Who Killed The Phillips Curve?
A Murder Mystery

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Disclaimer

The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff or the Board of Governors.

I. Introduction

A Conventional Narrative:

John Ydstile: *"But these days, jobs are very plentiful, yet inflation remains very low. That's got some people writing the obituary for the Phillips curve."*

James Bullard: *"If you put it in a murder mystery framework – "Who Killed The Phillips Curve?"– it was the Fed that killed the Phillips curve."*

NPR, October 29, 2018, 4:28 PM ET

A Bit More Sophisticated Version:

- The Phillips curve is not dead (McLeay and Tenreyro [2019]):

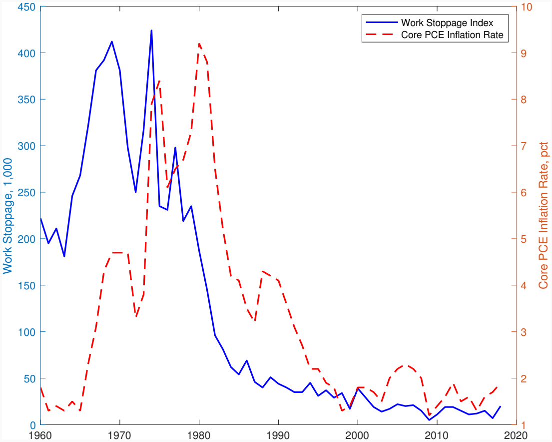
  "This (optimal) targeting rule will impart a negative correlation between inflation and the output gap, blurring the identification of the (positively sloped) Phillips curve."

- Optimal discretionary policy (Clarida, Gali and Gertler [1999]):

$$
\begin{aligned}
\pi_t &= -\frac{\lambda}{\kappa} x_t \\
\pi_t &= \frac{\lambda}{\kappa^2 + \lambda(1 - \beta\rho)} u_t
\end{aligned}
$$

An Alternative Narrative: A Real Root of Disinflation

Figure 1: Trade Union Power and Inflation



Two Schools of Monetary Economics

- Monetarists: Money and/or monetary policy controls inflation.

$$M_t V_t = P_t Y_t$$

- Conflict theory of inflation: Inflation is the result of class conflict.
  - Post-Keynesians in the Kaleckian Tradition. James Tobin [1981]:

    "*inflation is the symptom of ... social and economic ... conflict ... The major economic groups are claiming pieces of pie that together exceed the whole pie. Inflation is the way that their claims, so far as they are expressed in nominal terms, are temporarily reconciled.*"

Was it Volker or Reagan who killed the Phillips Curve?

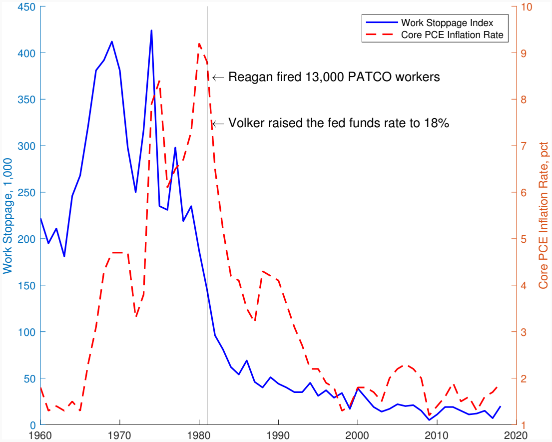
- We try a third way in between the two: Kaleckian Phillips curve.
  - We don't ditch NK framework, but adds a Kaleckian element.
  - Trade union power determines the slope of the Phillips curve.
- We show a possibility that it was not Volker's monetary policy, but Reagan's labor market policy that killed the Phillips curve.

Byproduct: Explaining the Decline of Labor Share

- Comparative statics indicates that the decline of worker bargaining power can explain the secular trends of labor and profit shares.
  - Unions bargain over employment size, which allows the unions to extract part of the monopoly rent.
  - Union power explains the secular trends without the product market concentration hypothesis (De Loecker et al [2018]).
  - Barkai [2018], Gutierrez and Phillippon [2018], Farhi and Gourio [2018], Eggertsson et al [2018]: all rely on the concentration hypothesis to explain the rises of profit share, Tobin's Q.

In the Summer of 1981...

Figure 2: Trade Union Power and Inflation



PATCO Firing and the New Era

"Well, I think that really set off a whole chain of people who were starting to cut wages. We found that right after the PATCO People were fired, the United Autoworkers ended negotiations, made an agreement to freeze their wages. That put a lot of pressure on the other unions to do the same thing."
– Dolores Huerta, June 11, 2004, www.democracynow.org

Road Map

Model

Linear Production

- Production technology:

$$y_t(i) = a_t k_{t-1}(i)^{\alpha} n_t(i)^{1-\alpha}$$

- Monopolistic competition:

$$y_t(i) = p_t(i)^{-\epsilon} y_t, \quad p_t(i) \equiv P_t(i)/P_t$$

- Production linear in $n_t(i)$:

$$y_t(i) = \tilde{a}_t n_t(i), \quad \tilde{a}_t = a_t^{\frac{1}{1-\alpha}} \left(\alpha \frac{\mu_t(i)}{r_t^K} \right)^{\frac{\alpha}{1-\alpha}}$$

Trade Union Preference

- Conditional labor demand

$$n_t(i) = p_t(i)^{-\epsilon} \frac{y_t}{\tilde{a}_t}$$

- Too high a markup, too small employment
- Trade union preferences:

$$U_t(i) = W_t(i) h(n_t(i)),\ h'(\cdot) > 0$$

  - $W_t(i)$ is the surplus of matched worker
  - Specific functional form of h irrelevant, $h(n_t(i)) = \tau \cdot n_t(i)$.

Nash Bargaining Over Product Price

- A firm and a trade union maximize

$$S_t^p(i) = \max_{p_t(i)} \Pi_t(i)^b U_t(i)^{1-b}$$

where

$$\begin{aligned} \Pi_t(i) &= p_t(i)^{1-\epsilon} y_t - \mu_t(i) p_t(i)^{-\epsilon} y_t \\ &\text{and} \\ U_t(i) &= W_t(i) n_t(i) = W_t(i) p_t(i)^{-\epsilon} \frac{y_t}{\tilde{a}_t} \end{aligned}$$

- $b \in (0, 1]$ is the bargaining power of the firm.
- The FOC is given by

$$\frac{\partial \Pi_t(i)}{\partial p_t(i)} = -\frac{1-b}{b} \frac{\partial U_t(i)}{\partial p_t(i)} \frac{\Pi_t(i)}{U_t(i)}$$

Kaleckian Markup Pricing Rule

- Using $-\frac{\partial U_t(i)}{\partial p_t(i)} \frac{p_t(i)}{U_t(i)} = \epsilon$, the FOC rewritten as

$$\frac{\partial \Pi_t(i)}{\partial p_t(i)} = \underbrace{\epsilon(1/b-1)\frac{\Pi_t(i)}{p_t^*(i)}}_{\substack{\text{Profits appropriated by workers} \\ \text{“aspiration gap”, Rowthorn [1977]}}} \geq 0$$

- Kaleckian markup pricing rule:

$$p_t(i) = \frac{\epsilon}{\epsilon - b}\mu_t(i)$$

- “*trade-union power restrains the markups*” (Kalecki [1976], p. 161)

Nash Bargaining and Nominal Rigidity

- A firm and a trade union still maximize

$$S_t^p(i) = \max_{p_t(i)} \Pi_t(i)^b U_t(i)^{1-b}$$

where, following Ireland [2007],

$$\begin{aligned} \Pi_t(i) &= \mathbb{E}_t \sum_{s=t}^{\infty} m_{t,s}^F \left[\begin{array}{c} p_s(i)^{1-\epsilon} y_s - \mu_s(i) p_s(i)^{-\epsilon} y_s \\ -\frac{\theta}{2} \left(\frac{\pi_s}{\pi_{s-1}^{\chi} \bar{\pi}^{1-\chi}} \frac{p_s(i)}{p_{s-1}(i)} - 1 \right)^2 y_s \end{array} \right] \\ &\text{and} \\ U_t(i) &= W_t(i) n_t(i) = W_t(i) p_t(i)^{-\epsilon} \frac{y_t}{\tilde{a}_t} \end{aligned}$$

Kaleckian Phillips Curve

- The FOC is still given by

$$\frac{\partial \Pi_t(i)}{\partial p_t(i)} = \epsilon(1/b-1)\frac{\Pi_t(i)}{p_t^*(i)} \geq 0$$

- Loglinearized Phillips Curve:

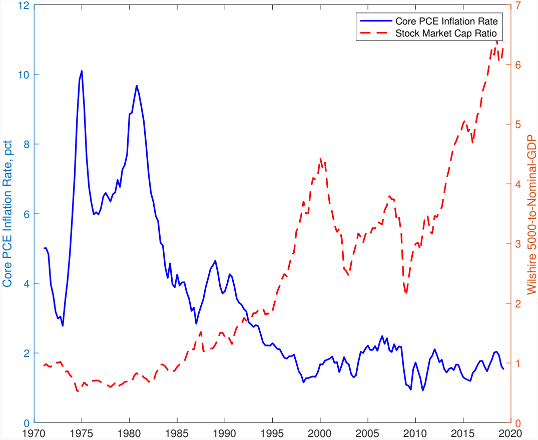
$$\begin{aligned} \hat{\pi}_t \quad = \quad & \frac{\chi}{1+\chi\beta}\hat{\pi}_{t-1} + \frac{\beta}{1+\chi\beta}\mathbb{E}_t[\hat{\pi}_{t+1}] \\ & + \frac{\epsilon}{\theta(1+\chi)}\left[\mu\hat{\mu}_t - (1/b-1)\frac{\bar{\Pi}}{\bar{y}}(\hat{\Pi}_t - \hat{y}_t)\right] \end{aligned}$$

- Additional term: market cap ratio

$$\hat{\Pi}_t - \hat{y}_t = -\frac{\mu}{\bar{\Pi}/\bar{y}}\mathbb{E}_t\left[\sum_{s=0}^{\infty}\beta^s\hat{\mu}_{t+s}\right]$$

Inflation and Stock Market in the Data

Figure 3: Inflation Rate and Wilshire 5000-to-GDP



Semi-Structural Form

- The PC and the market cap ratio yield a semi-structural form:

$$\begin{aligned}\hat{\pi}_t &= \frac{\chi}{1+\chi\beta}\hat{\pi}_{t-1} + \frac{\beta}{1+\chi\beta}\mathbb{E}_t[\hat{\pi}_{t+1}] \\ &\quad +\kappa_1(b)\left[\hat{\mu}_t + (1/b-1)\sum_{s=0}^{\infty}\beta^s\mathbb{E}_t[\hat{\mu}_{t+s}]\right]\end{aligned}$$

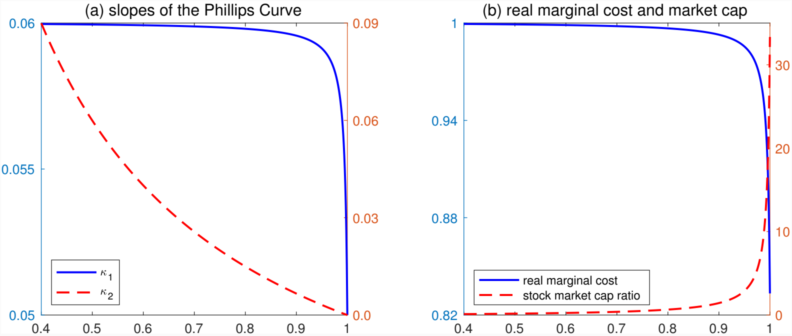
- Two slope coefficients are factored:

$$\begin{aligned}\kappa_1(b) &\equiv \frac{\epsilon\mu(\epsilon, b)}{\theta(1+\chi)} = \frac{\epsilon - 1}{\theta(1+\chi)} \text{ if } b = 1 \\ &\quad \text{and} \\ \kappa_2(b) &\equiv \kappa_1(b)(1/b-1) = 0 \text{ if } b = 1.\end{aligned}$$

Slope of the Phillips Curve and Stock Market

- Real marginal cost: $\mu(\epsilon, b) = \frac{1-\beta}{1/b-\beta}\left(\frac{\epsilon-1}{\epsilon} + \frac{1/b-1}{1-\beta}\right)$

Figure 4: Slopes, Real Marginal Cost and Stock Market



The Rest of the Model

- A two-agent New Keynesian model with two agents (type K, W).
- Each type consists of a continuum of "family members".
- Consumption insurance within a type, but not across types.
  - Two types trade bonds: $\psi b_t^K + (1-\psi) b_t^W = 0$
- Type K plays the role of owners of the firms (pop. share $\psi = 0.01$).
- Type W plays the role of workers of the firms (pop. share $\psi = 0.99$).
- Labor market is subject to search/matching friction.
- Monetary policy follows an inertial Taylor (1999) rule.
- Dividend and interest taxes to finance unemployment benefits.

Type K problem

- Maximize consumption utility

$$
\begin{aligned}
& \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s u(c^K_{t+s} - h c^K_{t+s-1}) \\
& \text{s.t.} \\
c^K_t \quad = \quad & \frac{(1-\tau)\Pi_t}{\psi} + \frac{1+(1-\tau)i_{t-1}}{\pi_t} b^K_{t-1} + \frac{r^K_t k_{t-1}}{\psi} \\
& - \frac{q^K_t k_t - (1-\delta)k_{t-1}}{\psi} - b^K_t - \frac{\eta}{2}(b^K_t)^2
\end{aligned}
$$

- Efficiency conditions:

$$
\begin{aligned}
1 \quad &= \quad \beta \mathbb{E}_t \left[\frac{u'(c^K_{t+1} - h c^K_t)}{u'(c^K_t - h c^K_{t-1})} \frac{1+(1-\tau)i_t}{\pi_{t+1}(1+\eta b^F_t)} \right] \\
1 \quad &= \quad \beta \mathbb{E}_t \left[\frac{u'(c^K_{t+1} - h c^K_t)}{u'(c^K_t - h c^K_{t-1})} \frac{r^K_{t+1} + (1-\delta) q^K_{t+1}}{q^K_t} \right]
\end{aligned}
$$

Type W problem

- Maximize consumption utility

$$
\begin{aligned}
& \mathbb{E}_t \sum_{s=0}^{\infty} \beta^s u(c^W_{t+s} - hc^W_{t+s-1}) \\
& \text{s.t.} \\
c^W_t \quad = \quad & \frac{1-\tau}{1-\psi} \left[\int w_t(i) n_t(i) di + b^U u_t \right] \\
& + \frac{1+(1-\tau) i_{t-1}}{\pi_t} b^W_{t-1} - b^W_t - \frac{\eta}{2} (b^W_t)^2
\end{aligned}
$$

- Efficiency condition:

$$
1 = \beta \mathbb{E}_t \left[\frac{u'(c^W_{t+1} - hc^W_t)}{u'(c^W_t - hc^W_{t-1})} \frac{1+(1-\tau) i_t}{\pi_{t+1}(1+\eta b^F_t)} \right]
$$

Labor market

- Law of motion for employment stock:

$$n_t = (1-\rho)n_{t-1} + q_t v_t$$

- Matching technology (Den Hann, Ramey and Watson [2000]):

$$m(v_t, \tilde{u}_t) = \frac{v_t \tilde{u}_t}{(v_t^\gamma + \tilde{u}_t^\gamma)^{1/\gamma}}$$

  - $\tilde{u}_t = 1 - \psi - (1-\rho)n_{t-1}$, $u_t = 1 - \psi - n_t$

- Wage is set to maximize

$$S_t^w(i) = \max_{w_t(i)} J_t(i)^b W_t(i)^{1-b}$$

  - $J_t(i)$ is the match surplus to the firm.
  - $W_t(i)$ is the match surplus to the worker.

Results

GMM Estimation of the Phillips Curve

- The model suggests the empirical Phillips curve:

$$\pi_t = \beta_1 s_t + \beta_2 PV_t^s + \beta_3 \pi_{t-1} + \beta_4 \mathbb{E}_t[\pi_{t+1}] + \epsilon_t$$

  - s_t = labor share, PV_t^s = expected PV of labor share.
- PV_t^s : A bivariate VAR forecast (Abel and Blanchard [1986])
  - $x_t = [WSI_t \; s_t]'$; $x_t = [DST_t \; s_t]'$, $x_t = Ax_{t-1} + \epsilon_t$

$$PV_t^s = c_2'(1-\beta)^{-1}(I - \beta A)^{-1}\beta A^2 x_{t-1}$$

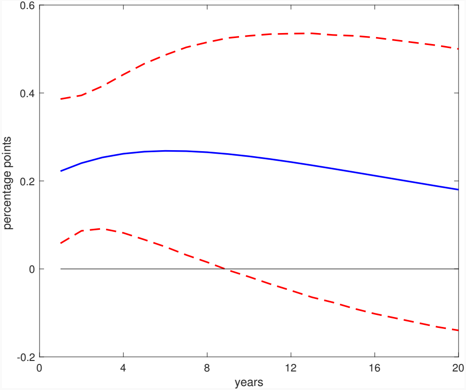
- Recovering the bargaining power of the firm b :

$$\hat{b} = \left(\hat{\beta}_2 / \hat{\beta}_1 + 1\right)^{-1}$$

- Subsample estimates: 1961-1980, 1981-2014

Impact of Strike on Labor Share

- Impulse response of labor share to 1 STD shock to strike index



Empirical Phillips Curve: U.S., 1961-2014

Table 1: GMM Estimations of the Phillips Curve: U.S.

	1961-1980	1981-2014
s_t	0.055	0.073
	(5.573)	(0.714)
PV_t^s	-	-
$E_t[\pi_{t+1}]$	0.573	0.936
	(49.43)	(4.814)
π_{t-1}	0.486	0.430
	(32.37)	(4.459)
$\hat{b}$	-	-
Adj R^2	0.716	0.862
J-stat	4.848	5.441
p-value	0.676	0.364

Empirical Phillips Curve: U.S., 1961-2014

Table 2: GMM Estimations of the Phillips Curve: U.S.

	1961-1980		1981-2014	
s_t	0.055	0.092	0.073	-0.130
	(5.573)	(2.782)	(0.714)	(-1.410)
PV_t^s	-	0.040	-	-0.011
		(6.013)		(-2.290)
$E_t[\pi_{t+1}]$	0.573	0.957	0.936	1.219
	(49.43)	(6.123)	(4.814)	(3.380)
π_{t-1}	0.486	0.400	0.430	0.411
	(32.37)	(3.838)	(4.459)	(3.500)
$\hat{b}$	-	0.696	-	1.000
Adj R^2	0.716	0.708	0.862	0.863
J-stat	4.848	3.738	5.441	3.601
p-value	0.676	0.442	0.364	0.463

Empirical Phillips Curve: U.K., 1961-2014

Table 3: GMM Estimations of the Phillips Curve: U.K.

	1961-1978	1979-2014
s_t	0.072	-0.028
	(3.162)	(-0.546)
PV_t^s	-	-
$E_t[\pi_{t+1}]$	0.456	0.441
	(7.038)	(6.898)
π_{t-1}	0.506	0.583
	(9.496)	(8.249)
$\hat{b}$	-	-
Adj R^2	0.629	0.858
J-stat	4.288	4.562
p-value	0.368	0.472

Empirical Phillips Curve: U.K., 1961-2014

Table 4: GMM Estimations of the Phillips Curve: U.K.

	1961-1978		1979-2014	
s_t	0.072	0.051	-0.028	-0.025
	(3.162)	(1.969)	(-0.546)	(-0.449)
PV_t^s	-	0.045	-	0.003
		(0.434)		(0.277)
$E_t[\pi_{t+1}]$	0.456	0.349	0.441	0.454
	(7.038)	(2.700)	(6.898)	(6.365)
π_{t-1}	0.506	0.646	0.583	0.582
	(9.496)	(2.835)	(8.249)	(8.221)
$\hat{b}$	-	0.536	-	1.000
Adj R^2	0.629	0.568	0.858	0.855
J-stat	4.288	3.195	4.562	4.875
p-value	0.368	0.526	0.472	0.300

Empirical Phillips Curve: Sweden, 1961-2014

Table 5: GMM Estimations of the Phillips Curve: Sweden

	1961-1978	1979-2014
s_t	0.036	-0.035
	(3.162)	(-0.521)
PV_t^s	-	-
$E_t[\pi_{t+1}]$	0.575	0.374
	(21.16)	(2.113)
π_{t-1}	0.515	0.557
	(13.27)	(3.715)
$\hat{b}$	-	-
Adj R^2	0.812	0.822
J-stat	3.328	0.115
p-value	0.650	0.998

Empirical Phillips Curve: Sweden, 1961-2014

Table 6: GMM Estimations of the Phillips Curve: Sweden

	1961-1978		1979-2014	
s_t	0.036	0.034	-0.035	-0.026
	(3.162)	(3.552)	(-0.521)	(-0.316)
PV_t^s	-	0.021	-	-0.001
		(1.390)		(-0.196)
$E_t[\pi_{t+1}]$	0.575	0.576	0.374	0.368
	(21.16)	(7.119)	(2.113)	(2.027)
π_{t-1}	0.515	0.644	0.557	0.563
	(13.27)	(4.830)	(3.715)	(3.607)
$\hat{b}$	-	0.622	-	1.000
Adj R^2	0.812	0.789	0.822	0.817
J-stat	3.328	3.534	0.115	62.24
p-value	0.650	0.473	0.998	0.071

Empirical Phillips Curve: Denmark, 1961-2014

Table 7: GMM Estimations of the Phillips Curve: Denmark

	1961-1978	1979-2014
s_t	0.024	-0.060
	(2.074)	(-1.260)
PV_t^s	-	-
$E_t[\pi_{t+1}]$	0.574	0.829
	(5.812)	(5.343)
π_{t-1}	0.478	0.310
	(6.826)	(1.932)
$\hat{b}$	-	-
Adj R^2	0.611	0.689
J-stat	1.414	2.668
p-value	0.842	0.751

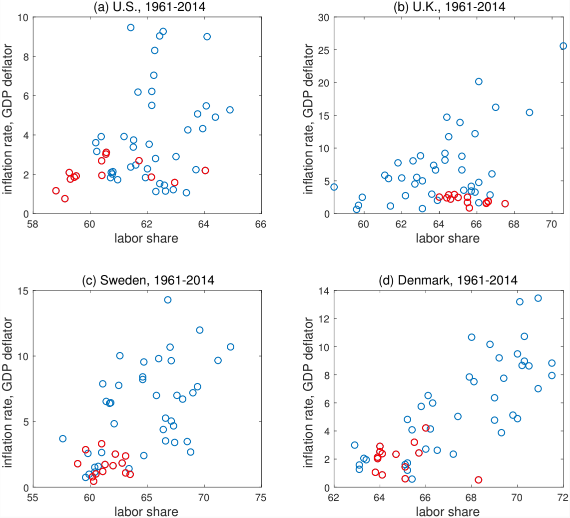
Empirical Phillips Curve: Denmark, 1961-2014

Table 8: GMM Estimations of the Phillips Curve: Denmark

	1961-1978		1981-2014	
s_t	0.024	0.024	-0.060	-0.060
	(2.074)	(1.200)	(-1.260)	(-1.273)
PV_t^s	-	0.010	-	0.008
		(0.757)		(0.988)
$E_t[\pi_{t+1}]$	0.574	0.546	0.829	0.901
	(5.812)	(4.087)	(5.343)	(4.192)
π_{t-1}	0.478	0.535	0.310	0.246
	(6.826)	(3.448)	(1.932)	(1.145)
$\hat{b}$	-	0.699	-	1.000
Adj R^2	0.611	0.586	0.689	0.661
J-stat	1.414	1.378	2.668	2.347
p-value	0.842	0.711	0.751	0.672

Inflation and Labor Share

Figure 5: Inflation and Labor Share: U.S., U.K., Sweden and Denmark



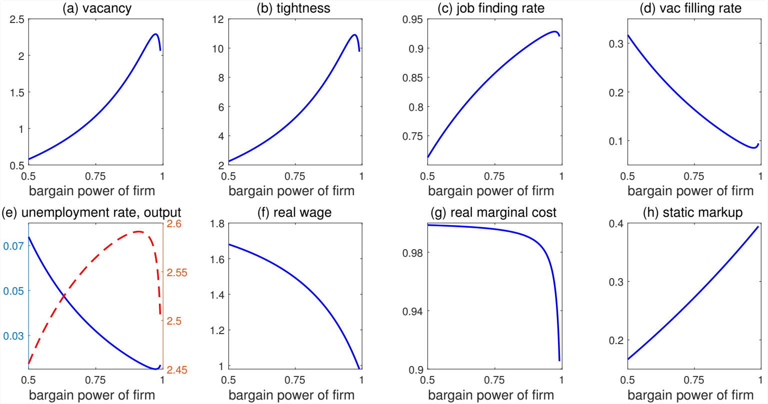
Comparative Statics

Range of Bargaining Power (b): From 0.5 to 0.99

Table 9: Fixed Parameters

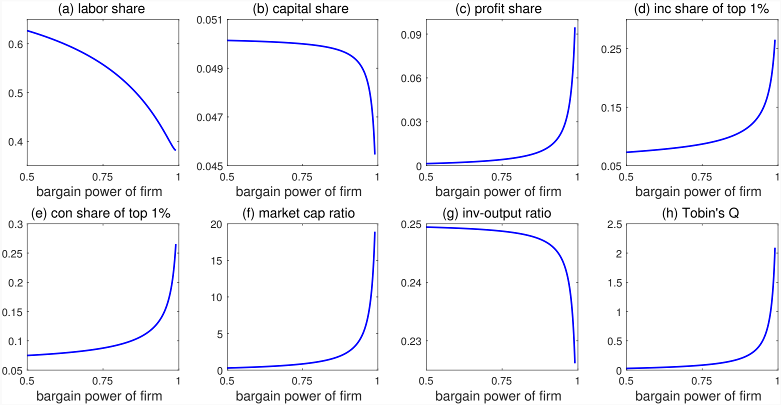
Parameters ($b = 0.75$)	Values
Elasticity of subs. (ϵ)	3.5
Separation rate (ρ)	0.2
Unemployment benefit (b^U/w)	0.7
Vacancy posting cost (ξ/y)	0.12
Population share of the owners (ψ)	0.01
Matching function (γ)	1.05
Depreciation rate (δ)	0.025
Capital share (α)	0.3
CRRA, habit (σ, h)	1.5,0.85
Price adjustment cost (θ)	2,000
Investment adjustment cost (κ)	5
Indexation (χ)	0.5
Trend inflation ($\bar{\pi}$)	2
Inertial Taylor (1999) rule	1.5,1.0,0.85

Comparative Statics: Rabor Market and Real Economy



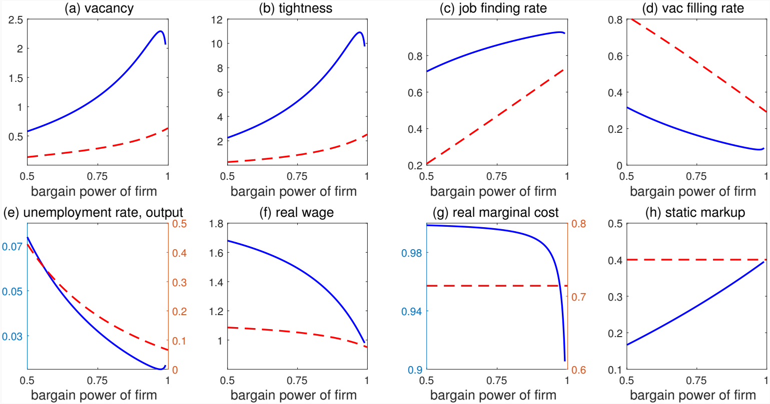
- Firms have greater incentives to create more jobs as b increases.
- The current low unemployment rate and lack of inflation are the symptoms of extremely low level of bargaining power of workers.

Comparative Statics: Factor Shares and Financial Market



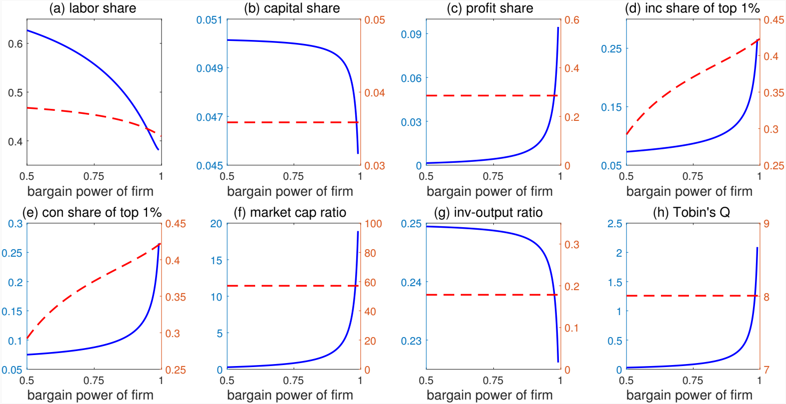
- Barkai , De Loecker_et_al , Gutierrez and Phillippon [2018], Farhi and Gourio , [2018], Eggertsson et al [2018] explain the rise of profit share and Tobin's Q by market power.

Wage Bargain Power Only: Real Economy



- Trade union does not engage in bargaining over employment size
- Counter factual unemployment rate, static markup

Wage Bargain Power Only: Financial Market



- Not able to generate trends for factor shares, market cap, Tobin's Q
- Still able to explain the rise of income, consumption shares.

Model Results: Trade Union Power and Inflation Dynamics

Figure 6: Impacts of Demand Shock: b = 0.4 vs b = 0.99

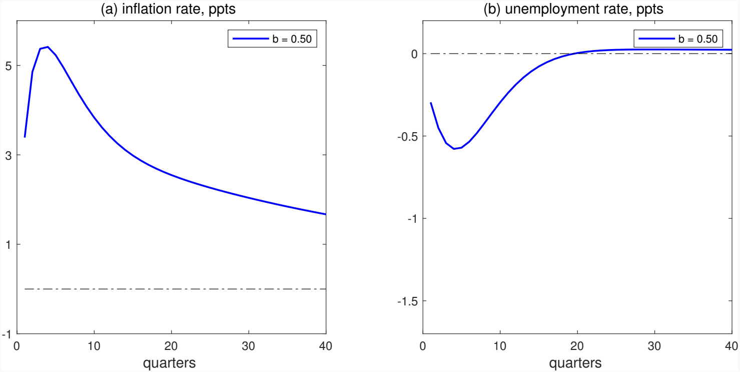


Figure 7: Impacts of Demand Shock: b = 0.4 vs b = 0.99

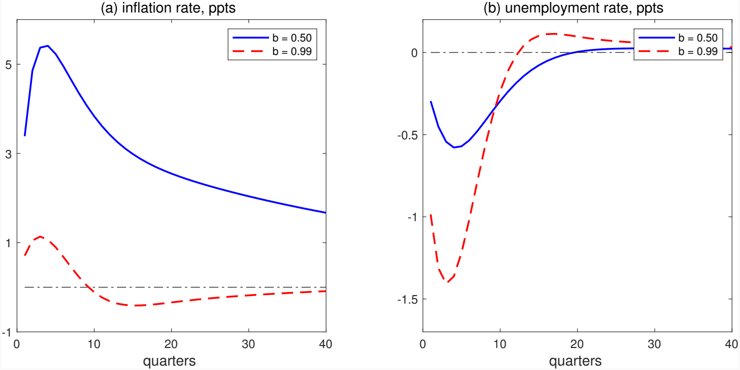
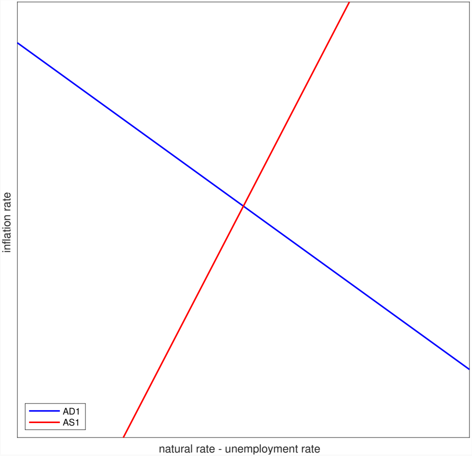
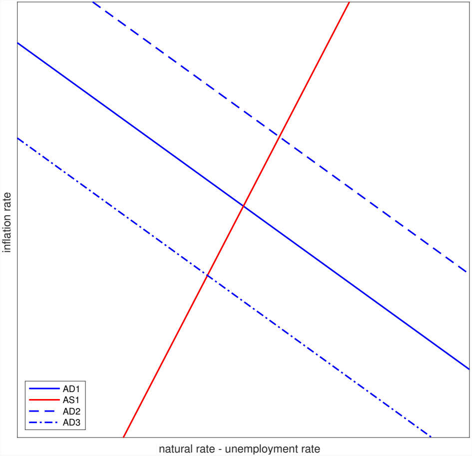


Figure 8: Slope of the Phillips Curve and Relative Volatilities



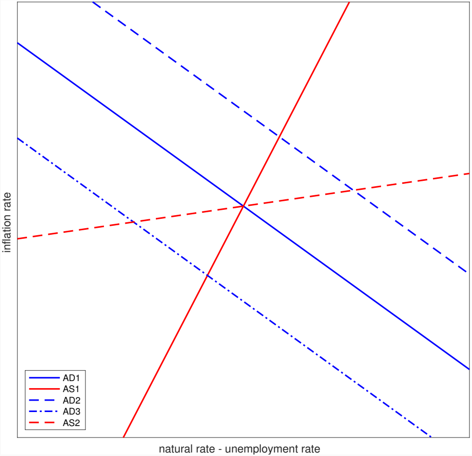
Illustration

Figure 9: Slope of the Phillips Curve and Relative Volatilities



Illustration

Figure 10: Slope of the Phillips Curve and Relative Volatilities



Trade Union Power and Aggregate Volatility

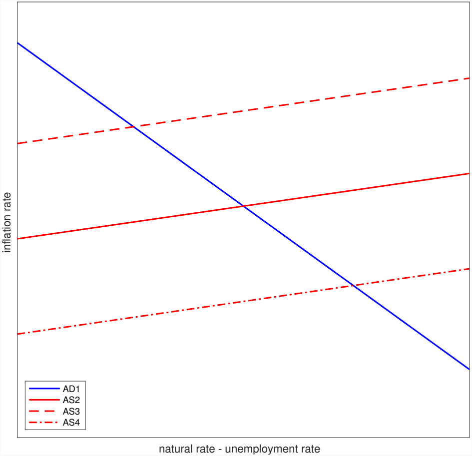
Table 10: Bargaining Power and Volatility

	$b = 0.40$	$b = 0.55$	$b = 0.75$	$b = 0.99$
	STD(π) $\times$ 100			
Demand shock only	1.77	2.06	1.92	0.29
Supply shock only	4.01	3.77	3.28	0.44
Both shocks (50:50)	4.37	4.29	3.80	0.53
	STD(u)/E(u) $\times$ 100			
Demand shock only	5.87	7.44	10.7	49.3
Supply shock only	4.75	5.82	9.06	40.8
Both (50:50)	4.74	9.45	14.1	40.6

- 85 percent reduction in STD(π) through bargaining power channel

What If Price Markup Shock Is the Driver?

Figure 11: Flat Phillips Curve and Markup Shock



Markup Shock and Flat Phillips Curve

Table 11: Markup shock, Flat Phillips Curve and Inflation Volatility

	$b = 0.40$	$b = 0.55$	$b = 0.75$	$b = 0.99$
		STD(π) $\times$ 100		
Markup shock only	0.84	1.05	1.09	1.96
		STD(u)/E(u) $\times$ 100		
Markup shock only	2.74	4.33	8.24	37.7

Implication for Monetary Policy

- The combination of "flat" Phillips curve and lack of inflation volatility: the price markup shock is not the primary driver of data.
- Implication for monetary policy: loss function weight for $u - u^N = 0$
  - A positive weight for $u - u^N$ is not from the dual mandate.
  - It's the presence of markup shock that justifies the positive weight.
- Policymakers should focus on achieving the inflation target.

Conclusion

In Lieu of Conclusion...

"But in different stages of society, the proportions of the whole produce of the earth which will be allotted to each of these classes, under the names of rent, profit, and wages, will be essentially different...To determine the laws which regulate this distribution, is the principal problem in Political Economy" – *David Ricardo, 1817, On the Principles of Political Economy and Taxation.*