

# ENDOGENOUS GROWTH, DOWNWARD WAGE RIGIDITY AND OPTIMAL INFLATION

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The views expressed in this paper are those of the authors  
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## MOTIVATION

### STANDARD NEW-KEYNESIAN MODELS FEATURE:

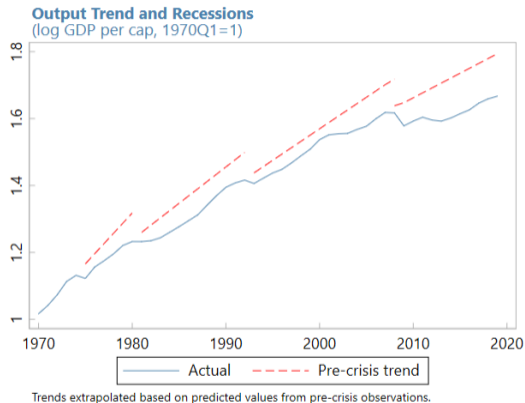
- ▶ Small welfare costs of business cycle fluctuations
- ▶ Monetary policy invariance hypothesis
- ▶ Optimal inflation target in a range between zero and 2%

### WE DEVELOP A NEW-KEYNESIAN MODEL:

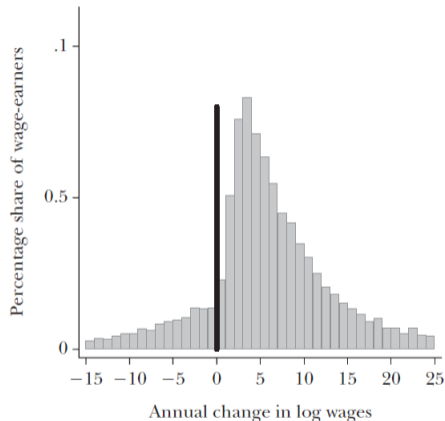
- ▶ Endogenous growth via R&D
- ▶ Search and matching unemployment
- ▶ Downward wage rigidity

**Reconcile Friedman (1968) and Tobin (1972) on the optimal rate of inflation**

# STYLIZED FACTS: OUTPUT HYSTERESIS AND DOWNWARD WAGE RIGIDITY



Sources: EA data from ECB's AWM database.



Sources: Dickens et. al. 2007, based on international micro survey data for 8 EA and 3 EU countries, as well as CH, NO, UK, US prior to 2003

## SUMMARY OF THE RESULTS

### KEY FEATURES AND IMPLICATIONS

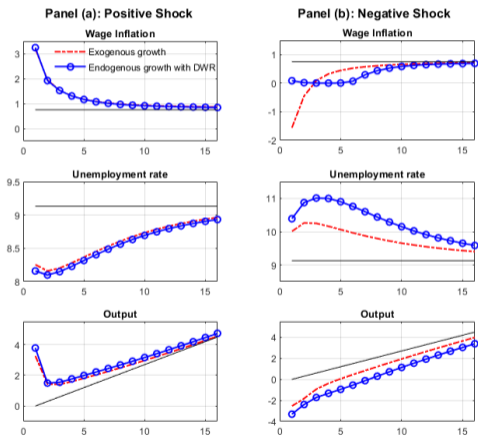
- F.1 **Asymmetric** business cycle and **hysteresis** effects on output/unemployment
- F.2 Long-run trade-off between growth/unemployment and inflation
- F.3 Consumption-equivalent welfare losses are a multiple of those associated with standard models
  
- I.1 **Inflation targeting**: the optimal inflation rate is **in excess of 2%** and balances the **welfare trade-off** between **price distortions** and **output hysteresis**
- I.2 **Price-level targeting** or a **Taylor-rule responding to unemployment** lead to **lower welfare losses** and would call for a lower optimal inflation target

# ASYMMETRY AND HYSTERESIS

## KEY MECHANISMS AT PLAY

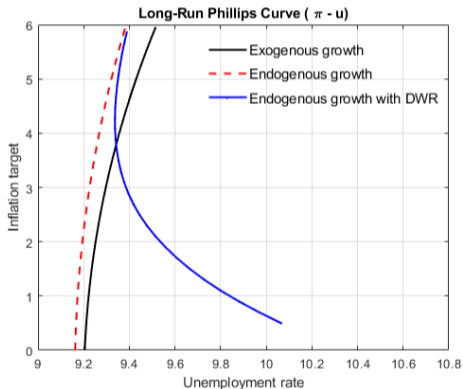
- ▶ **DWR** leads to asymmetric and larger effects on output and unemployment
- ▶ **Endogenous growth:** temporary shocks generate permanent effects on TFP and output via lower profits and R&D investment
- ▶ Higher real wages and weaker profitability delay the **matching process** resulting in higher unemployment duration

Figure: IRFs to a positive and negative demand shock (risk premium) between **exogenous** and **endogenous with DWR** model

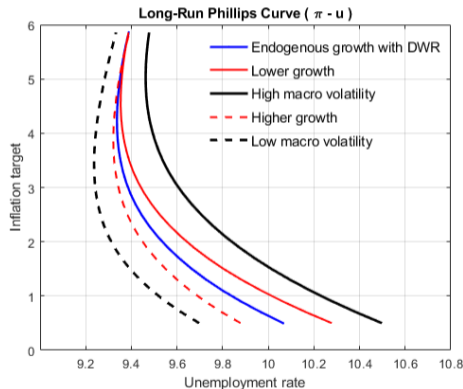


# LONG-RUN PHILLIPS CURVE

- Our model features a non-vertical Phillips curve for low inflation target rates

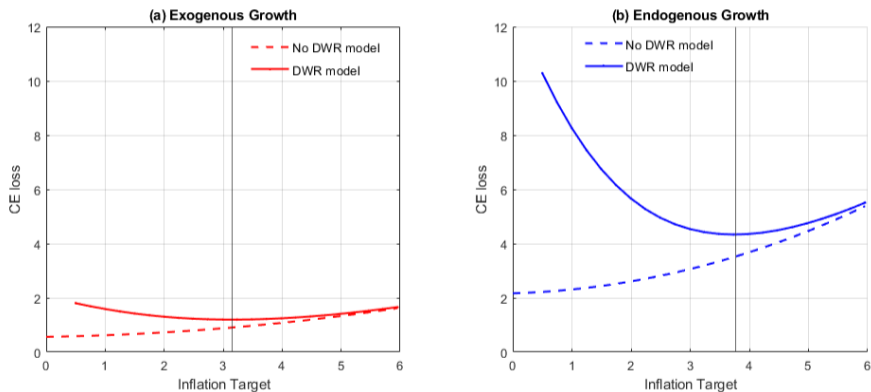


- The flattening of the long-run Phillips curve depends on macro volatility and growth



# WELFARE TRADE-OFF AND OPTIMAL INFLATION TARGET

**FIGURE: Welfare losses from exogenous and endogenous growth models**



Note: Panel (a) and Panel (b) show consumption-equivalent (CE) welfare losses for different inflation targets in models with exogenous and endogenous growth, respectively.

## ENDOGENOUS GROWTH, DWR AND ZLB

- ▶ Welfare losses at the ZLB remain significantly lower in exog. growth models
- ▶ As in other papers (Coibion et al, Amano and Gnocchi), DWR reduces the likelihood of ZLB
- ▶ In our model, the interaction of ZLB and DWR calls for higher  $\pi^*$

**TABLE: Optimal  $\pi$  and welfare at the zero lower bound**

Model variation	Optimal	Welfare Loss at		Frequency at	
	$\pi^*$	$\pi = \pi^*$	$\pi = 1.8$	DWR	ZLB
<b>Exog. growth + SAM</b>	0.00	0.56	0.70	0.00	0.00
<b>Exog. growth</b> with ZLB	1.72	0.84	0.84	0.00	0.08
<b>Exog. growth</b> with ZLB & DWR	3.24	1.22	1.39	0.20	0.04
<b>Endog. growth + SAM</b>	0.00	2.16	2.53	0.00	0.00
<b>Endog. growth</b> with ZLB	2.30	3.20	3.27	0.00	0.08
<b>Endog. growth</b> with ZLB & DWR	3.86	4.42	6.40	0.22	0.05
<b>Baseline</b>	3.76	4.34	6.05	0.22	0.00



## ALTERNATIVE MONETARY POLICY STRATEGIES

- ▶ Lower welfare losses from **PLT** or a **Taylor rule responding to  $u_t$**
- ▶ The optimal inflation target is lower and equal to **0.95%** and **2.5%**, respectively
- ▶ PLT captures history dependence of shocks and hysteresis effects in our model
- ▶ The Taylor rule responding to  $u_t$  captures asymmetric business cycles in our model embedded in the unemployment rate

Model variation	Optimal	Welfare Loss at		$\Delta$ Loss	Statistics at $\pi = 1.8$		
	$\pi^*$	$\pi = \pi^*$	$\pi = 1.8$	$(\pi^* - 1.8)$	$P(\Delta w = 0)$	$\mathbb{E}(u_t)$	$\mathbb{E}(\Delta y)$
<b>Baseline calibration</b>	3.76	4.34	6.05	-1.72	0.22	9.55	1.14
<b>Alternative policy</b>							
Price level targeting	0.95	1.03	1.16	-0.13	0.01	9.06	1.19
Taylor rule with $u_t$	2.49	3.09	3.23	-0.14	0.15	9.26	1.17

## CONCLUDING REMARKS

- ▶ **Propose a NK model** with (a) endogenous growth, (b) search and matching unemployment and (c) downward wage rigidity
  - Monetary policy invariance hypothesis is violated (non-vertical PC)
  - Welfare costs of business cycles are large, asymmetric and persistent.
- ▶ There is a **trade-off** between welfare costs of **price distortions** and **output hysteresis**. In our model, this trade-off calls for an **optimal inflation target above 2%**
  - A higher inflation target is not a *tactical* consideration related to ELB.
- ▶ **Make-up monetary policy strategies do better** in terms of **welfare** and call for a **lower optimal inflation target**. Better suited to deal with asymmetry and hysteresis
- ▶ **CAVEATS**: the analysis does not account for important issues such as de-anchoring of inflation expectations, central bank credibility and transition dynamics

## ROBUSTNESS ANALYSIS AND KEY DRIVERS

- ▶ Looking at factors making DWR less binding, price distortions more costly or output hysteresis lower:
  - Long-term productivity growth and shocks' assumptions
  - Degree of nominal rigidities and Calvo's pricing
  - R&D process

**Table: Robustness analysis**

Model variation	Optimal $\pi^*$	Welfare Loss $\pi = \pi^*$
<b>Baseline calibration</b>	3.76	4.34
<b>Parameter assumptions</b>		
Higher growth ( $g = 1.6$ )	3.44	4.31
Higher wage rigidity	3.52	4.41
Higher price rigidity	3.16	5.67
Calvo pricing	3.30	4.75
Lower OBC on DWR ( $-1.0\%$ )	3.00	3.72
Lower R&D diffusion	3.50	3.40
<b>Shock assumptions</b>		
Small risk premium shocks ( $\sigma = 0.15$ )	3.06	3.05
Small technology shocks ( $\sigma = 0.4$ )	3.68	4.12

FULL PRESENTATION:

ENDOGENOUS GROWTH,  
DOWNWARD WAGE RIGIDITY AND  
OPTIMAL INFLATION