Downward Nominal Wage Rigidity

Award Ceremony Lecture

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Columbia University

This lecture is based on joint work with Martín Uribe on downward nominal wage rigidity, in particular,

Schmitt-Grohé and Uribe, "Heterogeneous Downward Nominal Wage Rigidity: Foundations of a Static Phillips Curve," NBER WP 30774, 2022.

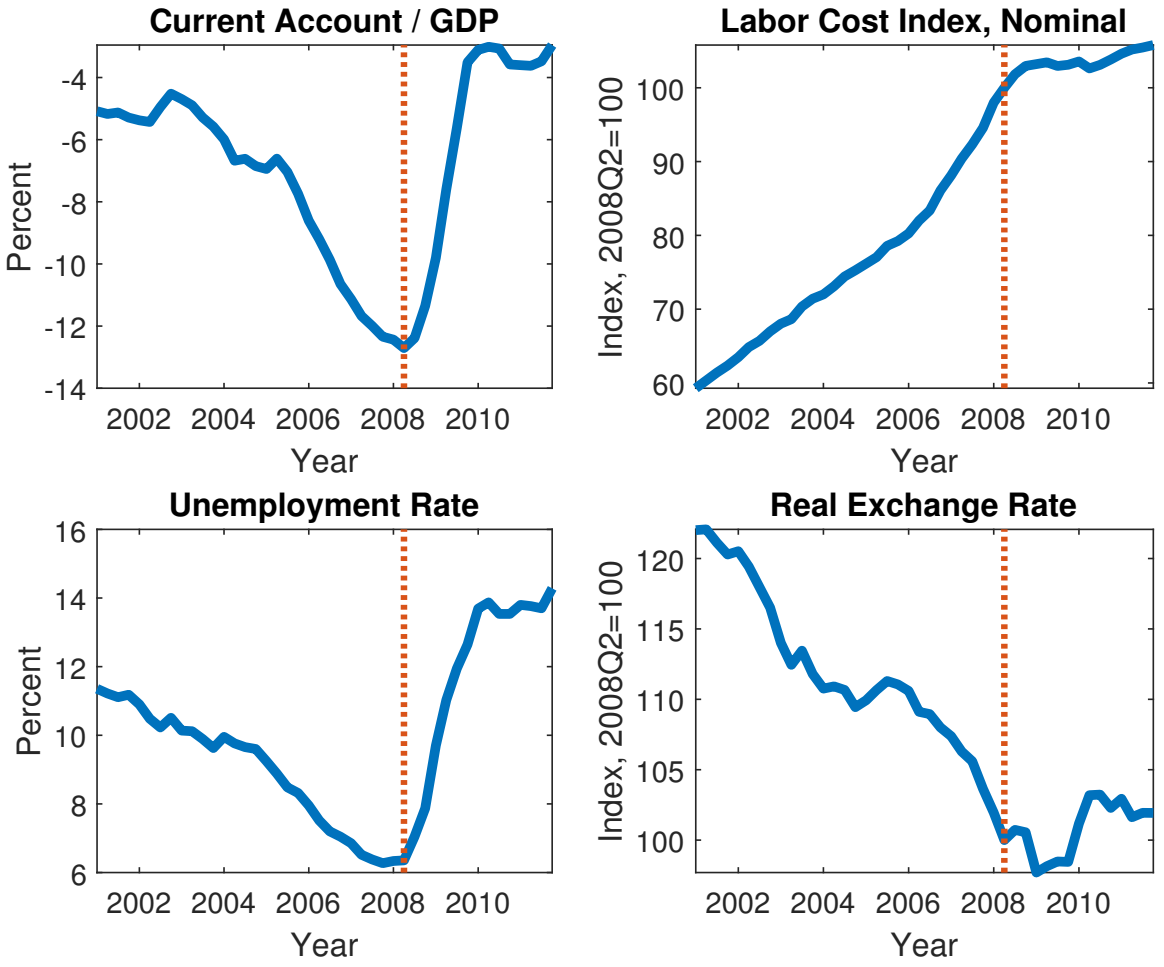
Na, Schmitt-Grohé, Uribe, and Yue, "The Twin Ds: Optimal Default and Devaluation, " *American Economic Review*, 2018.

Schmitt-Grohé and Uribe, "Liquidity Traps and Jobless Recoveries," *American Economic Journal: Macroeconomics*, 2017.

Schmitt-Grohé and Uribe, "Downward Nominal Wage Rigidity, Currency Pegs and Involuntary Unemployment," *Journal of Political Economy*, 2016.

Schmitt-Grohé and Uribe, "Downward Nominal Wage Rigidity and the Case for Temporary Inflation in the Eurozone," *Journal of Economic Perspectives*, 2013.

The Boom-Bust Cycle in Peripheral Europe, 2000-2011



Notes. Arithmetic mean of Bulgaria, Cyprus, Estonia, Greece, Ireland, Lithuania, Latvia, Portugal, Spain, Slovenia, and Slovakia. The vertical line indicates the beginning of the recession in 2008Q2. A decline in the real exchange rate indicates a real appreciation of the domestic currency (RER is relative price of foreign basket in terms of domestic goods basket.) Data Source: Eurostat.

A Model with

Downward Nominal Wage Rigidity

and

Involuntary Unemployment

– Downward Nominal Wage Rigidity: $W_t \geq W_{t-1}$

– Law of one price: $P_t^T = \mathcal{E}_t P_t^{T^*} = \mathcal{E}_t$; assume $(P_t^{T^*} = 1)$

– Tradable goods, exogenous endowment, Q_t^T.

– Nontraded goods: $Q_t^N = F(h_t)$

– Profit maximization: $P_t^N F'(h_t) = W_t$

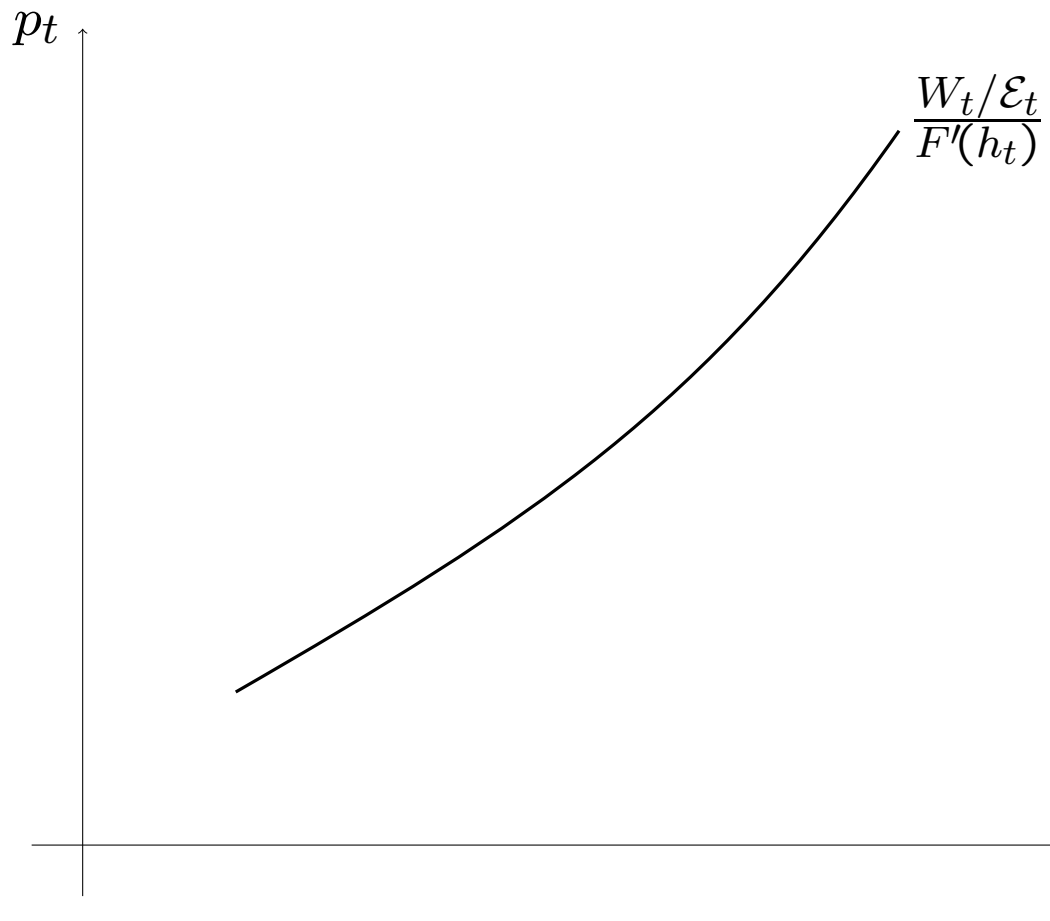
– Relative price of nontraded goods: $p_t = P_t^N / P_t^T$

– Market clearing: $C_t^N = F(h_t)$

– Preference: $C_t = {C_t^T}^{\gamma} {C_t^N}^{1-\gamma}$; optimality condition: $p_t = \frac{1-\gamma}{\gamma} \frac{C_t^T}{C_t^N}$

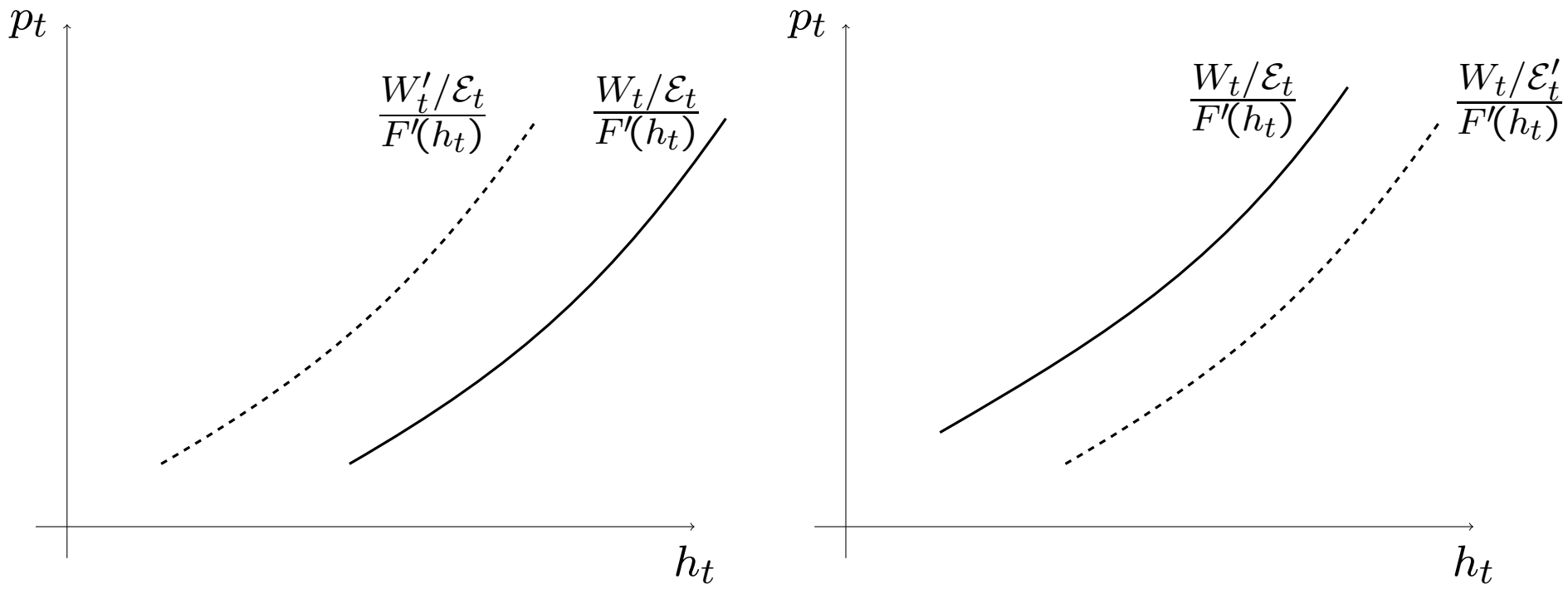
– Labor : $h_t \leq \bar{h}$

The Supply Schedule: $p_t = \frac{W_t/\mathcal{E}_t}{F'(h_t)}$



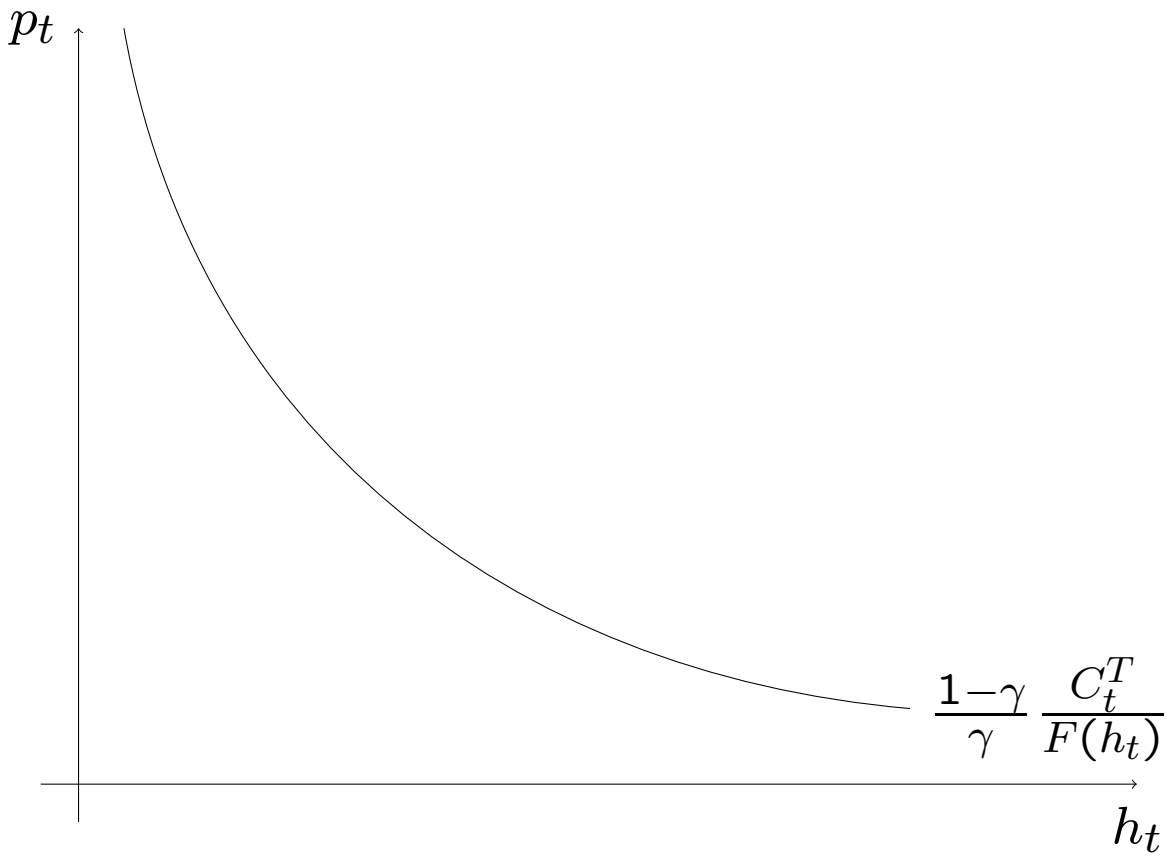
Notes. Given the real wage, $W_t/\mathcal{E}_t$, the supply schedule is an increasing relationship between the relative price of nontradables in terms of tradables, $p_t = P_t^N/P_t^T$, and employment, h_t. All other things equal, an increase in p_t opens up a positive gap between marginal revenue and marginal cost, $p_t - (W_t/\mathcal{E}_t)/F'(h_t)$, which induces firms to expand production and employment until the gap disappears.

Shifters of the Supply Schedule



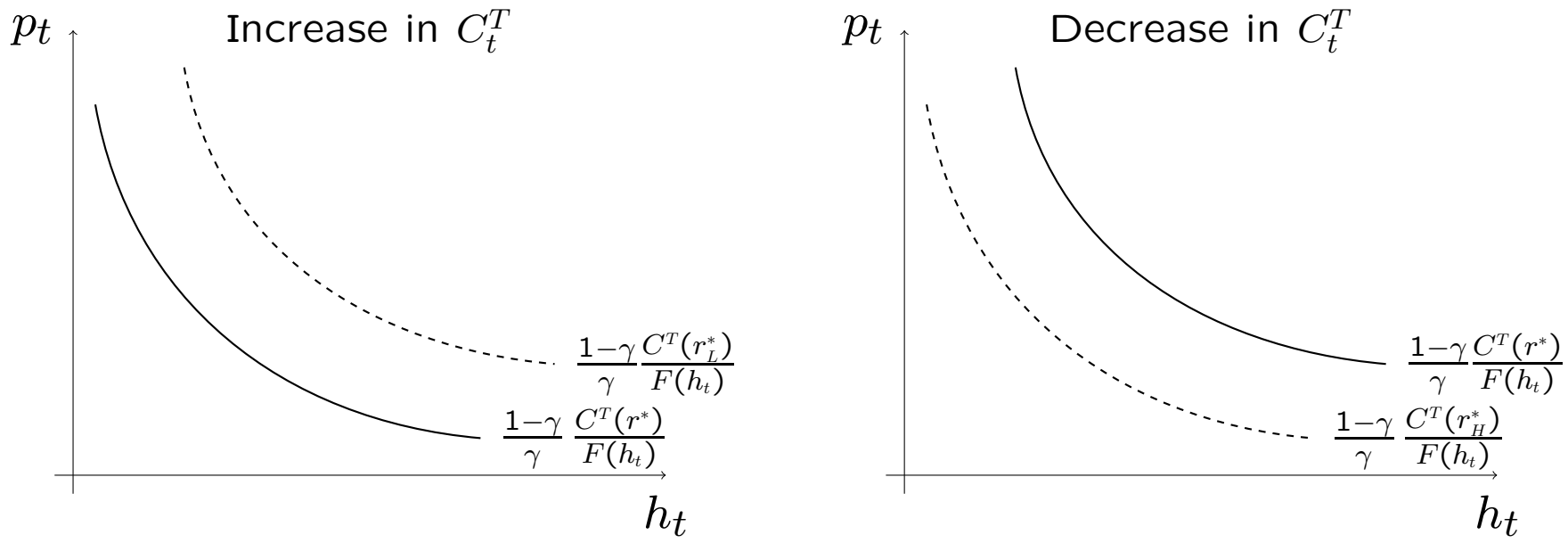
Notes. The left panel shows that an increase in the nominal wage from W_t to $W_t' > W_t$, holding constant the nominal exchange rate, $\mathcal{E}_t$, shifts the supply schedule up and to the left. Given $\mathcal{E}_t$, an increase in W_t raises marginal cost, which discourages production and employment for any given relative price, p_t. The right panel shows that holding constant the nominal wage, W_t, an increase in $\mathcal{E}_t$ to $\mathcal{E}_t' > \mathcal{E}_t$ (a depreciation of the domestic currency) shifts the supply schedule down and to the right. Given W_t, a depreciation lowers the real wage, which induces firms to expand output and employment at any given level of p_t.

The Demand Schedule: $p_t = \frac{1-\gamma}{\gamma}\frac{C_t^T}{F(h_t)}$



Notes. The figure depicts the demand schedule in period t. Holding constant C_t^T, the higher the relative price of nontradables, p_t, is, the lower the demand for nontradables, C_t^N, will be. If the nontradable market is in equilibrium, a lower demand for nontradables implies lower nontradable output, $F(h_t)$, and hence lower employment, h_t.

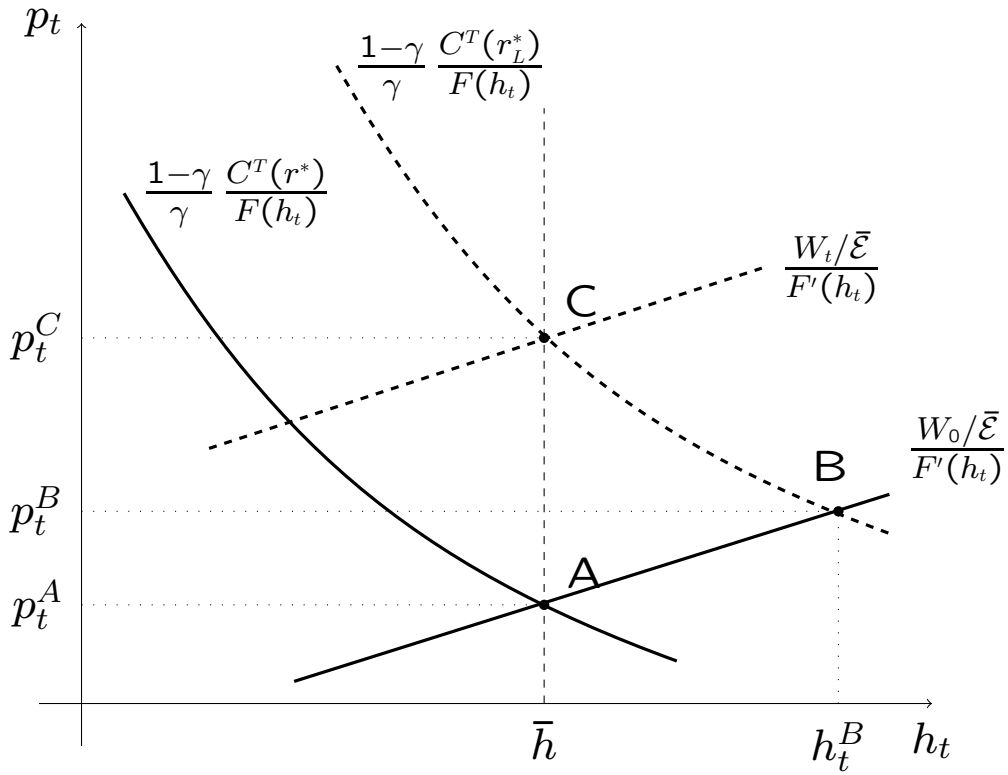
Shifters of the Demand Schedule



Notes. The left panel shows that an increase C_t^T, say due to a decline in the country interest rate from r^* to $r_L^* < r^*$, shifts the demand schedule up and to the right. A decrease in the interest rate increases the demand for tradable and nontradable goods for every level of the relative price p_t and thereby the implied demand for labor, h_t.

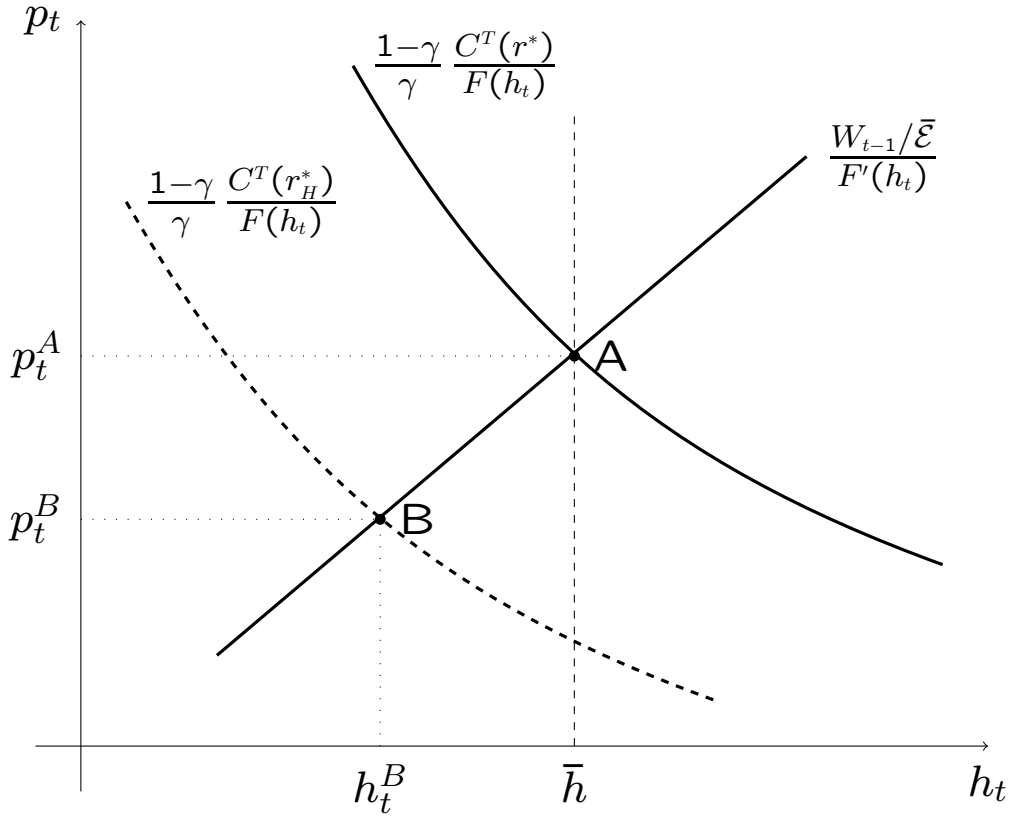
The right panel shows that a decline in C_t^T, say, due to an increase in the world interest rate from r^* to r_H^*, shifts the demand schedule down and to the left. A lower demand for tradable goods, C_t^T, for every level of the relative price p_t, lowers the demand for nontradable goods, C_t^N, and thereby the implied demand for labor, h_t.

A Decrease in the World Interest Rate under a Fixed Exchange Rate



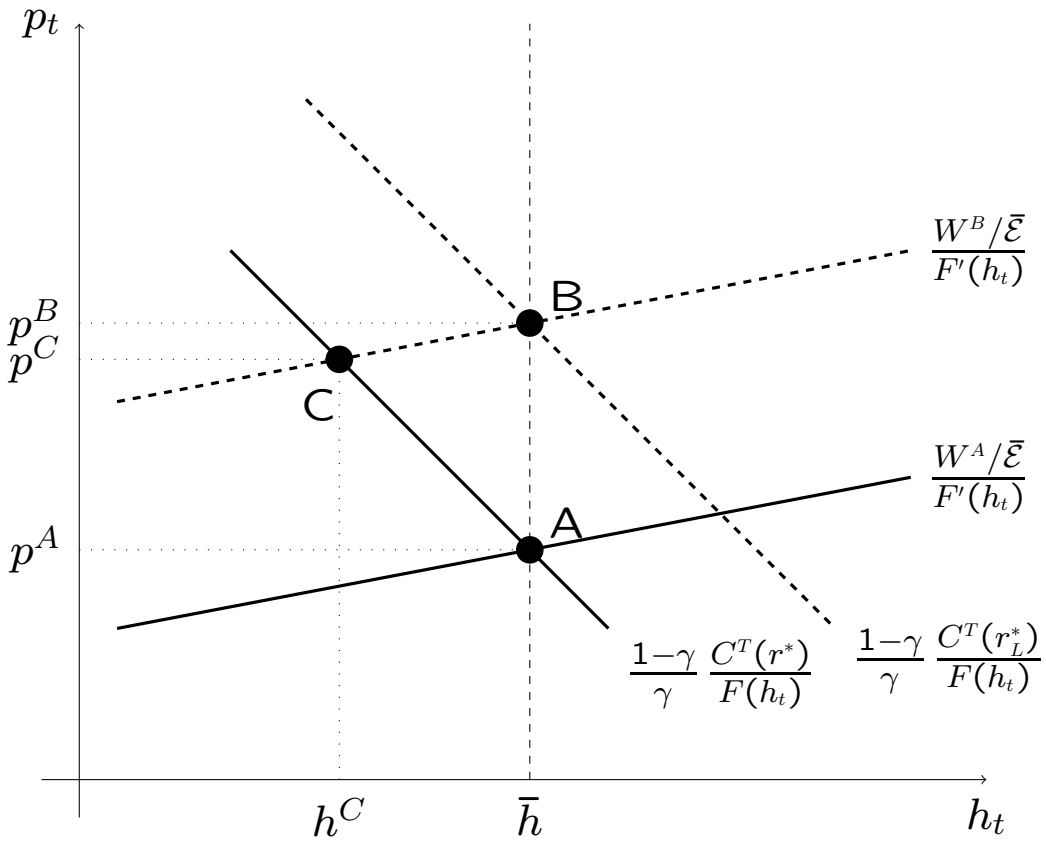
Notes. The nominal exchange rate is fixed at $\bar{\mathcal{E}}$. Prior to the decrease in the world interest rate from r^* to $r_L^* < r^*$, the equilibrium is at point A, where there is full employment, $h_t = \bar{h}$, and the nominal wage is W_0. The fall in r^* shifts the demand schedule up and to the right. Absent an increase in nominal wages, the equilibrium would be at point B, where labor demand exceeds labor supply, $h_t^B > \bar{h}$. As a result, wages will rise until the excess demand is eliminated. The increase in wages shifts the supply schedule up and to the left. The new equilibrium is at point C, where there is full employment, $h_t = \bar{h}$, the nominal wage rate is equal to $W_t > W_0$, and the relative price of nontradables is higher, $p_t^C > p_t^A$.

Asymmetric Adjustment: Adjustment to an Increase in the World Interest Rate under a Fixed Exchange Rate



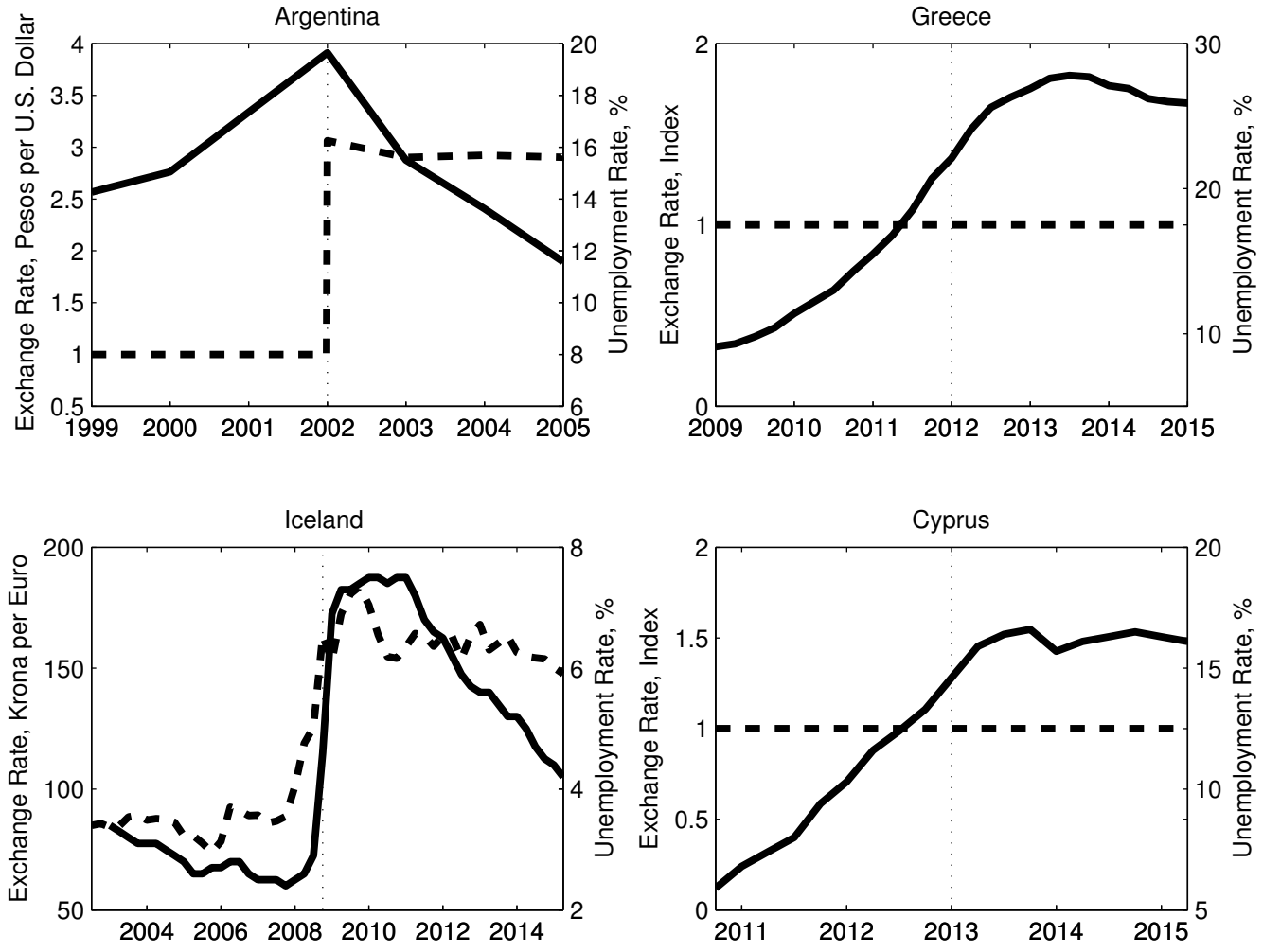
Notes. Prior to the increase in the world interest rate from r^* to $r^*_H > r^*$, the equilibrium is at point A, where there is full employment, $h_t = \bar{h}$. The nominal wage is W_{t-1} and the nominal exchange rate is fixed at $\bar{\mathcal{E}}$. The increase in the world interest rate lowers traded consumption from $C^T(r^*)$ to $C^T(r^*_H)$ and shifts the demand schedule down and to the left. Because the combination of downward nominal wage rigidity and a fixed exchange rate prevents a decline in the real wage, the supply schedule is unchanged. As a result, unemployment in the amount $\bar{h} - h_t^B$ emerges at the new equilibrium, point B.

A Boom-Bust Cycle with a Fixed Exchange Rate



Notes. The economy starts at point A, with full employment and wage W^A. The nominal exchange rate is fixed at $\bar{\mathcal{E}}$. A decline in the world interest rate from r^* to $r_L^* < r^*$ sets off a boom. The demand schedule shifts up and to the right. Wages rise to W^B and the supply schedule shifts up and to the left. In the boom equilibrium (point B) there is full employment and the relative price of nontradables rises to $p^B > p^A$. Then the interest rate goes back up to r^* and the bust begins. The demand schedule shifts down and to the left back to its original position. The new equilibrium is at point C, with large involuntary unemployment $\bar{h} - h^C$ and only a small real depreciation $p^C < p^B$. Model captures observed boom bust dynamics shown on slide 3.

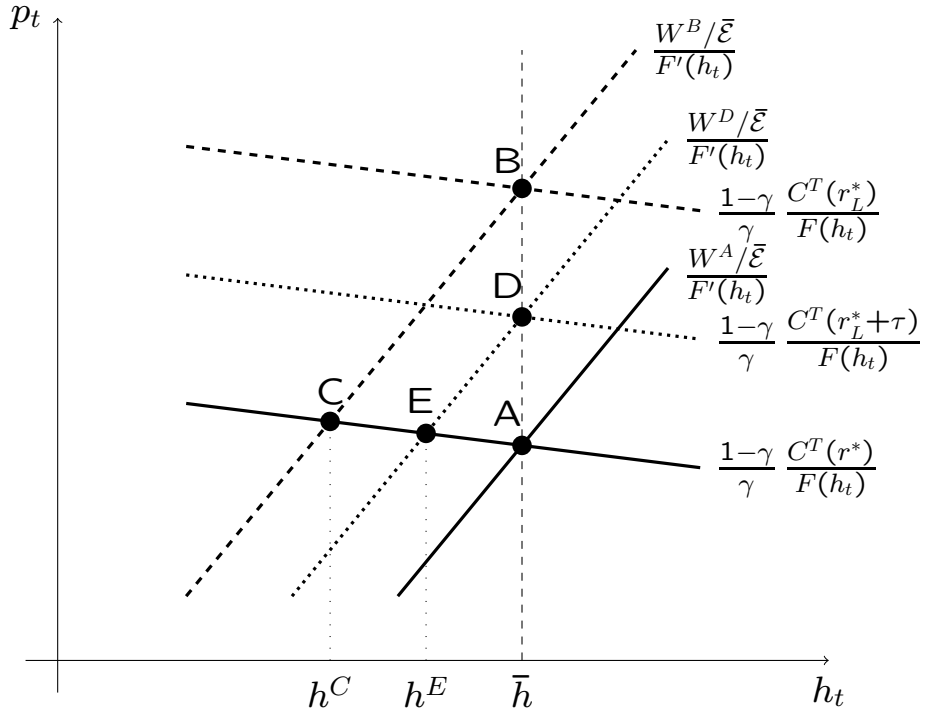
Countries that devalued in a deep recession experienced lower unemployment than those who did not devalue



Source: Na, Schmitt-Grohé, Uribe and Yue, 2017. Vertical line indicates the year of default. Own calculations based on data from INDEC (Argentina), EuroStat, and the Central Bank of Iceland.

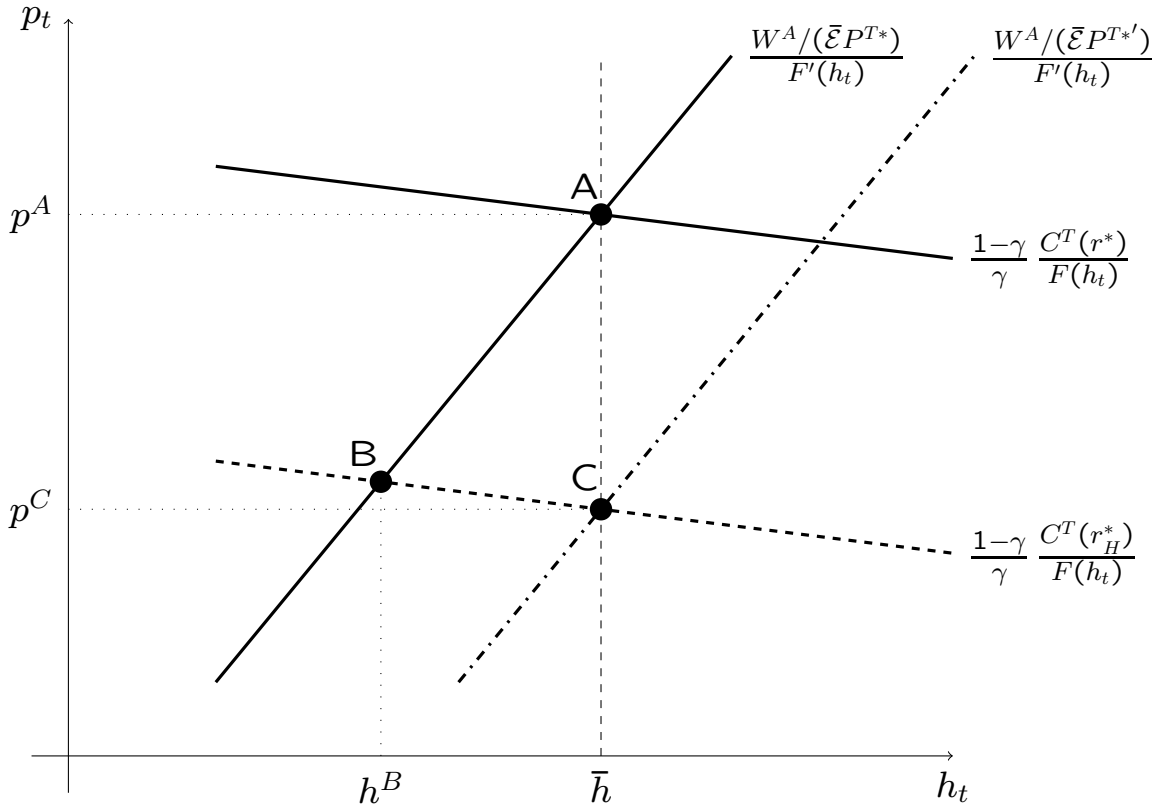
DNWR model can provide justifications for counter-cyclical macroprudential policy

Capital Controls during a Boom-Bust Cycle in a Peg



The boom-bust dynamics under free capital mobility are identical to those shown in slide 12: the initial equilibrium is at point A. A fall in the interest rate from r^* to $r_L^* < r^*$ moves the equilibrium to point B, where wages and consumption of tradables are higher ($W^B > W^A$ and $C^T(r_L^*) > C^T(r^*)$). When the interest rate goes back up to r^*, the equilibrium shifts to point C, where there is unemployment in the amount $\bar{h} - h^C$. During the boom, the government imposes a capital control tax τ, which raises the effective interest rate to $r_L^* + \tau \in (r_L^*, r^*)$. The fall in the interest rate shifts the demand schedule to the right but by less than under free capital mobility. The equilibrium is at point D, where the wage and consumption of tradables are higher but lower than under free capital mobility ($W^D \in (W^A, W^B)$ and $C^T(r_L^* + \tau) \in (C^T(r^*), C^T(r_L^*))$. When the interest rate goes back up to r^*, the government removes the capital control tax ($\tau = 0$), and the equilibrium is at point E, where there is unemployment but less than under free capital mobility ($\bar{h} - h^E < \bar{h} - h^C$).

Adjustment to an Interest Rate Increase with Monetary Union-Wide Inflation



The initial equilibrium is at point A, where the external price is P^{T*}, the wage is W^A, the exchange rate is fixed at $\bar{\mathcal{E}}$, and there is full employment. The increase in r^* shifts the demand schedule down and to the left. Then, the monetary authority of the currency union increases the price level to $P^{T*\prime} > P^{T*}$, which shifts the supply schedule down and to the right. The new equilibrium is at point C, where full employment is preserved and the real exchange rate depreciates ($p_t \downarrow$).

Empirical Evidence

on

Downward Nominal Wage Rigidity

A.) Evidence From Micro Data from Developed Countries

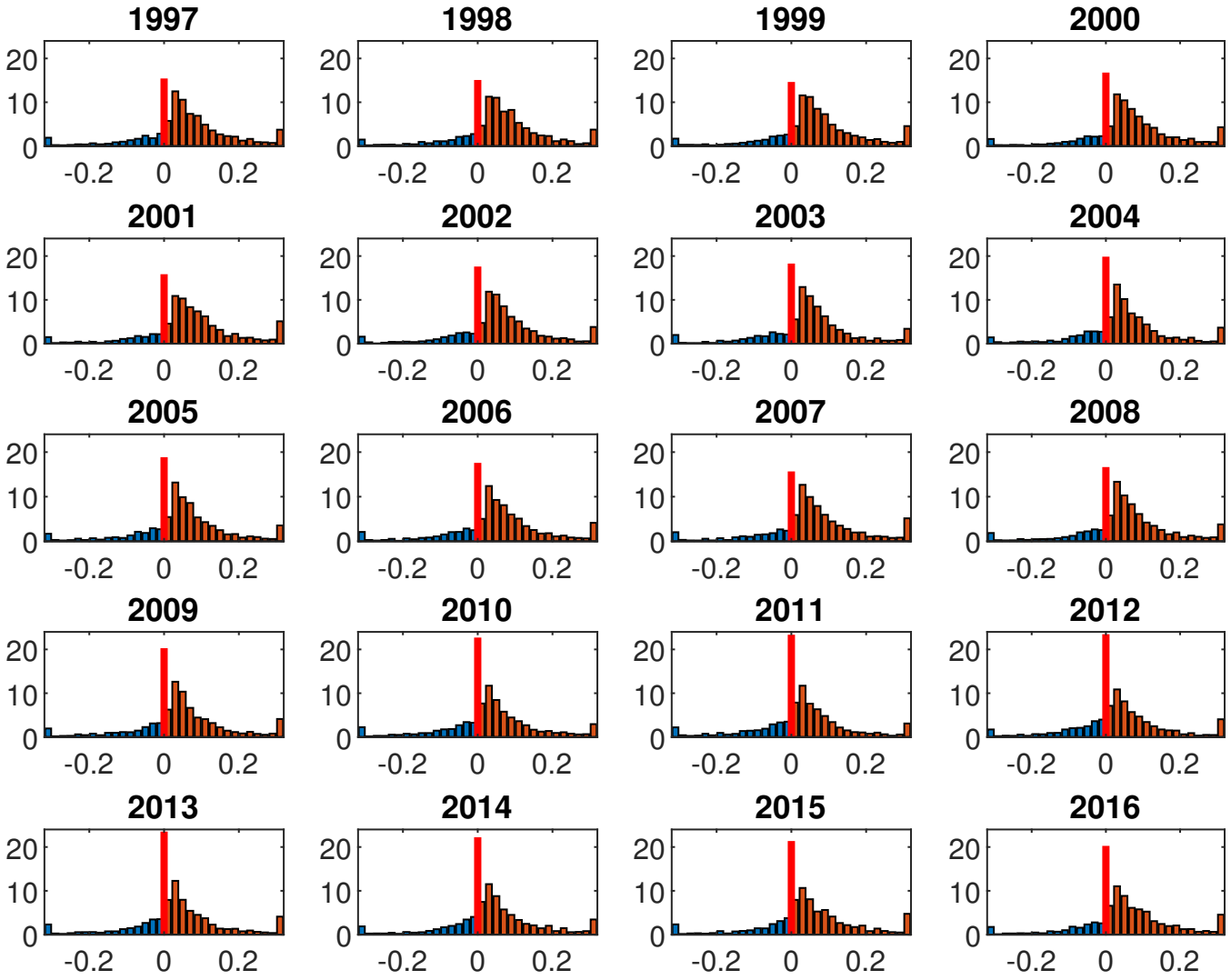
1. United States, 1997-2016, CPS survey data (Jo, Schmitt-Grohe, Uribe, 2017)

2. United States, 1979-2017, CPS and SIPP survey data (Jo, 2019)

3. United States, 2008-2016, ADP administrative data (Grigsby, Hurst, Yildirmaz, 2022)

4. Micro Evidence On Downward Nominal Wage Rigidity From Other Developed Countries

A1.) United States, 1997-2016, CPS panel data



- Large spike at zero wage changes.
- Many more wage increases than wage cuts.
- Fraction of wage freezes is cyclical, rises from 15.7 percent in 2007 to 22.7 percent in 2010.
- Much smaller cyclical increase in wage cuts.

Source: Jo, Schmitt-Grohé, and Uribe (2017).

A2.) Cross-Section of U.S. States, CPS data

Low Inflation recession, 2007-2010

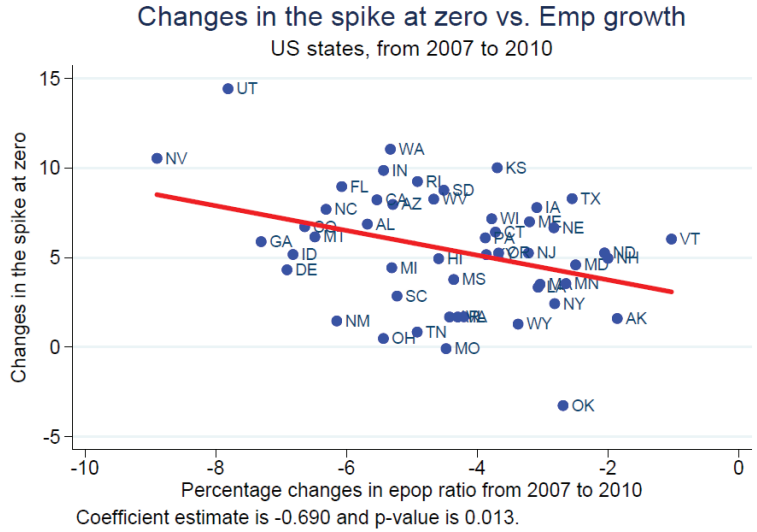


Figure 5: Nominal wage growth rates and changes in the spike at zero vs. employment growth from 2007 to 2010

Data source: CPS and author's calculation. The top panel shows the median nominal wage growth versus employment growth rates from 2007 to 2010 across states. The bottom panel shows the changes in the spike at zero versus employment growth from 2007 to 2010 across states. From 2007 to 2010, the annualized inflation rate was 1.7 percent, and the cumulative inflation was 5 percent.

Source: Figure 5 of Jo (2019).

- 5% cumulative inflation from 2007-2010.
- Slope coefficient -0.69 and significant.

$\Rightarrow$ states with larger declines in employment, had greater increase in share of workers with nominal wage freezes.

High inflation recession, 1979-1982

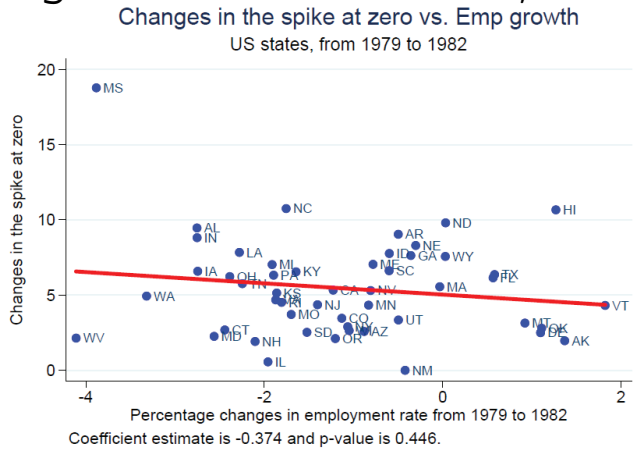


Figure 6: Nominal wage growth and changes in the spike at zero vs. employment growth from 1979 to 1982

Data source: CPS and author's calcuation. The top panel shows the median nominal wage growth with respect to employment growth rates from 1979 to 1982 across states. The bottom panel shows the change in the spike at zero with respect to employment growth from 1979 to 1982 across states. From 1979 to 1982, the average of annualized inflation rate was 9.5 percent and the cumulative inflation was 28.5 percent.

Source: Figure 6 of Jo (2019).

- 28.5% cumulative inflation from 1979-1982.
- Slope coefficient insignificant.

... no such negative association when inflation is high

A3.) United States, 2008-2016, ADP administrative data (Grigsby, Hurst, Yildirmaz, 2022)

The data:

– sample period 2008 to 2016 (avg inflation rate: 1.6% per year)

– 20 million workers per month (representative of the US pop)

– includes base pay, bonuses, overtime, and total compensation

– job-stayers, job-changers, new hires

Findings:

– For most workers, base earnings comprise essentially all earnings.

– Base wages capture the relevant wage rigidity, the cyclicality of the marginal cost to the firm. (Bonuses and overtime pay are acyclical)

– Job-stayers: downward nominal base wage rigidity: only 2.5 percent of workers received a nominal base wage cut during a year.

– Base wages of new hires and job-switchers are no more flexible than the base wages of job-stayers suggesting no excess wage rigidity for job-stayers relative to new hires or job-switchers.

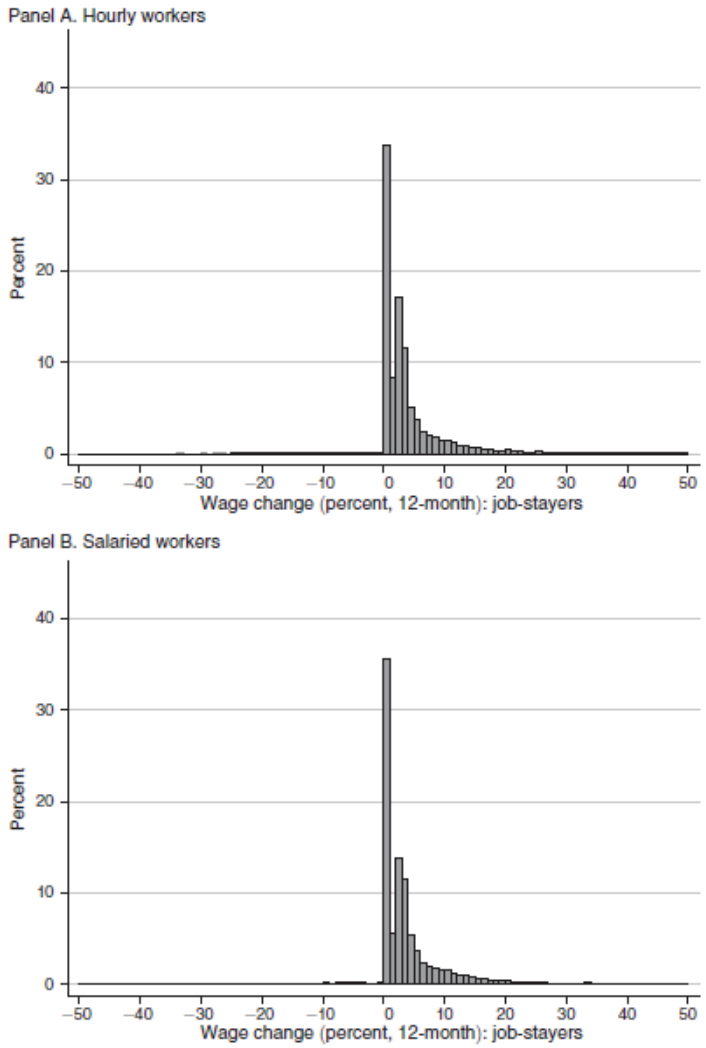


FIGURE 2. TWELVE-MONTH NOMINAL BASE WAGE CHANGE DISTRIBUTION, JOB-STAYERS

Note: Figure shows the annual change in nominal base wages for workers in our employee sample (including commission workers) who remain employed on the same job for 12 consecutive months.

Comments on the Figure 2 of Grigsby et al:

12-month with same job/firm, this is for all years 2008-2016

- 32% of hourly and 35% of salaried have a base wage freeze

- patterns of nominal base wage adjustments for hourly workers and salaried workers are nearly identical.

- clear asymmetry in the base wage change distribution, only 2.5 percent of workers (combining hourly and salaried) in the United States who remained continuously employed with the same firm for 12 months received a nominal base wage decline.

A4.) Micro Evidence On Downward Nominal Wage Rigidity From Other Developed Countries

- Switzerland: Fehr and Goette (2005).
- Canada: Fortin (1996).
- Japan: Kuroda and Yamamoto (2003).

B.) Evidence From Informal Labor Markets

• Are nominal wages downwardly flexible in informal labor markets, where labor unions, wage legislation, or regulation play, if any, a small role?

• Kaur (2019) addresses this issue by examining the behavior of nominal wages, employment, and rainfall in casual daily agricultural labor markets in rural India (500 districts from 1956 to 2008).

• Finds asymmetric nominal wage adjustment:

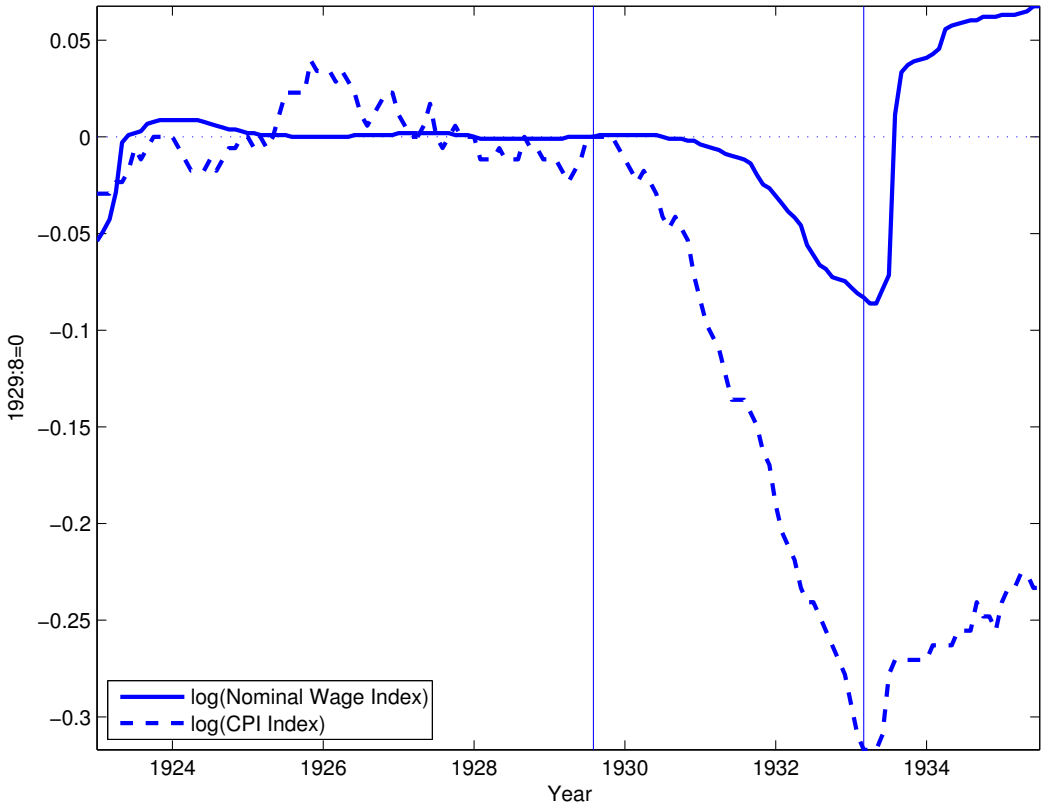
— W_t increases in response to positive rainfall shocks

— W_t failure to fall, labor rationing, and unemployment are observed in response to negative rain shocks.

• Inflation (uncorrelated with local rain shocks) tends to moderate rationing and unemployment during negative rain shocks, suggesting downward rigidity in nominal rather than real wages.

C.) Evidence From the Great Depression in the United States

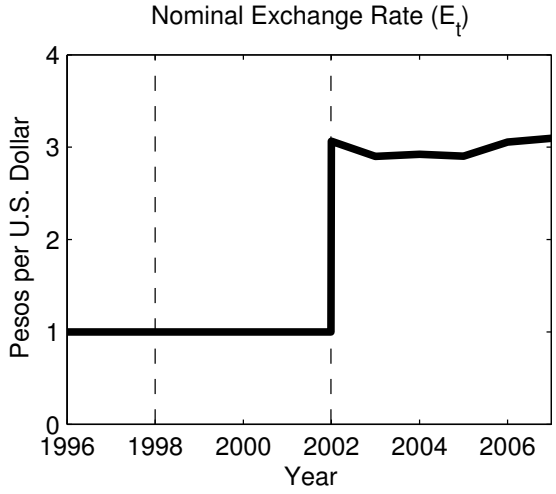
Nominal Wage Rate and Consumer Prices, United States 1923:1-1935:7

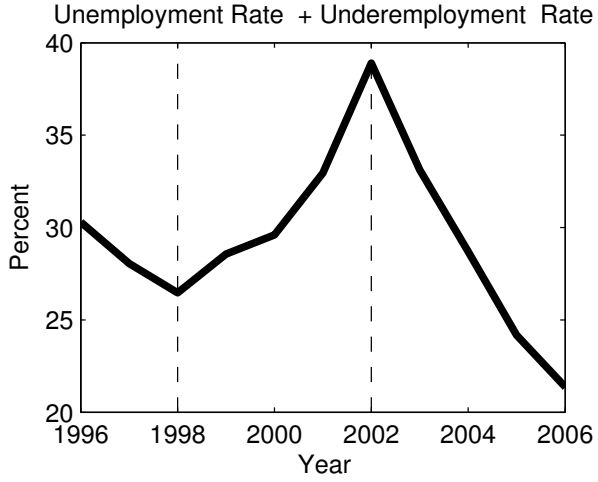


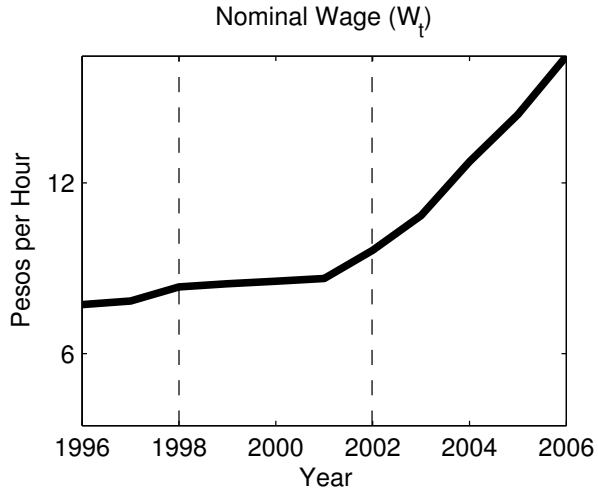
Solid line: natural logarithm of an index of manufacturing money wage rates.

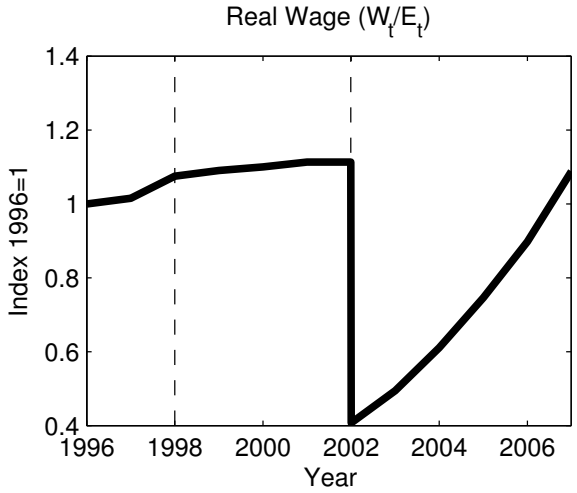
Broken line: logarithm of the consumer price index. Source: USG, 2017.

D1.) Evidence From Emerging Countries: Argentina 1996-2006









- Argentina pegged the peso at a 1-to-1 rate to the dollar between 1991 and 2001.
- Starting in 1998, the economy was buffeted by a number of large negative shocks (weak commodity prices, large devaluation in Brazil, large increase in country premium).
- Not surprisingly, between 1998 and 2001, unemployment rose sharply.
- Nonetheless, nominal wages remained remarkably flat.

D2.) Evidence From Emerging Countries: Peripheral Europe (2008-2011)

Country	Unemployment Rate 2008Q1 (in percent)	Unemployment Rate 2011Q2 (in percent)	Cumulative Wage Growth, $\frac{W_{2011Q2}}{W_{2008Q1}}$ (in percent)
Bulgaria	6.1	11.3	43.3
Cyprus	3.8	6.9	10.7
Estonia	4.1	12.8	2.5
Greece	7.8	16.7	-2.3
Ireland	4.9	14.3	0.5
Italy	6.4	8.2	10.0
Lithuania	4.1	15.6	-5.1
Latvia	6.1	16.2	-0.6
Portugal	8.3	12.5	1.91
Spain	9.2	20.8	8.0
Slovenia	4.7	7.9	12.5
Slovakia	10.2	13.3	13.4

Note. W_t is an index of nominal average hourly labor cost in manufacturing, construction, and services, including the public sector (except for Spain). Source: Schmitt-Grohé and Uribe (JPE, 2016)

- Between 2008 and 2011, all countries in the periphery of Europe experienced increases in unemployment; Some very large increases.
- In spite of extreme duress in the labor market, nominal hourly wages experienced increases in most countries.

Downward Nominal Wage Rigidity

and the

Wage Phillips Curve

Figure 1 of Phillips (1958)

‘

Each dot is a year. Each cross is the average for observations in the following intervals for u_t: $[0,2]$, $(2,3]$, $(3,4]$, $(4,5]$, $(5,7]$, and $(7,11]$. The line is the fitted regression line, $\Pi_t^W + 0.9 = 9.638 u_t^{-1.394}$.

Source: "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom 1861-1957," A. W. Phillips, Economica 25, November 1958, 283-299. Figure 1.

Wage Phillips Curve Implied by DNWR Model

Labor market conditions

$$W_t \geq \gamma W_{t-1}$$

$$h_t \leq \bar{h}$$

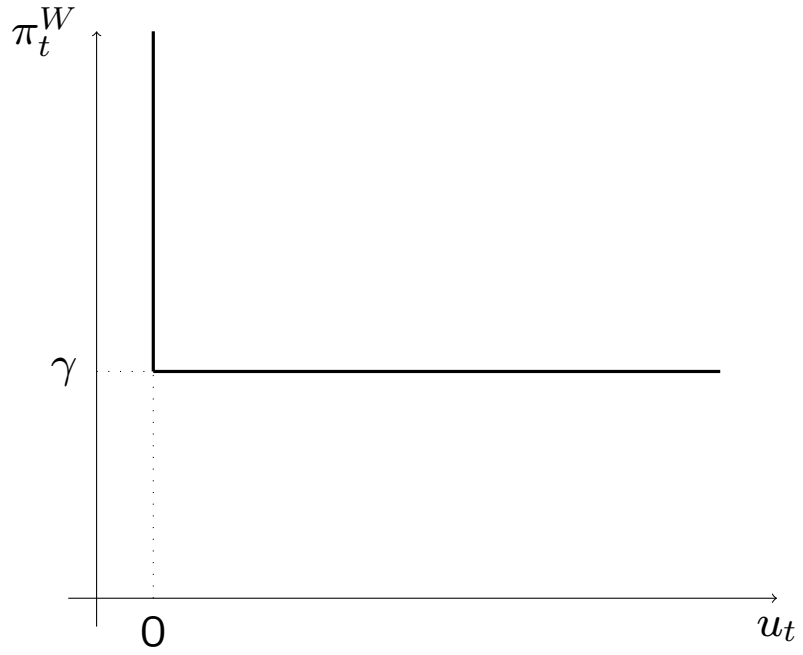
$$[\bar{h} - h_t][W_t - \gamma W_{t-1}] = 0$$

Unemployment rate, u_t:

$$u_t = \frac{\bar{h} - h_t}{\bar{h}}$$

Wage inflation, π_t^W:

$$1 + \pi_t^W = \frac{W_t}{W_{t-1}}$$



A Model with Heterogeneous Downward Nominal Wage Rigidity (HDNWR)

- heterogeneous downward nominal wage rigidity

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

– $\gamma(j) =$ positive and increasing function, governing the degree of nominal wage rigidity for labor of variety j.

- production: $y_t = z_t F(h_t)$

- labor input, $h_t = \left[\int_0^1 h_{jt}^{1-\frac{1}{\eta}} dj \right]^{\frac{1}{1-\frac{1}{\eta}}}; \quad \eta > 0$

- labor demand $h_{jt} = \left(\frac{W_{jt}}{W_t} \right)^{-\eta} h_t$

Labor Market (Non Walrasian)

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

$$h_{jt} \leq \bar{h}$$

$$[\bar{h} - h_{jt}][W_{jt} - \gamma(j) W_{t-1}] = 0$$

The cut-off labor variety j_t^*

$$W_{j_t^* t} = \gamma(j_t^*) W_{t-1}$$

$$h_{j_t^* t} = \bar{h}$$

For labor varieties $j < j_t^*$

$$W_{jt} = W_{j_t^* t}$$

$$h_{jt} = \bar{h}$$

For labor varieties $j > j_t^*$

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

$$h_{jt} < \bar{h}$$

Wage inflation:

$$\frac{W_t}{W_{t-1}} \equiv \left(\int_0^1 \left(\frac{W_{jt}}{W_{t-1}} \right)^{1-\eta} dj \right)^{\frac{1}{1-\eta}}$$

Unemployment rate:

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

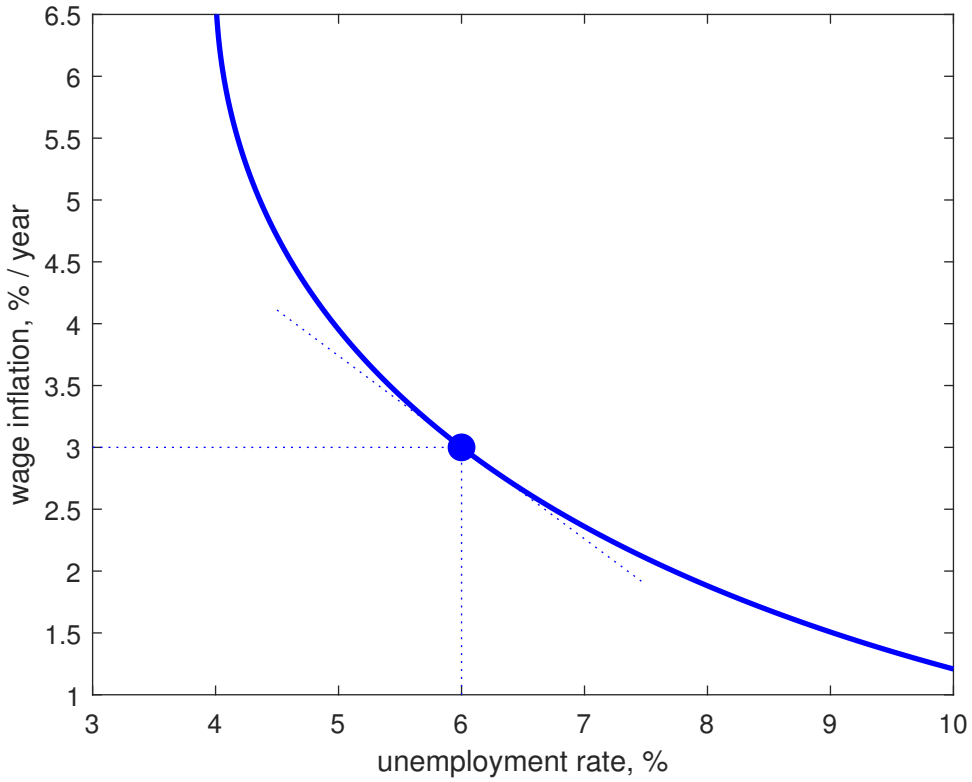
Express as:

$$(1+\pi_t^W)^{1-\eta} = j_t^* \gamma(j_t^*)^{1-\eta} + \int_{j_t^*}^1 \gamma(j)^{1-\eta} dj \quad (1)$$

$$u_t = (1-j_t^*) - \int_{j_t^*}^1 \left(\frac{\gamma(j)}{\gamma(j_t^*)} \right)^{-\eta} dj \quad (2)$$

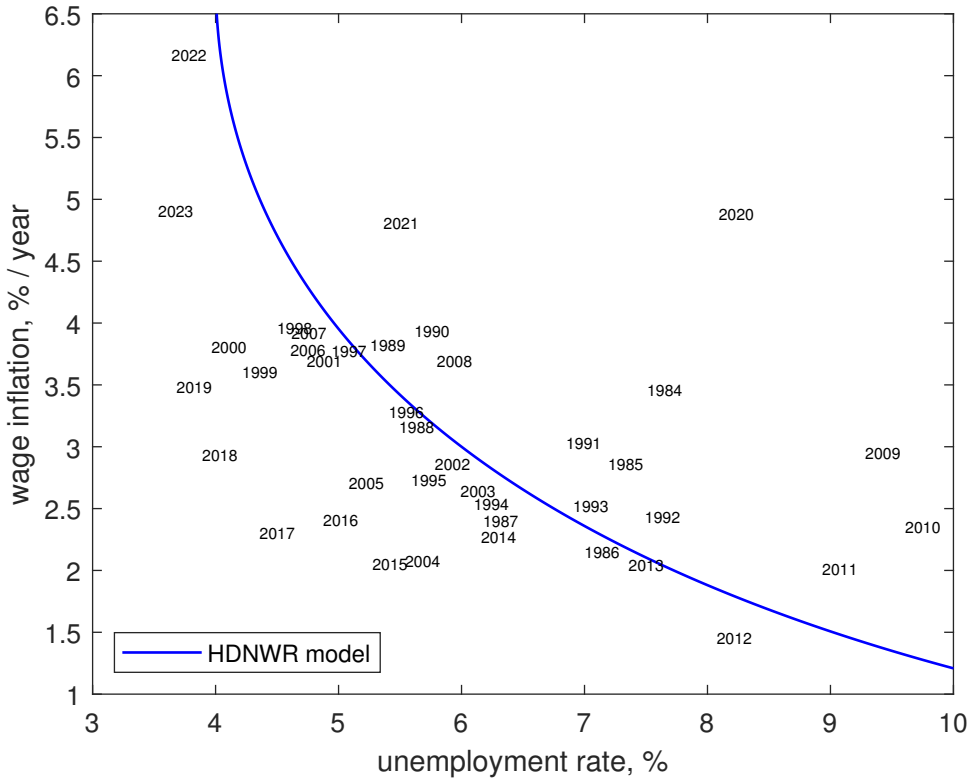
$\Rightarrow$ **Key Result:** HDNWR model implies Phillips's Phillips Curve: a negative **nonlinear** relation between u_t and π_t^W (without a forward-looking component).

The Short-Run Wage Phillips Curve of the HDNWR Model



Notes. The figure shows the short-run wage Phillips curve implied by the calibrated heterogeneous downward nominal wage rigidity model with $\gamma(j) = (1+\pi^*)(\Gamma_0+\Gamma_1 j)$. The calibration requires the Phillips curve to go through the point $(6,3)$ and to have a slope of -0.74 at that point, following the estimates of Gali and Gambetti (2019).

Empirical and HDNWR Wage Phillips Curve



Notes. The figure shows with a solid line the short-run wage Phillips curve implied by the calibrated heterogeneous downward nominal wage rigidity model. The figure also shows the (u_t, π_t^W) pairs observed in annual U.S. data over the period 1984 to 2023. 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 2023 in the figure refers to unemployment and wage inflation in the first six months of 2023.

Varying Parameters of the Short-Run Wage Phillips Curve

$$W_{it} \geq \gamma(j) W_{t-1}; \quad \gamma(j) = (1+\pi^*)(\Gamma_0 + \Gamma_1 j)$$