Heterogeneous Downward Nominal Wage Rigidity: Foundations of a Nonlinear Phillips Curve

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Motivation

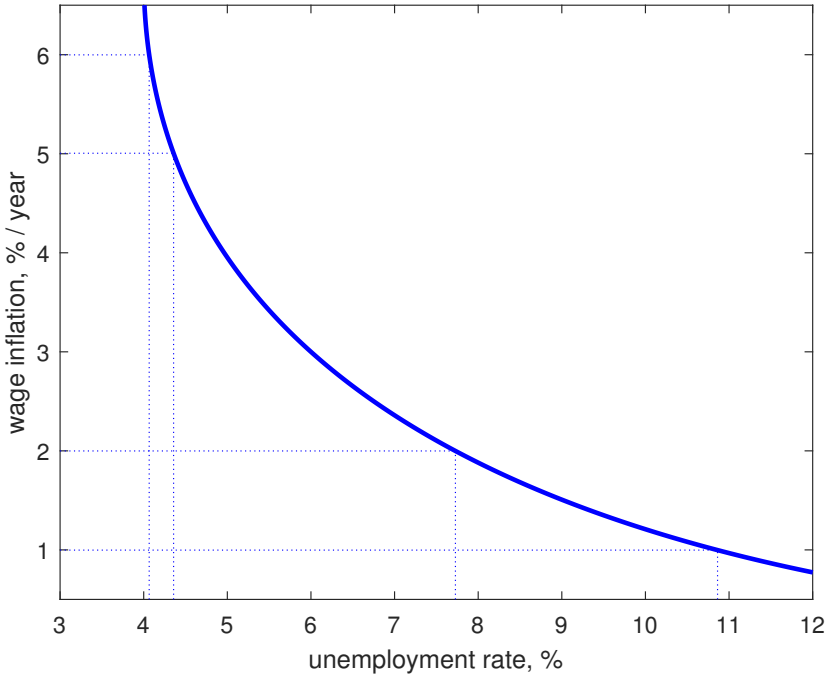
• Two recent major economic events have rekindled interest in a nonlinear Phillips curve:

(1) Resilience of the labor market during the post-Covid-19 monetary tightening (the "missing unemployment" puzzle)
$\Rightarrow$ Is the Phillips curve steeper at high inflation? If so, then low cost of fighting high inflation in terms of unemployment.

(2) No significant increase in inflation in the recovery from the 2008 great contraction (the "missing inflation" puzzle)
$\Rightarrow$ Is the Phillips curve flatter at high unemployment rates? If so, then low cost of reducing high unemployment in terms of inflation.

This paper proposes a model with heterogeneous downward nominal wage rigidity (HDNWR) for individual labor varieties

- The model delivers a nonlinear wage Phillips curve linking current wage inflation with current unemployment that is relatively steep at high levels of inflation and relatively flat at low levels of inflation.
- Calibrated to the US economy, the model predicts that lowering wage inflation from 6 to 5 percent raises unemployment by 0.3 percentage points, whereas lowering wage inflation from 2 to 1 percent raises unemployment by 3 percentage points.



- **Missing unemployment and missing inflation**

Model can account for the resilience of the labor market in the tightening cycle following the post-Covid-19 inflation spike and for the missing inflation in the recovery from the 2008 great contraction.

- **What caused the post-pandemic inflation?**

For the pandemic era, the model predicts that in 2020 and 2021 the U.S. economy was hit by large adverse supply shocks, but that the inflation spike of 2022 was primarily due to demand shocks.

Heterogeneous downward nominal wage rigidity (HDNWR) for individual labor varieties due to:

– cross-sectional dispersion in nominal fairness standards

$$W_{jt} \geq \gamma(j)\, W_{t-1}$$

– or cross-sectional dispersion in labor productivity

$$W_{jt} \geq z_{jt}^{\xi}\, \gamma\, W_{t-1}$$

Empirical evidence on HDNWR: Fehr and Goette, 2005; Bewley, 1999; Campbell and Kamlani, 1997; Murray, 2021; Faia and Pezone, 2023; Fanfani, 2023; Adamopoulou et al, 2024; Davis and Krolikowski, 2024.

The HDNWR Model

- production: $y_t = z_t F(h_t)$; labor input: $h_t = \left[\int_0^1 h_{jt}^{1-\frac{1}{\eta}} dj\right]^{\frac{1}{1-\frac{1}{\eta}}}$
- demand for labor of type j, $h_{jt} = \left(\frac{W_{jt}}{W_t}\right)^{-\eta} h_t$; $W_t^{1-\eta} = \int_0^1 W_{jt}^{1-\eta} dj$
- inelastic labor supply:* $h_{jt} \leq \bar{h}(1 - u_t^n)$
- labor market clearing: $[\bar{h}(1 - u_t^n) - h_{jt}]\,[W_{jt} - \gamma(j) W_{t-1}] = 0$

*For exposition. Results robust to assuming endogenous labor supply.

Short-Run Wage Phillips Curve: $\pi_t^W = f(u_t; u_t^n)$

Wage inflation and unemployment

$$W_t^{1-\eta} = \int_0^1 W_{jt}^{1-\eta} dj$$

$$u_t = \int_0^1 \frac{\bar{h} - h_{jt}}{\bar{h}} dj$$

Express as:

$$\begin{aligned}(1+\pi_t^W)^{1-\eta} &= j_t^* \gamma(j_t^*)^{1-\eta} + \int_{j_t^*}^1 \gamma(j)^{1-\eta} dj \\ u_t &= u_t^n + (1-u_t^n)\left[(1-j_t^*) - \int_{j_t^*}^1 \left(\frac{\gamma(j)}{\gamma(j_t^*)}\right)^{-\eta} dj\right]\end{aligned}$$

$\Rightarrow$ HDNWR model implies Phillips's Phillips Curve: a negative **nonlinear** relation between u_t and π_t^W (without a forward-looking component).

Calibration of the Wage Phillips Curve

Functional form for the wage lower bound

$$\gamma(j) = (1 + \pi^*)(\Gamma_0 + \Gamma_1 j)$$

Calibration of Γ_0 and Γ_1: Two targets

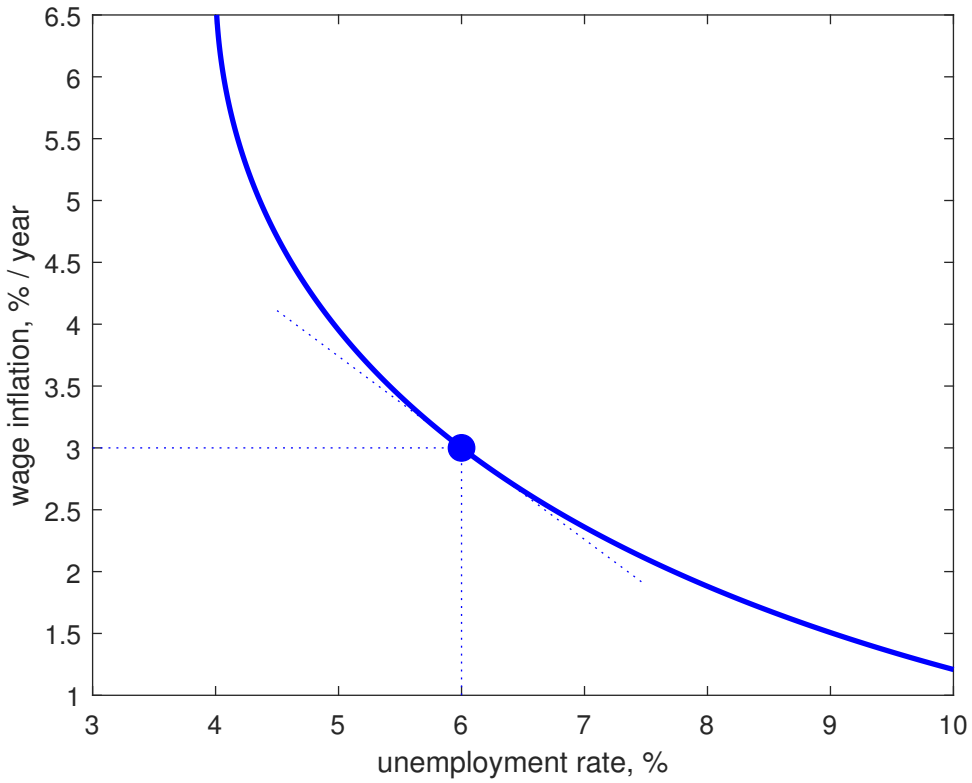
(1) the wage Phillips curve goes through $(u_t, \pi_t^W) = (0.06, 0.03)$, the median of US unemployment and wage inflation 1986–2007.

(2) at that point, the slope of the wage Phillips curve is -0.74 (Galí and Gambetti, 2019, estimate on 1986–2007 US data)

Set $u^n = 4\%$ (natural rate of unemployment) and $\eta = 11$ (elast. subs. across varieties), and $\pi^* = 0.03$ (annual inflation target).

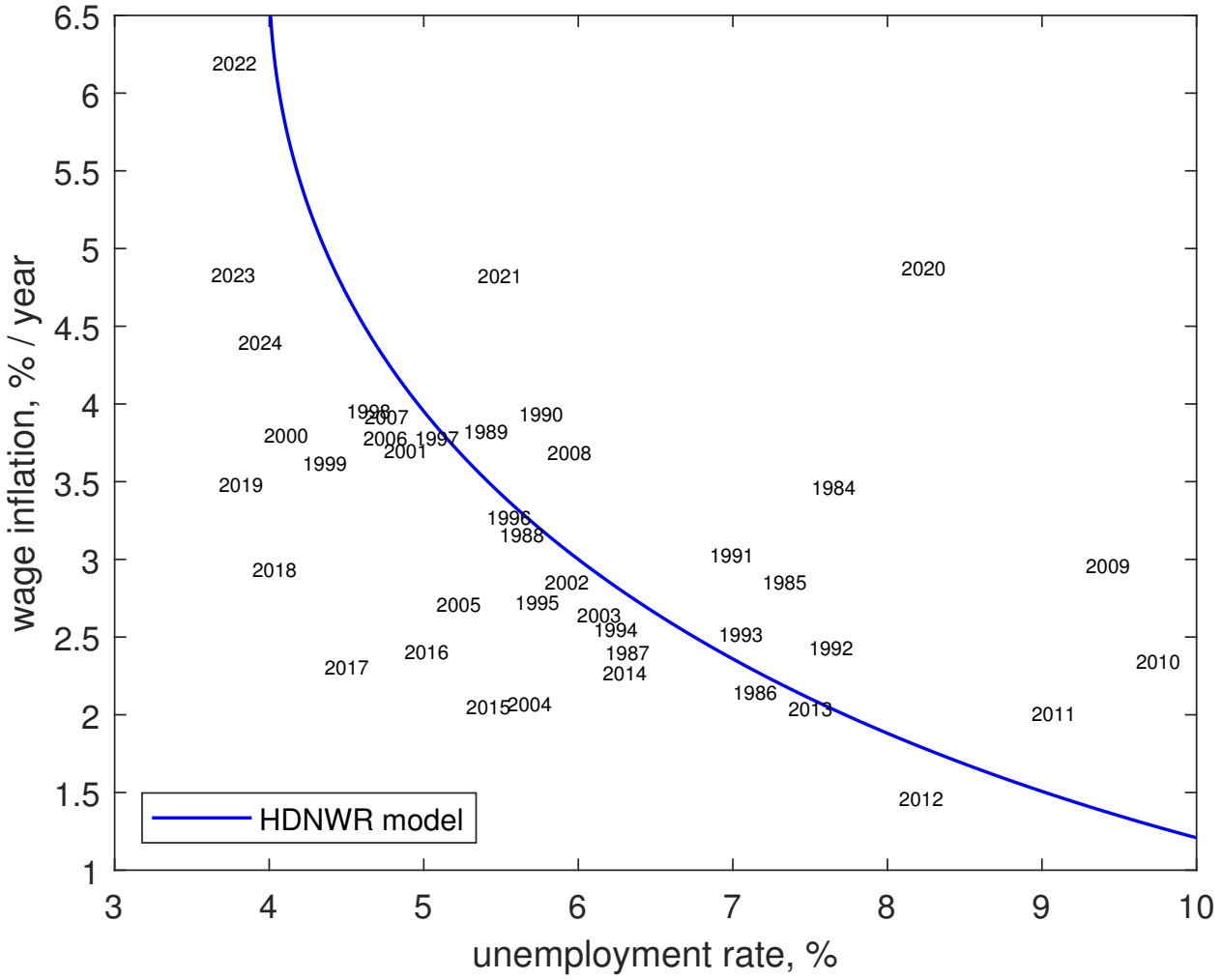
Result: $\Gamma_0 = 0.978$ and $\Gamma_1 = 0.031$ at quarterly frequency.

The Short-Run Wage Phillips Curve of the HDNWR Model



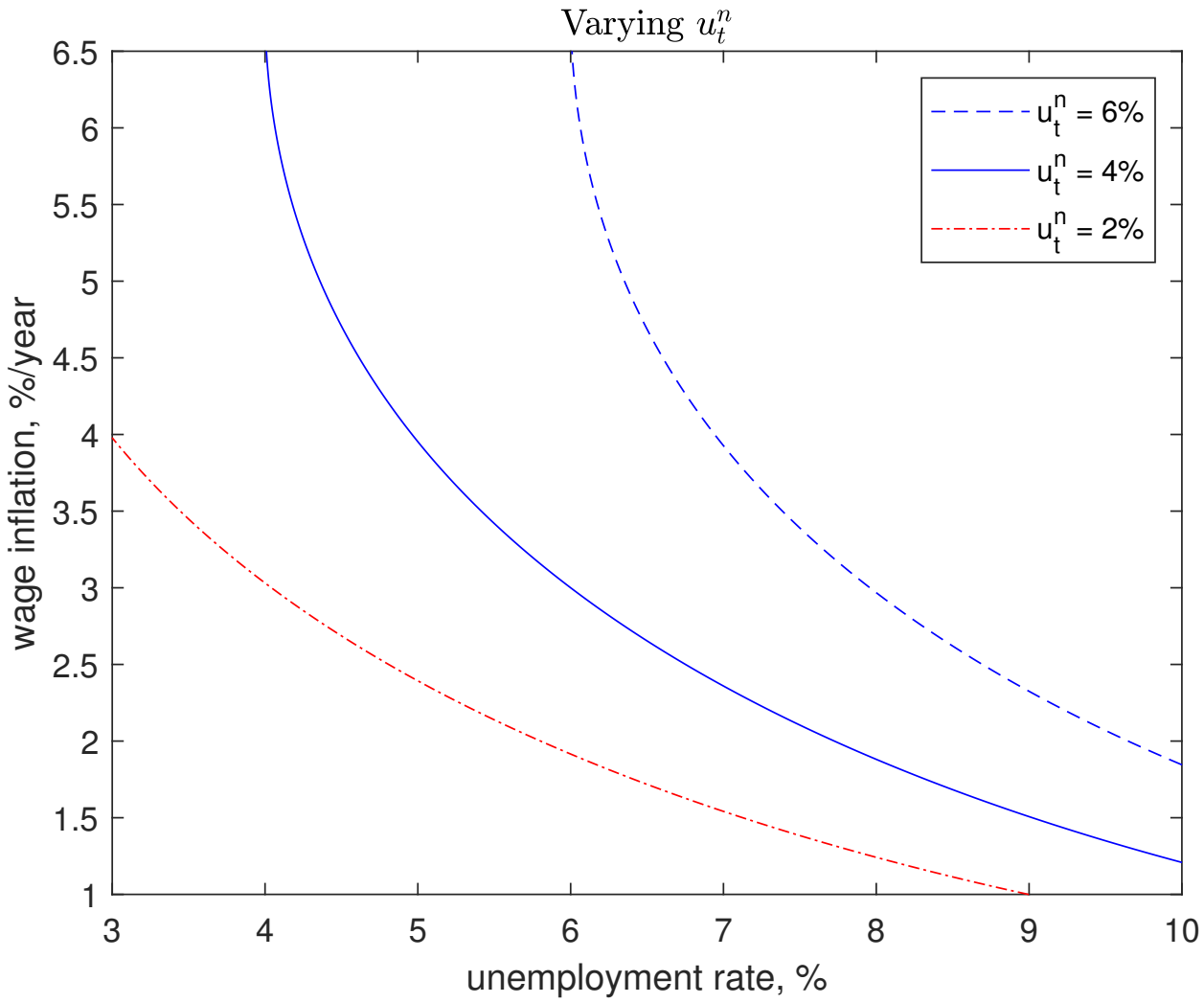
Nonlinearity: lowering inflation from 6 to 5 percent raises the unemployment rate by 0.3 percentage points, whereas lowering inflation from 2 to 1 percent raises the unemployment rate by 3 percentage points.

The HDNWR Wage Phillips Curve and U.S. Data



Notes. Annual wage inflation is computed as the average of year-over-year monthly wage inflation. The measure of monthly nominal wages is Average Hourly Earnings of Production and Nonsupervisory Employees, FRED series AHETPI. The annualized unemployment rate is the arithmetic mean of monthly unemployment rates, FRED series UNRATE. The observation labeled 2024 in the figure refers to unemployment and wage inflation in the first three months of 2024. Sample: 1984 to 2024.

Shifters of the Wage Phillips Curve
The Aggregate Supply Shock, u_t^n



Note. The solid line corresponds to the baseline calibration.

Aggregate Supply Shocks in the Pandemic Era

Year	Actual Wage Inflation π_t^W	Actual Unemployment u_t	Predicted Supply Shock $u_t^n - u^n$
2020	4.88	8.09	3.70
2021	4.83	5.35	0.92
2022	6.20	3.63	-0.40
2023	4.84	3.63	-0.81

This analysis suggests that:

• the predicted curvature of the Phillips curve is not at odds with the prediction that the economy was buffeted by significant supply shocks during the worst of the pandemic.

• the model interprets the 2022 inflation spike as primarily due to demand shocks.

Conclusions

• This paper proposes a model with heterogeneous downward nominal wage rigidity (HDNWR).

• The model implies a nonlinear convex wage Phillips curve.

• The model can account for both the missing inflation in the aftermath of the 2008 great recession and the missing unemployment during the post-Covid-19 inflation stabilization.

• For the pandemic era, the model predicts that in 2020 and 2021 the U.S. economy was hit by large negative supply shocks, but that the inflation spike of 2022 was primarily due to demand shocks.