A Single Monetary Policy for Heterogeneous Labour Markets: The Case of the Euro Area

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Motivation

Both the ECB and the FED in their recent strategy reviews paid more attention to employment and inequality.

- The ECB: "...the medium-term orientation provides flexibility to take account of employment in response to economic shocks, giving rise to a **temporary trade-off between short-term employment and inflation stabilisation without endangering medium-term price stability**." and "... important to [...] account for uncertainty, **heterogeneity** and ongoing structural changes shaping the outlook for economic activity and employment in the euro area and its member countries."
- The FOMC reviewed its strategy and clarified the maximum employment goal. "Our revised statement reflects our **appreciation of a strong labour market, particularly for many in low- and moderate-income communities**..." (J. Powell)

Job finding rates by educational attainment in the EA

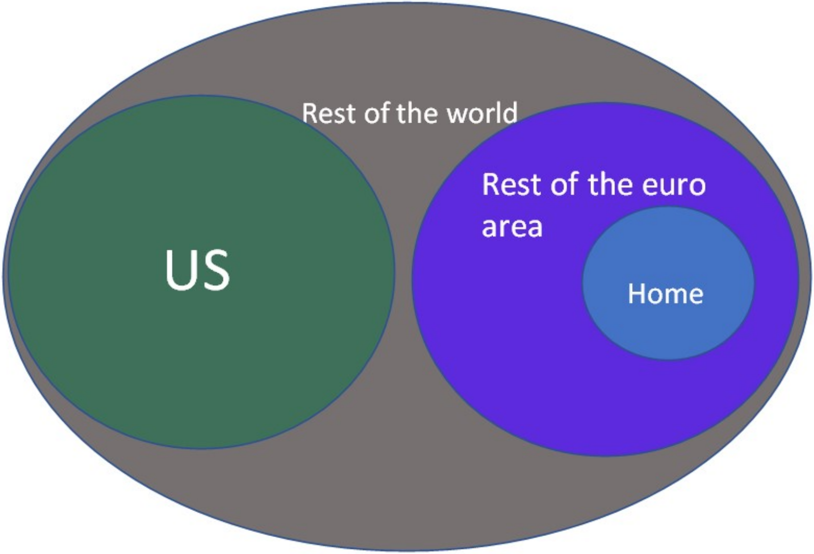
EA countries differ (trade direction...), but country-specific labour institutions are typical (computed from OECD data):

Country	Below upp. secondary	Upper sec., non-tertiary	Tertiary
Austria	0.40	0.36	0.20
Belgium	0.10	0.18	0.33
Finland	0.14	0.44	0.35
France	0.14	0.19	0.20
Germany	**0.21**	**0.29**	**0.35**
Greece	**0.12**	**0.12**	**0.13**
Hungary	0.22	0.25	0.33
Ireland	0.10	0.16	0.19
Italy	0.15	0.14	0.24
Latvia	0.16	0.19	0.26
The Netherlands	0.25	0.26	0.35
Slovak Republic	0.12	0.23	0.34
Slovenia	0.28	0.07	0.30
Spain	**0.28**	**0.29**	**0.30**

What we do

- Consider a typical two-agent New Keynesian model:
  - Constrained households consume their labour income (minus taxes, plus eventual transfers)...
  - ...so their consumption $=$ their disposable income...
  - ...so disposable income is the only (!) determinant of their consumption...
  - ...and then the typical assumption is that wages of the unconstrained households ("the rich") behave exactly the same as wages of the constrained households ("the poor").
- We relax this assumption and allow for different unemployment rates, matching probabilities, separation rates...
- We look at monetary policy and inflation-(un)employment trade-off

Model of the euro area and the global econ. (EAGLE)



Heterogeneity in the model

- We have several dimensions of heterogeneity in the model:
  - Cross-country heterogeneity within the euro area (arising from different trade orientation, etc.)
  - Each country is modelled as a two-agent (TANK) model
  - Each type of agents has its own labour market segment with search-and-matching
  - Each type of agents has their own wage-setting, with the distinction between wages of new hires and existing workers

Targeting rules

Benchmark Taylor rule

$$r_t = \varphi_r \; r_{t-1} + (1 - \varphi_r)\,(r^* + \pi^* + \varphi_\pi\,(\pi_t - \pi^*) + \varphi_u \; \hat{u}_t) + \varepsilon_t^R$$

Taylor rule with an asymmetric response to unemployment

$$r_t = \varphi_r \; r_{t-1} + (1 - \varphi_r)\,(r^* + \pi^* + \varphi_\pi\,(\pi_t - \pi^*) + I_{u>u^*} \varphi_U \hat{u}_t) + \varepsilon_t^R$$

Average inflation targeting rule (4 y-o-y rates)

$$r_t = \varphi_r \; r_{t-1} + (1 - \varphi_r)\left(r^* + \pi^* + \varphi_\pi\left(\bar{\pi}_t^T - \pi^*\right) + \varphi_u \; \hat{u}_t\right) + \varepsilon_t^R$$

Calibration

We pay particular attention to the calibration of the labour market:

- Compute job finding probabilities for Ricardian and HtM households (OECD, search duration) to match matching efficiencies
- Use replacement ratios from OECD (for Ricardian and HtM) to get vacancy posting costs
- Use unemployment by educational attainment to match separation rates
- Calibrate disutility weight to normalise hours worked to 1 in the steady state

Simulations

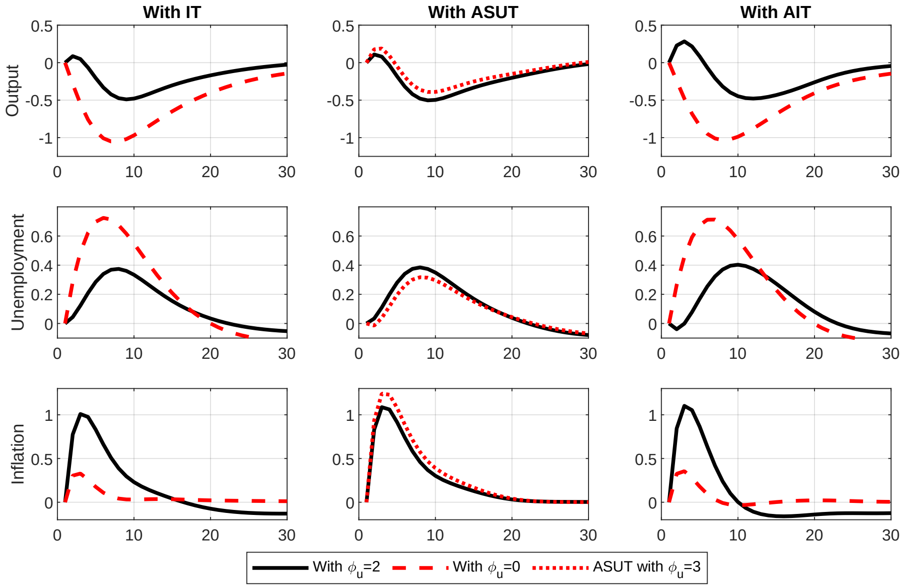
We simulate two types of shocks:

- Inflationary supply shock
  - Increase in markups in tradable and non-tradable sectors
  - $\Rightarrow$ Monetary policy cannot stabilise output/employment and simultaneously fight inflation

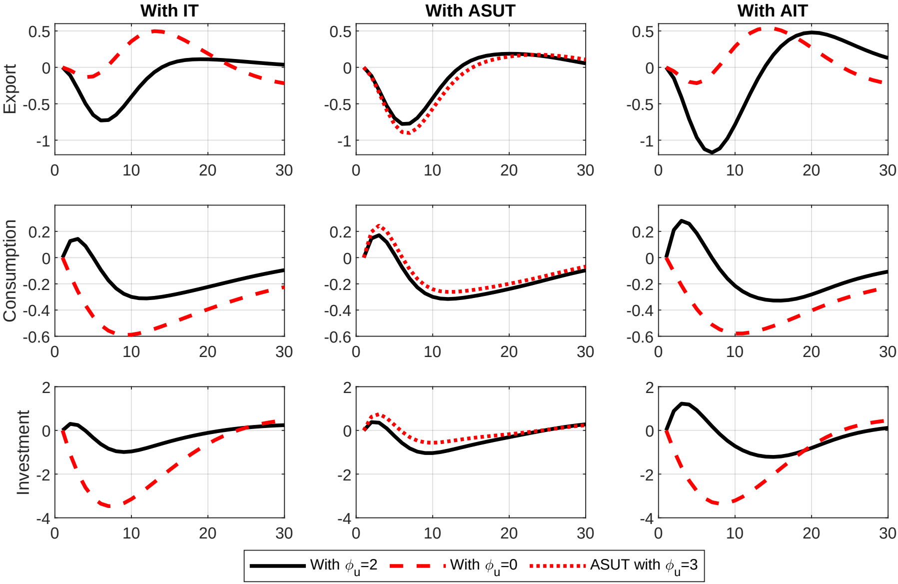
- Expansionary demand shock
  - Preference shock and investment-specific demand shock
  - $\Rightarrow$ Monetary policy can stabilise output/employment and fight inflation

We look at the performance of the three monetary policy rules, with emphasis on employment and heterogeneity between and within EA countries.

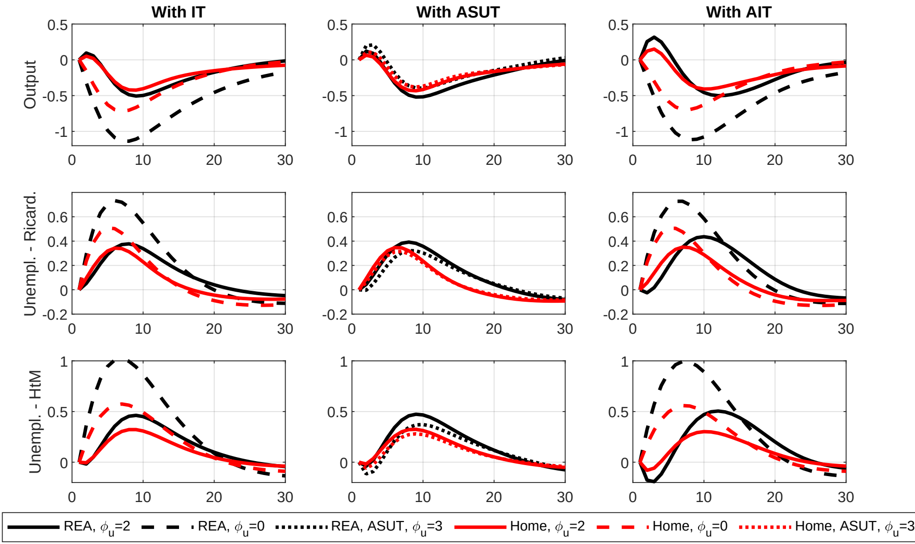
Inflationary supply shock - EA-wide



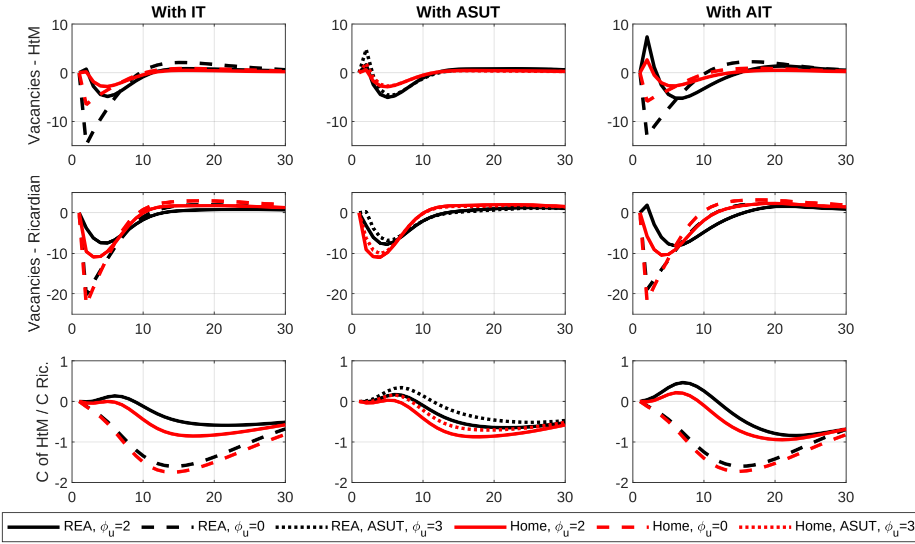
Inflationary supply shock - EA-wide



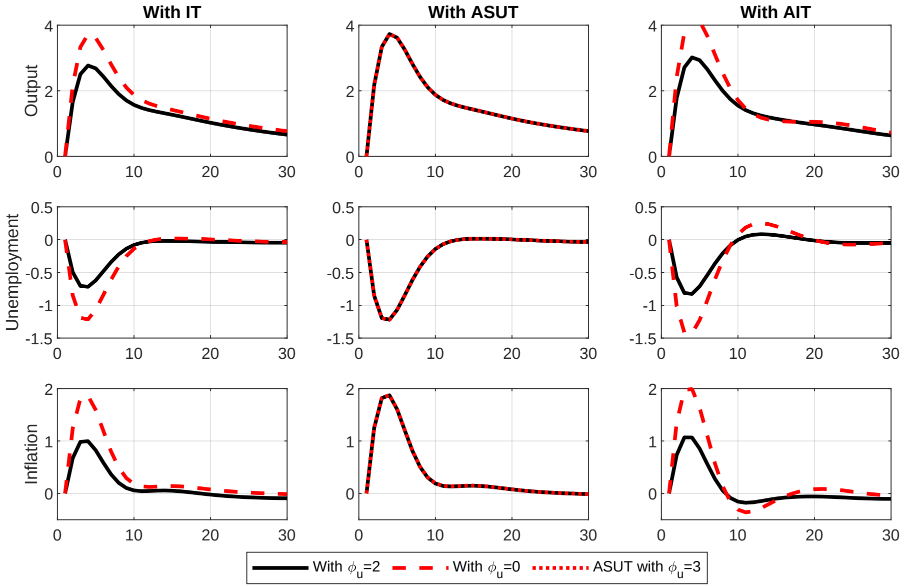
Inflationary supply shock - country-specific



Inflationary supply shock - country-specific labour



Expansionary demand shock - EA-wide



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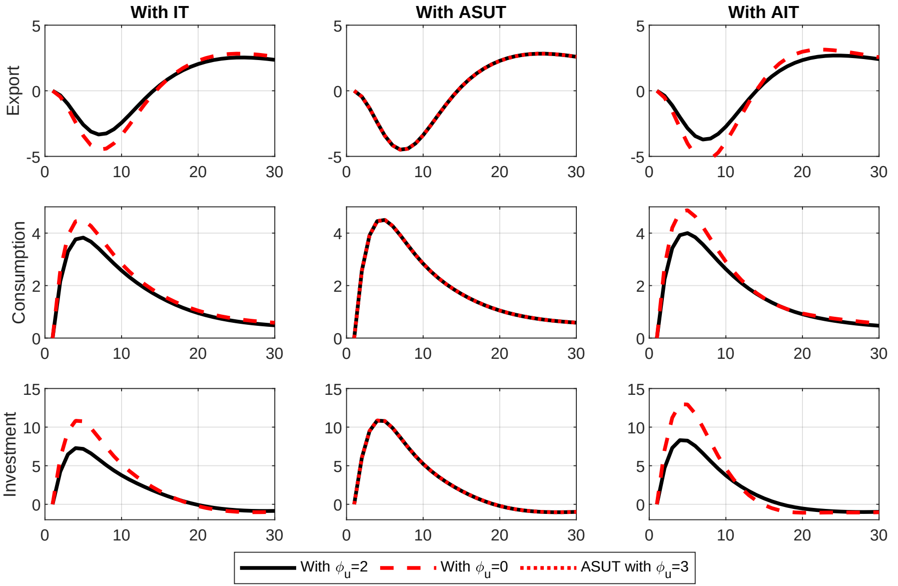
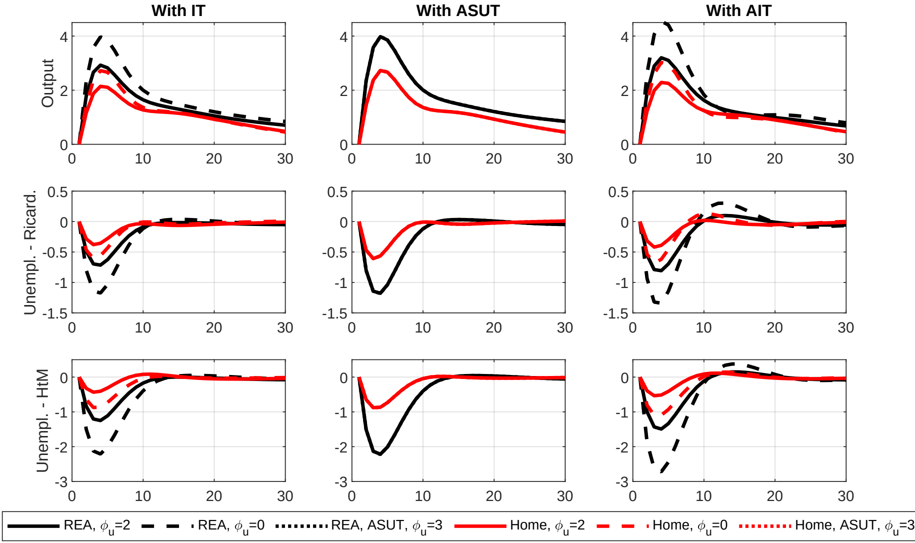
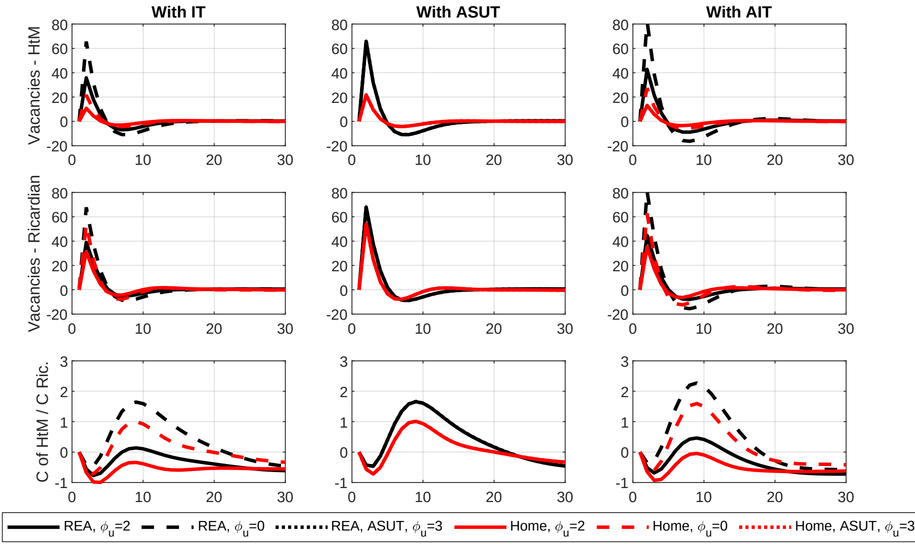


Expansionary demand shock - country-specific



Expansionary demand shock - country-specific labour

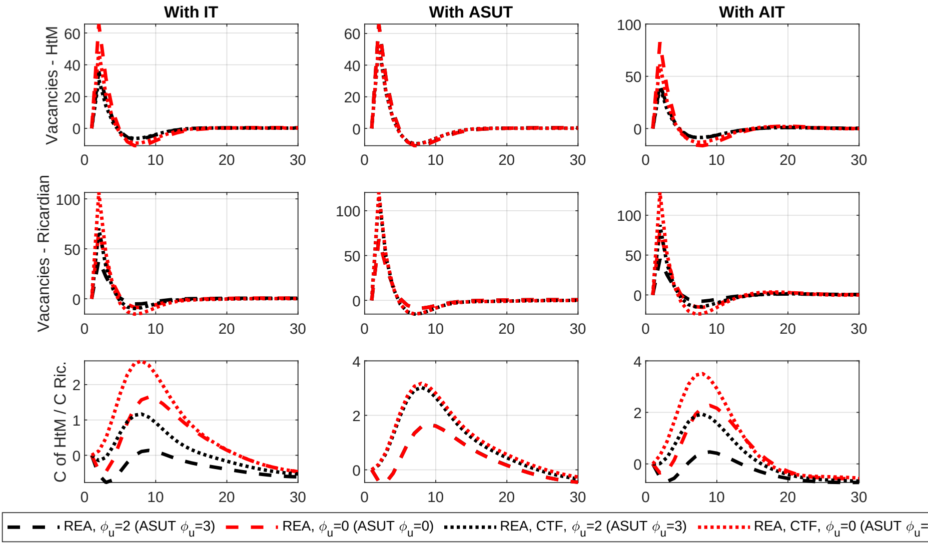


Key findings

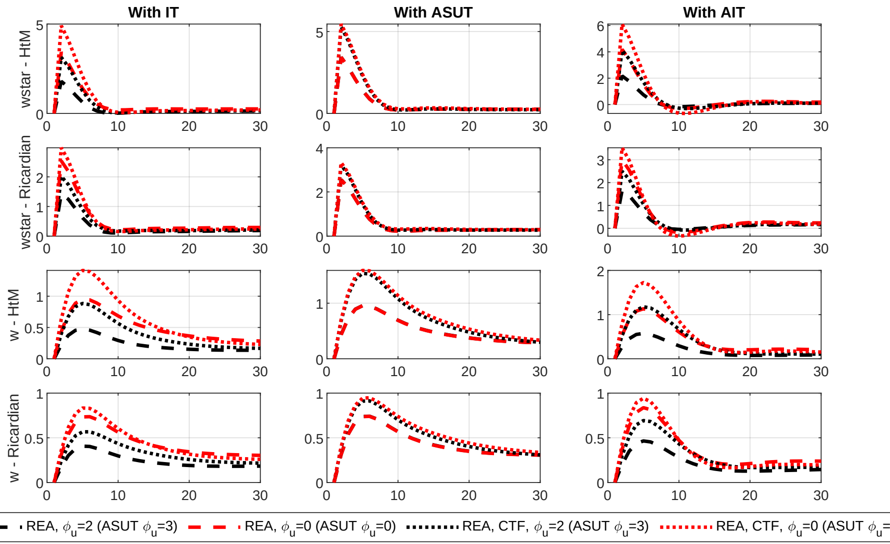
- Responding to unemployment in the EA has the following implications:
  - It results in stronger unemployment decrease after expansionary demand shocks and lower unemployment increase after a contractionary supply shock
  - It tends to lower inequality between and within EA countries
  - It leads to somewhat faster increase in inflation, but also faster return of inflation after a supply shock
- Responding to inflation alone causes large fluctuations between and within EA countries

BACKUP SLIDES

Counterfactual on REA - Consumption



Counterfactual on REA - Wages



Labour market flows

We have 2 segments s ($s = i$ for Ricardian and $s = j$ for HtM):

$$nde_{s,t} = (1 - \delta_{x,s})\; nde_{s,t-1} + M_{s,t},$$

where $M_{s,t}$ is the number of new matches defined as:

$$M_{s,t} = \phi_{s,M}(un_{s,t})^{\mu}(vac_{s,t})^{1-\mu} = p^{W}_{s,t} un_{s,t} = p^{F}_{s,t} vac_{s,t},$$

The probability for a searching worker to find a job is

$$p^{W}_{s,t} = \frac{M_t}{un_{s,t}} = \phi_{s,M}(\frac{vac_{s,t}}{un_{s,t}})^{1-\mu}$$

and the probability of a firm finding a worker is

$$p^{F}_{s,t} = \frac{M_{s,t}}{vac_{s,t}} = \phi_{s,M}(\frac{vac_{s,t}}{un_{s,t}})^{-\mu}$$

Wages and hiring

We adopt the staggered wage bargaining from Bodart et al. (2006) and de Walque et al. (2009), by labour market segments and by countries (blocs):

- In every segment, for a worker and for a firm, there are two value functions, one for a newly-renegotiated wage $w^*_{s,t}$ and one for the existing (average) wage $w_{s,t}$
- Newly-renegotiated wage is determined by Nash bargaining
- Firms hire workers with some probability at newly-renegotiated wage or at an average wage of the period

Value functions - firm

Let $A^F(w^*_{s,t})$ denote the value of a job for a firm employing a worker from household type $s \in [i,\ j]$, where $w^*_{s,j}$ is the renegotiated wage. It will be convenient to use this value in marginal utility terms, so we define $\mathcal{A}^F(w^*_{s,t}) \equiv u'(c_{s,t})A^F(w^*_{s,t})$. The value of a job with a renegotiated wage for a labour firm can then be written as

$$\mathcal{A}^F_t(w^*_{s,t}) = u'(c_{s,t})\left(h^{\alpha_H}_{s,t}x_{s,t} - h_{s,t}w^*_{s,t}(1+\tau^{wf}_t)\right) + \beta(1-\delta_{x,s})\left[(1-\xi_{w,s})\mathcal{A}^F_{t+1}(w^*_{s,t+1}) + \xi_{w,s}\mathcal{A}^F_{t+1}(w^*_{s,t})\right]$$

$\mathcal{A}^F_{t+1}(w^*_{s,t})$ prevents to write the expression recursively. But we can write it out:

$$\mathcal{A}^F_{t+1}(w^*_{s,t}) = u'(c_{s,t+1})\left(h^{\alpha_H}_{s,t+1}x_{s,t+1} - h_{s,t+1}w^*_{s,t}\frac{(1+\overline{\pi})P_t}{P_{t+1}}(1+\tau^{wf}_{t+1})\right) + \beta(1-\delta_{x,s})\left[(1-\xi_{w,s})\mathcal{A}^F_{t+2}(w^*_{s,t+2}) + \xi_{w,s}\mathcal{A}^F_{t+2}(w^*_{s,t})\right]$$

Value functions - firm

If we then substitute in the expression, and repeat this forever, we get

$$\mathcal{A}^F_t(w^*_{s,t}) = \sum_{j=0}^{\infty} [\beta(1-\delta_{x,s})\xi_{w,s}]^j \, u'(c_{s,t+j}) \left(h^{\alpha_H}_{s,t+j} x_{s,t+j} - h_{s,t+j} w^*_{s,t}(1+\tau^{wf}_{t+j}) \right)$$
$$+ \sum_{j=0}^{\infty} \beta(1-\delta_{x,s})(1-\xi_{w,s}) \, [\beta(1-\delta_{x,s})\xi_{w,s}]^j \, \mathcal{A}^F_{t+j+1}(w^*_{s,t+j+1})$$
$$+ lim_{j\to\infty} [\beta(1-\delta_{x,s})\xi_{w,s}]^j \, \mathcal{A}^F_{t+j+1}(w^*_{s,t})$$

The last row goes to 0. The first row can be written recursively if we define:

$$S^x_{s,t} = u'(c_{s,t}) h^{\alpha_H}_{s,t} x_{s,t} + \beta(1-\delta_{x,s})\xi_{w,s} S^x_{s,t+1}$$

$$S^{wf}_{s,t} = u'(c_{s,t}) h_{s,t+j}(1+\tau^{wf}_{t+j}) + \beta(1-\delta_{x,s})\xi_{w,s} \frac{(1+\overline{\pi})P_t}{P_{t+1}} S^{wf}_{s,t+1}$$

Value functions - firm

Using these definitions we can simplify:

$$\mathcal{A}_t^F(w_{s,t}^*) = S_{s,t}^x - S_{s,t}^{wf} w_{s,t}^* + \sum_{j=0}^{\infty} \beta(1-\delta_{x,s})(1-\xi_{w,s}) \left[\beta(1-\delta_{x,s})\xi_{w,s}\right]^j \mathcal{A}_{t+j+1}^F(w_{s,t+j+1}^*)$$

This leaves us the infinite sum, but we can forward this equation one period, multiply it with $\beta(1-\delta_{x,s})\xi_{w,s}$, and subtract it from both sides of the above equation, which cancels the infinite sum. After some algebra, we finally get the recursive form:

$$\mathcal{A}_t^F(w_{s,t}^*) = \left(S_{s,t}^x - S_{s,t}^{wf} w_{s,t}^*\right) - \beta(1-\delta_{x,s})\xi_{w,s} \left(S_{s,t+1}^x - S_{s,t+1}^{wf} w_{s,t+1}^*\right) + + \beta(1-\delta_{x,s})\mathcal{A}_{t+1}^F(w_{s,t+1}^*)$$

Value functions - firm

We can then similarly define the value of a worker with an average wage for a labour firm:

$$\mathcal{A}_t^F(w_{s,t}) = u'(c_{s,t})\left(h_{s,t}^{\alpha_H} x_{s,t} - h_{s,t} w_{s,t}(1+\tau_t^{wf})\right) + \beta(1-\delta_{x,s})\left[(1-\xi_{w,s})\mathcal{A}_{t+1}^F(w_{s,t+1}^*) + \xi_{w,s}\mathcal{A}_{t+1}^F(w_{s,t})\right]$$

...and after some algebra

$$\mathcal{A}_t^F(w_{s,t}) = \left(S_{s,t}^x - S_{s,t}^{wf} w_{s,t}\right) - \beta(1-\delta_{x,s})\xi_{w,s}\left(S_{s,t+1}^x - S_{s,t+1}^{wf} w_{s,t+1}\right) + \beta(1-\delta_{x,s})\mathcal{A}_{t+1}^F(w_{s,t+1})$$

Value functions - worker

Let $A^H(w^*_{s,t})$ be the value of a job for a worker from household type $s \in [i,\ j]$, where $w^*_{s,j}$ is the renegotiated wage. We use this value in marginal utility terms, so we define $\mathcal{A}^H(w^*_{s,t}) \equiv u'(c_{s,t})A^H(w^*_{s,t})$. The value of a job with a renegotiated wage for a worker is then

$$
\begin{aligned}
\mathcal{A}^H_t(w^*_{s,t}) = {} & u'(c_{s,t})\left(h_{s,t}w^*_{s,t}(1-\tau^{wh}_t) - b_{s,t}\right) - \chi\frac{h_{s,t}^{1+\varphi}}{1+\varphi} \\
& + \beta(1-\delta_{x,s})\left[(1-\xi_{w,s})\mathcal{A}^H_{t+1}(w^*_{s,t+1}) + \xi_{w,s}\mathcal{A}^H_{t+1}(w^*_{s,t})\right] \\
& - \beta p^W_{s,t}\left[(1-\kappa_{w,s})\mathcal{A}^H_{t+1}(w^*_{s,t+1}) + \kappa_{w,s}\mathcal{A}^H_{t+1}(w_{s,t+1})\right]
\end{aligned}
$$

We again have the same problem, so we define

$$
S^h_{s,t} = \chi\frac{h_{s,t}^{1+\varphi}}{1+\varphi} + \beta(1-\delta_{x,s})\xi_{w,s}S^h_{s,t+1}
$$

$$
S^{wh}_{s,t} = u'(c_{s,t})h_{s,t}(1-\tau^{wh}_t) + \beta(1-\delta_{x,s})\frac{(1+\overline{\pi})}{(1+\pi_{t+1})}\xi_{w,s}S^{wh}_{s,t+1}
$$

Value functions - worker

And we obtain

$$\mathcal{A}_t^H(w_{s,t}^*) = \left(S_{s,t}^{wh}(w_{s,t}^* - b_{s,t})\right) - \beta(1-\delta_{x,s})\xi_{w,s}\left(S_{s,t+1}^{wh}(w_{s,t+1}^* - b_{s,t+1})\right)$$
$$- S_{s,t}^h + \beta(1-\delta_{x,s})\xi_{w,s}S_{s,t+1}^h$$
$$+ \beta\left[1-\delta_{x,s}-(1-\kappa_{w,s})p_{s,t}^W\right]\mathcal{A}_{t+1}^H(w_{s,t+1}^*) - \beta\kappa_{w,s}p_{s,t}^W\mathcal{A}_{t+1}^H(w_{s,t+1})$$

We do the same for the value function for the average wage of the worker.

Free entry

A firm posting a vacancy for household type s must pay a per-period constant cost ψ_s for having a vacancy open. $\kappa_{w,s}$ is the probability that a firm cannot renegotiate the wage for a newly hired worker from segment s. The free-entry condition is:

$$\psi_s = p^F_{s,t} \beta \frac{u'(c_{s,t+1})}{u'(c_{s,t})} \left[(1 - \kappa_{w,s}) \mathcal{A}^F_t (w^*_{s,t+1}) + \kappa_{w,s} \mathcal{A}^F_t (w_{s,t+1}) \right].$$

Wages and hours

Assuming standard (efficient) Nash bargaining between households and labour firms, every period, wages and hours worked are determined by maximising the following expression, where $0 < \eta_s < 1$ measures the bargaining power of workers of type s:

$$\max_{w^*_{s,t},h_{s,t}} \left(A^H_t(w^*_{s,t})\right)^{\eta_s} \left(A^F_t(w^*_{s,t})\right)^{1-\eta_s}.$$

The result is that wages are split according to the Nash sharing rule:

$$\eta_s(1-\tau^{wh}_t)A^F_t(w^*_{s,t}) = (1-\eta_s)(1+\tau^{wf}_t)A^H_t(w^*_{s,t}).$$

Hours are set as:

$$\alpha_H x_{s,t}(h_{s,t})^{\alpha_{H-1}} = \frac{\chi}{u'(c_{s,t})}\frac{(1+\tau^{wf}_t)}{(1-\tau^{wh}_t)}(h_{s,t})^{\varphi}.$$

Calibrated using data

	Home	REA	US	RW
Matching probability, Ricardian workers, (p_i^W)	0.3021	0.2238	0.5292	0.3442
Matching probability, HtM workers, (p_j^W)	0.2090	0.1848	0.5385	0.2598
Matching probability, firms, (p_s^F)	0.70	0.70	0.70	0.70
Matching efficiency, Ric. w., ($\varphi_{i,M}$)	0.4598	0.3957	0.6086	0.4908
Matching efficiency, HtM w. ,($\varphi_{j,M}$)	0.5496	0.5363	0.6642	0.5741
Vac. posting cost, Ric. w.,(Ψ_i)	0.4091	0.6768	1.1325	0.9170
Vac. posting cost, HtM w., (Ψ_j)	1.2933	1.0133	0.8246	1.1525
Break-up rate, Ric. w., ($\delta_{x,i}$)	0.0203	0.0298	0.0592	0.0344
Break-up rate, HtM w., ($\delta_{x,j}$)	0.0443	0.0348	0.1179	0.0359
Disutility of labour, Ric. w., (χ_i)	1.1481	1.2333	1.3882	1.4416
Disutility of labour, HtM w., (χ_j)	4.6902	4.2066	4.8728	4.4392
Replacement ratio, Ric. w., ($rrat_i$)	0.590	0.590	0.084	0.386
Replacement ratio, HtM w., ($rrat_j$)	0.228	0.486	0.084	0.320
Unemployment rate, (un)	0.0696	0.1038	0.0605	0.0694
Unemployment rate, HtM w., (un_j)	0.1437	0.1334	0.0918	0.0930

Note: REA=Rest of the euro area; US=United States; RW=Rest of world

Sources: Eurostat (unempl. r.), OECD (repl. r., unempl. r.), BLS (unempl. r.)

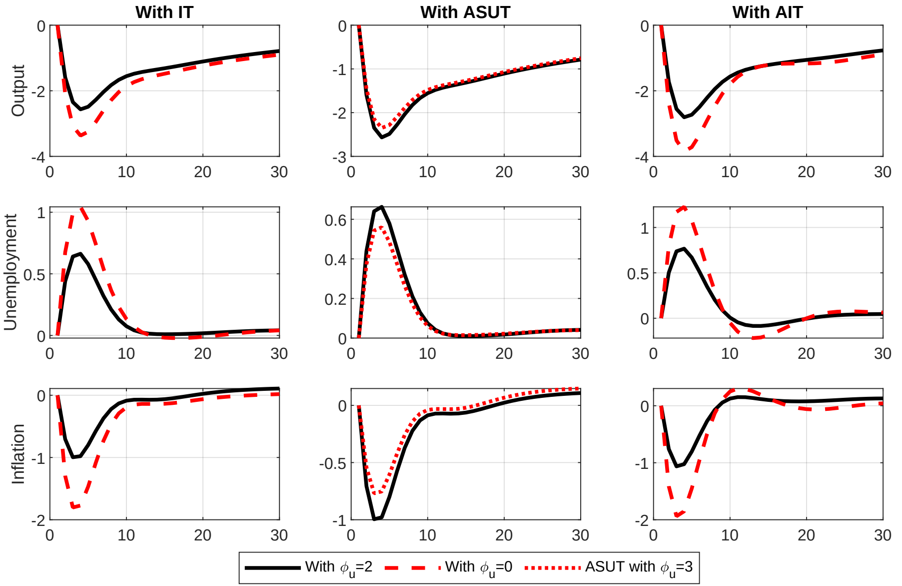
Calibrated based on the literature

	Home	REA	US	RW
Inverse of the Frisch elasticity of labour supply (ζ)	5.00	5.00	5.00	5.00
Matching elasticity, Ric. w., (μ_i)	0.50	0.50	0.50	0.50
Matching elasticity, HtM w., (μ_j)	0.20	0.20	0.20	0.20
Bargaining power, Ric. w., (η)	0.50	0.50	0.50	0.50
Bargaining power, HtM w., (η)	0.50	0.50	0.50	0.50
Prob. to renegotiate existing wage, Ric. w., ($\xi_{w,i}$)	0.8879	0.8879	0.8879	0.8879
Prob. to renegotiate existing wage, HtM w., ($\xi_{w,j}$)	0.8879	0.8879	0.8879	0.8879
Prob. to start job at avg. wage, Ric. w., ($\kappa_{w,i}$)	0.7	0.7	0.7	0.7
Prob. to start job at avg. wage, HtM w., ($\kappa_{w,j}$)	0.7	0.7	0.7	0.7

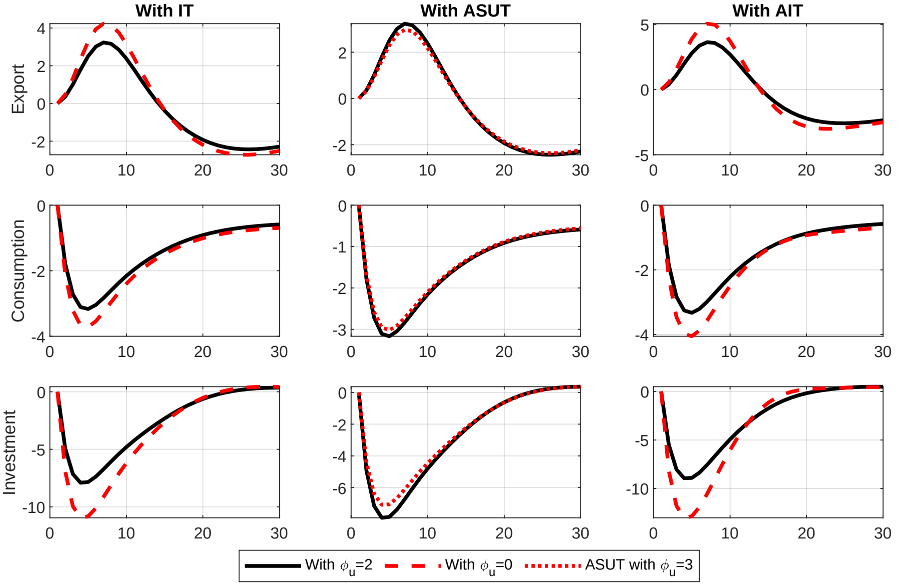
Note: REA=Rest of the euro area; US=United States; RW=Rest of world

Sources: De Walque et al. (2009), Petrongolo and Pissarides (2001)

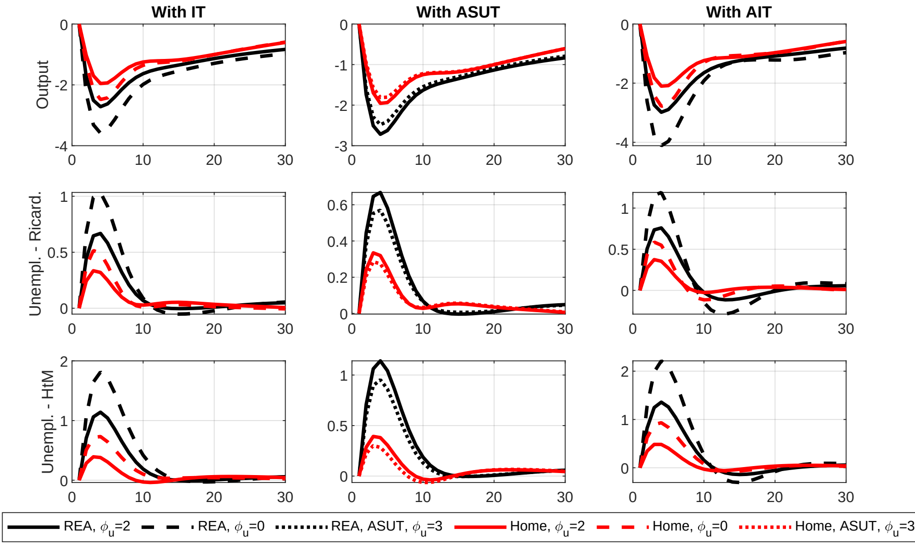
Contractionary demand shock - EA-wide



Contractionary demand shock - EA-wide



Contractionary demand shock - country-specific



Contractionary demand shock - country-specific labour