0$ in Equation (22), which implies all workers who enter into contracts are backward looking. This yields a Phillips curve of the form:

$$\pi_t^w = \gamma\overline{\pi}_{t-1} - \lambda_w\varphi(u_t - u_0). \tag{23}$$

Table 8 presents the results. In most of the economies λ_w is significant carries the correct sign. The only exception is Turkey. The sizes of the parameters are comparable with those in Table 2. Compared with the Phillips curve with forward-looking behaviour, the one with pure backward-looking behaviour fits the data in most of the economies in our sample.

Therefore, we conclude that the limiting case of Galí's nominal wage Phillips curve with indexation is comparable with the Phillips curve we have derived and estimated, and that this limiting case, fits the data better than the forward-looking case.

TABLE 8
Estimates of the Wage Phillips Curve with Backward-Looking Expectations

	λ_w	u^*	γ	R^2
Advanced economies				
Australia	0.64*	0.07*	0.68*	0.44
	(0.18)	(0.01)	(0.14)	
Canada	0.27*	0.08*	0.67*	0.37
	(0.13)	(0.02)	(0.19)	
European Union	030*	0.10*	0.79*	0.19
	(0.13)	(0.02)	(0.31)	
Japan	0.89*	0.03*	0.41*	0.38
	(0.31)	(0.01)	(0.15)	
New Zealand	0.41*	0.08*	0.51*	0.15
	(0.14)	(0.02)	(0.25)	
UK	0.51*	0.08*	0.82*	0.46
	(0.20)	(0.02)	(0.21)	
USA	0.56*	0.05*	0.92*	0.67
	(0.13)	(0.01)	(0.10)	
Emerging markets				
Chile	0.64*	0.09*	1.19*	0.64
	(0.29)	(0.02)	(0.49)	
Czech Republic	0.69*	0.07*	0.98*	0.26
	(0.32)	(0.02)	(0.29)	
Mexico	1.91*	0.07*	−1.04	0.78
	(0.59)	(0.01)	(0.85)	
Poland	0.49*	0.13*	0.73*	0.73
	(0.10)	(0.01)	(0.07)	
South Africa	0.63*	0.31*	0.57*	0.35
	(0.15)	(0.02)	(0.19)	
South Korea	1.09*	0.03*	0.89*	0.40
	(0.27)	(0.01)	(0.16)	
Turkey	−0.57	−0.07	−0.04	0.25
	(0.47)	(0.12)	(0.37)	

Note: HAC standard errors are shown in parentheses; *significant at 5%; and **significant at 10%.

VI Conclusions

This paper makes two contributions. First, we provide some theoretical underpinnings for the traditional nominal wage Phillips curve. We show that, based on simple contracting schemes and firms' optimisation, a traditional Phillips curve similar to that of Blanchard and Katz (1999) can be derived. Its parameters have a structural interpretation, in much the same way as its new Keynesian counterpart derived by Galí (2011). Second, our approach allows for an extension of the baseline traditional wage Phillips curve to include the effect of the labour share on nominal unit labour cost inflation. This effect is the subject of extensive discussion by Blanchard and Katz (1997, 1999) and King (2008). This effect is absent in the new Keynesian nominal wage Phillips curve.

Our estimations show that the parameters of our traditional Phillips curve are statistically significant. We find significant nominal wage rigidity across the economies in our sample. Specifically, with regard to the US and the EU, our findings are that nominal wages in the EU are more rigid than in the US. Second, we find that, contrary to an error-correction effect, the effect of the labour share on nominal unit labour cost inflation is positive in many economies over the whole sample periods. Third, we find a significant degree of anchoring of inflation expectations, as observed by Blanchard (2016) and Ball and Mazumder (2019). Fourth, our estimates of the Phillips curve are robust to the specification of inflation expectations. Lastly, we find tentative evidence that the shift towards inflation-targeting has been accompanied by increasing the anchoring of inflation expectations, a flattening of the Phillips curve through increased contracting, and the reduction in worker bargaining power, leading to the labour share generating an error-correcting influence on nominal unit labour cost inflation.

One direction in which the traditional Phillips curve research can be extended is to account for the excess volatility in nominal unit labour cost inflation that cannot be explained by fluctuations in the labour share and the unemployment rate. In many instances, we find that the coefficient of variation is not as high as it should be. We may be tempted to account for this by invoking the idea of persistence in nominal unit labour cost inflation, which can be introduced through indexation. However, another approach would be to explore the role of fluctuations in productivity growth along the lines of Ball and Moffitt (2001).

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Conflict of Interest

No conflict of interest to declare.

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