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A DSGE model for the European Unemployment Persistence

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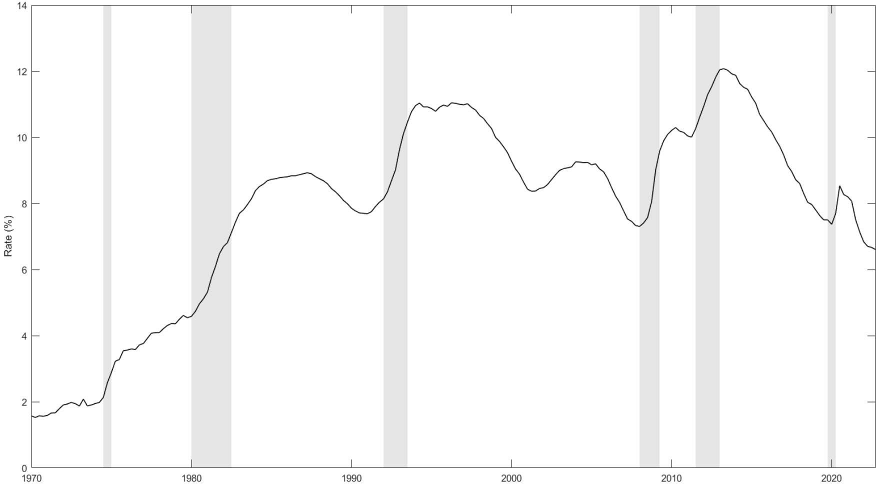
Unemployment Rate in the Euro Area



ADF and PP unit root tests results for the Unemployment Rate series

	Unemployment Rate					
	1970Q1-2022Q4			1999Q1-2022Q4		
	Constant	Constant & Trend	Neither Constant nor Trend	Constant	Constant & Trend	Neither Constant nor Trend
ADF	-2.3514(1) (0.1570)	-1.3763(1) (0.8652)	-0.1479(1) (0.6316)	-1.6271(1) (0.4649)	-1.6680(1) (0.7579)	-0.8453(1) (0.3472)
PP	-2.1922(9) (0.2098)	-0.9299(9) (0.9496)	-0.0340(10) (0.6704)	-1.1785(6) (0.6812)	-1.2111(6) (0.9023)	-0.9800(6) (0.2908)

The first value on the first line is the t-statistic for the corresponding ADF or PP unit root test, the value in parentheses is the number of lags that were used for the test. The value in parentheses on the second line is the McKinnon (1996) one-sided p-value for the test.

	1970Q1-2022Q4			1999Q1-2022Q4		
Level of Statistical Significance	Constant	Constant & Trend	Neither Constant nor Trend	Constant	Constant & Trend	Neither Constant nor Trend
1%	-3.4615	-4.0024	-2.5760	-3.4999	-4.0565	-2.5893
5%	-2.8751	-3.4314	-1.9423	-2.8919	-3.4573	-1.9442
10%	-2.5741	-3.1393	-1.6157	-2.5830	-3.1546	-1.6145

Critical values for ADF and PP unit root tests.

Motivation for Introducing Financial Frictions

During the past decade DSGE models (among other points) have been the target of criticism due to

- their failure to predict the financial crisis of 2007-2008.
- their dependence on strong exogenous shocks to generate time series of comparable persistence as in the “actual” macroeconomic data.

Research Objective

- Develop a quantitative DSGE model that fits the “actual” aggregate Eurozone business cycle data and can account for the European unemployment persistence.

The Model

I extend the Gertler & Karadi (2011) financial frictions DSGE model in two main directions:

- Firstly, to introduce unemployment in the extensive margin as in Galí (2011).
- Secondly, to allow for an insiders-outsiders wage setting.

Aside from financial and labor market frictions, the model also highlights

- Nominal rigidities in the goods market, where retail firms can adjust their prices only with a probability in any given period.
- Habit formation in consumption.
- Physical capital accumulation.
- Investment adjustment costs.
- Variable capital utilization in response to shocks.
- A fixed cost of production that ensures zero equilibrium profits for monopolistically competitive firms.
- A monetary authority that conducts policy according to a Taylor rule that allows for policy inertia.
    - The monetary authority has also the ability to apply unconventional stabilization policies (after a financial downturn) by conducting direct credit policy interventions.

Financial intermediaries (banks) are assumed:

- to borrow funds from households and then lend these funds to intermediate good producers.
- hold long term assets (financial claims on intermediate good producers) and fund these assets with their own net worth and with household deposits (short term liabilities), if their net worth is not enough.
  - Households receive a non contingent real gross return r_{t+1} for their deposits to financial intermediaries.
  - Financial intermediaries' assets earn a stochastic return r^k_{t+1}.
  - Both returns are endogenously determined and the difference between them is the premium the banker earns on his assets, $E_t \left\{ r^k_{t+1} / r_{t+1} \right\}$.
- A moral hazard problem ties net worth (profits of banks) to asset prices (private bonds).
- Higher the net worth, higher the loans banks can provide.
- Since, the mechanism works via asset prices we need the investment adjustment costs.

Unemployment

Unemployment is modeled in the extensive margin. Briefly,

- The unemployment rate, in period t, is defined as the ratio of the unemployed to the labor force: $u_t = \frac{L_t - n_t}{L_t}$.
- Where L_t denotes the labor force and corresponds to the employment level under a frictionless labor market, where it holds that the real wage is equal to the marginal rate of substitution between labor and consumption: $W_{j,t}/P_t = MRS_{j,t}$.
- Under a monopolistically competitive labor market, the wage markup is given by: $\mu^w_{j,t} = \frac{W_{j,t}/P_t}{MRS_{j,t}} > 1$.
- In this case we can derive a relationship between the unemployment rate and the aggregate wage mark-up:

$$u_t = 1 - \left(\frac{1}{\mu^w_t}\right)^{\frac{1}{\phi_n}} \tag{1}$$

where parameter ϕ_n denotes the elasticity with which household members of labor type j enter or leave employment in response to shocks.

- As long as the wage mark-up is greater than unity, there is unemployment in the model.
- The existence of nominal wage rigidities, leads to wage mark-up fluctuations and subsequently to fluctuations in unemployment.

Insiders-Outsiders Labor Market Structure

Insiders-outsiders labor market is modeled as in Galí (2022) who builds upon the framework of Blanchard & Summers (1986). Within this framework,

- Insiders are the (previous period) employed whereas, outsiders are the unemployed.
- Insiders are organized in labor unions and affect the wage setting.
- The number of insiders endogenously evolves over time as a function of employment. This is called hysteresis.
- Each union of labor type j, that is able to adjust its nominal wage in a given period, is sufficiently strong to unilaterally set the wage so as to make expected employment equal to some employment target:

$$E_t \left\{ n_{j,t+k} \right\} = n_j^*$$

- The employment target in any given labor union j evolves over time according to the difference equation (hysteresis equation):

$$n_{j,t}^* = n_{j,t-1}^{\gamma} \left(\bar{n}^* \right)^{1-\gamma} \tag{2}$$

where parameter $\gamma \in [0,1]$ determines the extent to which changes in employment affect the economy's state, by changing the portion of insiders (hysteresis). $\bar{n}^*$ denotes the (exogenously given) union's long-run target for employment, which is assumed to be common across labor types.

Insiders-Outsiders Labor Market Structure

$$n^*_{j,t} = n^{\gamma}_{j,t-1} \left(\bar{n}^*\right)^{1-\gamma} \tag{2}$$

- For $\gamma = 1$, full hysteresis is assumed. In this case even temporary shocks have permanent effects on macroeconomic aggregates.
- For $\gamma = 0$, no hysteresis is assumed. In this case the predictions of the model are similar to those of a standard Calvo wages version of the model.
- Only a portion of all unions is assumed to be able to optimally set their wages in a given period t.
- Unions which do not optimally choose their wages in a specific period, can adjust them to previous period inflation.

When choosing parameter values I assume:

- that the union's long-run employment target, $\bar{n}^*$, is equal to the natural level of employment from the standard Calvo wages version of the model (this assumption does not affect the model's dynamics).
- a moderate degree of hysteresis $\gamma = 0.65$ when examining the dynamics of the model. This value is compatible with the European unemployment hysteresis according to empirical evidence, see Alogoskoufis (2018).

The Model's Equations

The model is a system of 39 difference equations in 39 unknown variables:

- 10 Forward Looking Variables $\{\lambda_{t+1}, r_{t+1}, z^1_{t+1}, z^2_{t+1}, r^k_{t+1}, \rho_{t+1}, \nu_{t+1}, \eta_{t+1}, z_{t+1}, \Phi_{t+1}\}$.
- 11 Backward Looking Variables $\{w_{t-1}, k_{t-1}, q_{t-1}, \phi_{t-1}, i_{t-1}, \Delta^p_{t-1}, \Delta^w_{t-1}, \Delta^L_{t-1}, y_{t-1}, N_{t-1}, n_{t-1}\}$.
- 1 Exogenous Backward Looking Variable $\{\xi_{t-1}\}$.
- 3 Both Forward and Backward Looking Variables $\{c_{t-1}, \pi_{t-1}, x^n_{t-1}\}$.
- 14 Static Variables $\{\widetilde{\pi}_t, \psi^u_t, \widetilde{w}_t, L_t, u_t, \delta_t, u^k_t, \phi^c_t, N^n_t, N^e_t, mc_t, x_t, \mu^w_t, prem_t\}$.

The dynamics of the model are derived by linearizing all relevant equations around the non stochastic zero inflation steady state and then using standard methods of numerical simulations.

Calibration

Standard Eurozone values are given to the model's parameters.

Steady State

- I solve for the non stochastic zero inflation steady state.

"Simple" Taylor Rule

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[\bar{i} + \Phi_\pi ln\left(\frac{\pi_t}{\bar{\pi}}\right) + \Phi_y ln\left(\frac{y_t}{y_{t-1}}\right)\right] + \epsilon_{\upsilon,t}$$

- $\epsilon_{\upsilon,t} \overset{iid}{\sim} N(0, \sigma_\upsilon^2)$ is a monetary policy shock.
- For values of ρ_i close to unity (as assumed in the simulations below), this "simple" interest rate rule is similar to the one proposed in Orphanides (2006), Smets (2010) and Galí (2022) as a good approximation to ECB's policy.

Capital Quality

- Follows a logarithmic AR(1) process with drift:

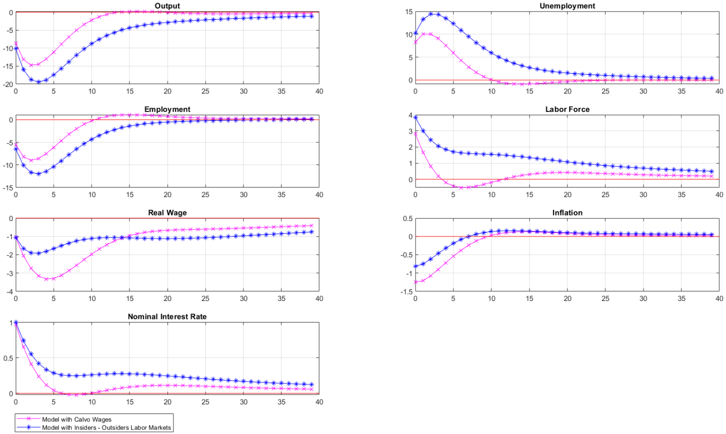
$$ln\left(\frac{\xi_t}{\bar{\xi}}\right) = \rho_\xi ln\left(\frac{\xi_{t-1}}{\bar{\xi}}\right) - \epsilon_{\xi,t}$$

- $\epsilon_{\xi,t} \overset{iid}{\sim} N(0, \sigma_\xi^2)$ is a shock on capital quality.

Calvo Wages vs Insiders-Outsiders Model

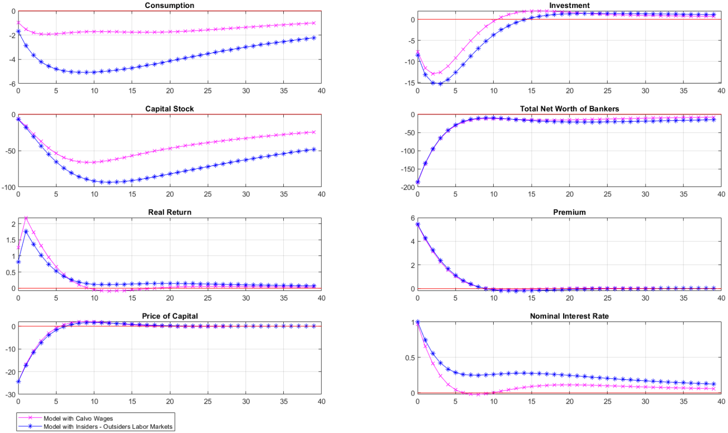
Dynamic Responses after a Monetary Policy Shock

Dynamic responses after a monetary policy shock, expressed as percentage deviations from steady state, $\rho_i = 0.90$, $\sigma_\upsilon = 1\%$. Policy response coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



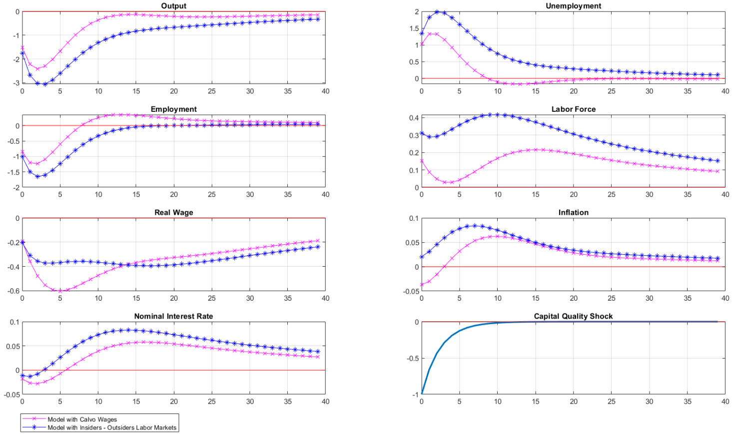
Dynamic responses after a Monetary Policy Shock (cont.)

Dynamic responses after a monetary policy shock, expressed as percentage deviations from steady state, $\rho_i = 0.90$, $\sigma_\upsilon = 1\%$. Policy response coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



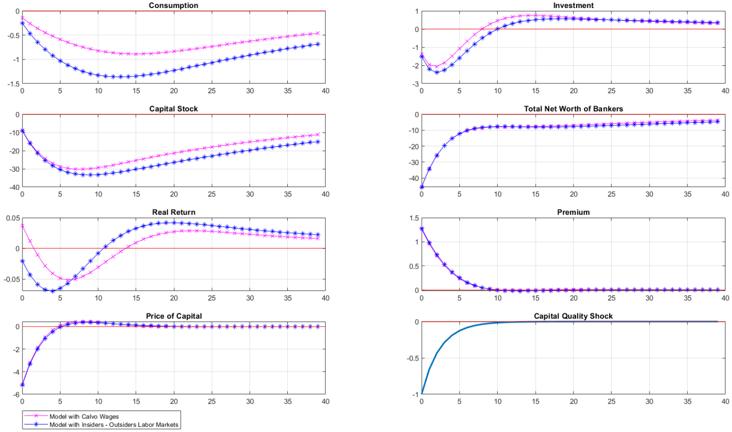
Dynamic Responses after a Capital Quality Shock

Dynamic responses after an unexpected drop in capital quality, expressed as percentage deviations from steady state, $\rho_\xi = 0.66$, $\sigma_\xi = 1\%$. Policy response coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



Dynamic Responses after a Capital Quality Shock (cont.)

Dynamic responses after an unexpected drop in capital quality, expressed as percentage deviations from steady state, $\rho_\xi = 0.66$, $\sigma_\xi = 1\%$. Policy response coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



A Wage Inflation Targeting Rule

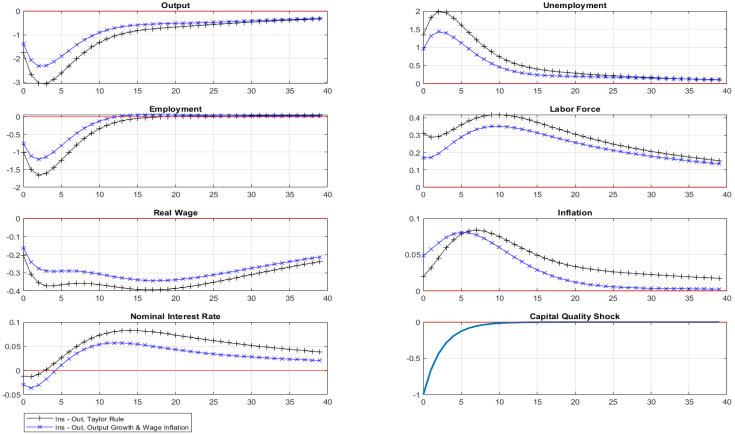
$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[\bar{i} + \Phi_\pi ln\left(\frac{\pi_t}{\bar{\pi}}\right) + \Phi_y ln\left(\frac{y_t}{y_{t-1}}\right) + \Phi_w ln\left(\frac{w_t}{w_{t-1}}\frac{\pi_t}{\bar{\pi}}\right)\right] + \epsilon_{\upsilon,t}$$

Policy Rule	ρ_i	Φ_π	Φ_y	Φ_w
Standard Taylor rule	0.90	1.5	0.5/4	0
Output growth & wage inflation targeting rule	0.90	0	0.5/4	1.5

Comparison of Different Monetary Policy Rules

Comparison of “Simple” Taylor Rules - Capital Quality Shock

Dynamic responses after an unexpected drop in capital quality, expressed as percentage deviations from steady state, $\rho_\xi = 0.66$, $\sigma_\xi = 1\%$. Policy response coefficients $\Phi_y = 0.5/4$ and $\Phi_\pi = 1.5$ & $\Phi_w = 0$ or $\Phi_\pi = 0$ & $\Phi_w = 1.5$.



Welfare Analysis (Examining Different Monetary Policy Rules)

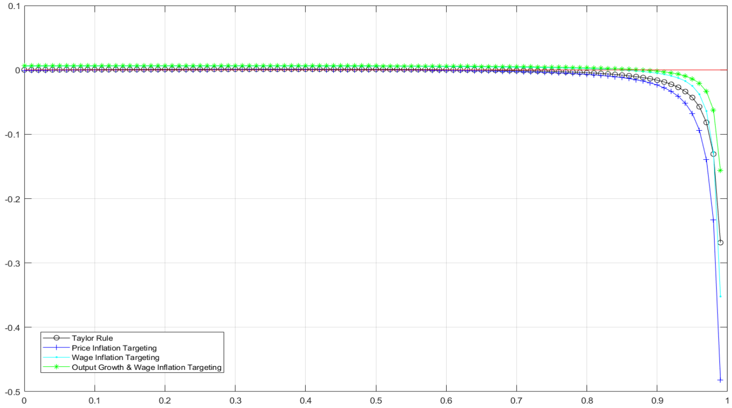
Monetary Policy Rule

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[\bar{i} + \Phi_\pi ln\left(\frac{\pi_t}{\bar{\pi}}\right) + \Phi_y ln\left(\frac{y_t}{y_{t-1}}\right) + \Phi_w ln\left(\frac{w_t}{w_{t-1}}\frac{\pi_t}{\bar{\pi}}\right)\right] + \epsilon_{\upsilon,t}$$

Policy Rule	ρ_i	Φ_π	Φ_y	Φ_w
Standard Taylor rule	0.90	1.5	0.5/4	0
Price inflation targeting rule	0.90	1.5	0	0
Wage inflation targeting rule	0.90	0	0	1.5
Output growth & wage inflation targeting rule	0.90	0	0.5/4	1.5

Welfare Comparisons - Capital Quality Shock

"Consumption equivalent" welfare losses across policies as a function of hysteresis (welfare losses are normalized to be equal to zero under the Taylor rule and in the absence of hysteresis).



Standard Taylor Rule

$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[\bar{i} + \Phi_\pi ln\left(\frac{\pi_t}{\bar{\pi}}\right) + \Phi_y ln\left(\frac{y_t}{y_{t-1}}\right)\right] + \epsilon_{\upsilon,t}$$

Credit Policy Rule

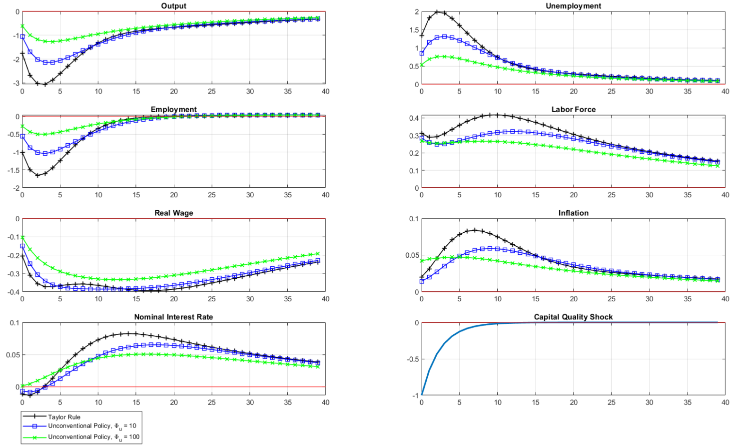
- The central bank conducts credit policy by issuing government debt to households that pays the riskless rate r_{t+1}.
- Then, it lends the funds to intermediate good producers at the market lending rate r^k_{t+1}.
- It is not balance sheet constrained but is less efficient than private banks (pays a proportional cost τ).
- It intermediates only a fraction of total assets ψ^u_t.
- We assume that the central bank increases credit when the premium $E_t\left\{r^k_{t+1}/r_{t+1}\right\}$ increases relative to its steady state value $\bar{r}^k/\bar{r}$, according to

$$\psi^u_t = \bar{\psi}^u + \Phi_u E_t\left\{ln\left(\frac{r^k_{t+1}/r_{t+1}}{\bar{r}^k/\bar{r}}\right)\right\} \tag{3}$$

Credit Policy (Impulse Responses)

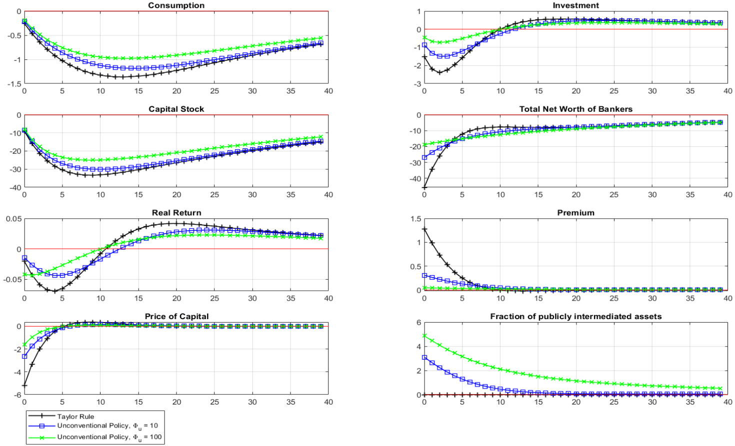
Unconventional Policy - Capital Quality Shock

Dynamic responses after an unexpected drop in capital quality, expressed as percentage deviations from steady state, $\rho_\xi = 0.66$, $\sigma_\xi = 1\%$. Taylor rule policy coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



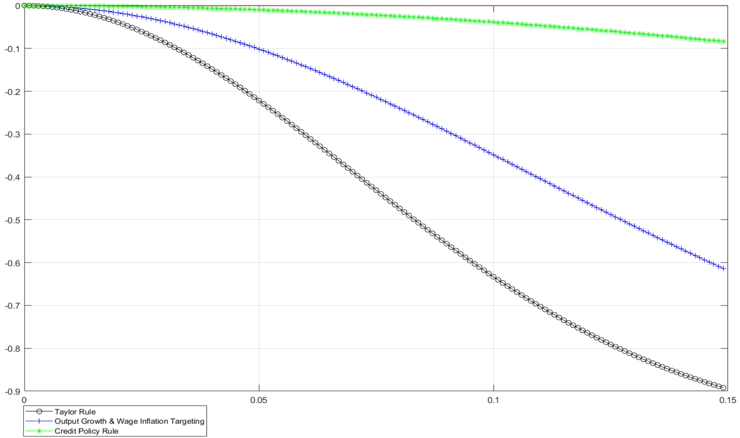
Unconventional Policy - Capital Quality Shock (cont.)

Dynamic responses after an unexpected drop in capital quality, expressed as percentage deviations from steady state, $\rho_\xi = 0.66$, $\sigma_\xi = 1\%$. Taylor rule policy coefficients $\Phi_\pi = 1.5$, $\Phi_y = 0.5/4$.



Welfare Comparisons - Capital Quality Shock

"Consumption equivalent" welfare losses across policies as a function of the shock's magnitude (welfare losses are normalized to be equal to zero in the absence of exogenous shocks).



Conclusions

Main Results

- Overall, the model generates strong endogenous persistence after either a monetary policy shock or a financial shock; both considered relevant to the onset of financial crises.
- Labor market hysteresis significantly enhances the impact of aggregate shocks on unemployment, real output and the rest of the examined macroeconomic aggregates.
- Financial market shocks appear to be an important source of aggregate fluctuations; especially in conjunction with an insiders-outsiders labor market structure.
- Under a high degree of hysteresis, a central bank which follows a "simple" Taylor rule can benefit from choosing to stabilize wage inflation.
  - Since a "simple" Taylor rule that stabilizes price inflation along with the growth rate of real output is a good approximation to ECB's policy, a change of policy towards wage inflation stabilization could potentially help towards a faster stabilization of the European economy after a severe financial crisis.
- Benefits from using credit policy interventions increase with the shock's magnitude.

End of Presentation

Thank you!