Adjustments along the intensive margin and wages: Evidence from the euro area and the US

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Introduction

- Empirical models for wage growth relate it to some measure of labour market slack expressed in heads (*extensive margin*).
- Under-utilization can also take the form of insufficient numbers of hours of work demanded by firms. (*intensive margin*). Crucial margin of adjustment after the Great Recession.
- Do changes in the intensive margin affect wage growth? Literature inconclusive.

The paper

- We show (partial eqb model) that the choice to adjust the extensive or the intensive margin depends on several factors, i.e. the relative cost of adjustment along the two margins and workers' preferences about working time.
- The relationship btw intensive margin and wages is ex ante unknown. To show that adjustment costs and time preferences matter we look at US and EA, which differ along these two dimensions. (e.g. Krugman, 2009, Prescott, 2004)
- We show that these differences determine the different reaction of nominal wages to the intensive margin (higher in the EA than in the US), using both synthetic data (from the model) and actual data.

What we do

- Partial equilibrium model with costly adjustments in both the extensive margin through the Diamond-Mortensen-Pissarides search and matching framework and the intensive margin, as in Trigari (2009).
- Explicit role for the intensive margin of labour utilization for wage determination (a Phillips curve).
- Model calibration for EA and US.
- For both EA and US we compare the estimate two different types of WPC: a standard one (with adjustments on the unemployment rate), and an augmented version, where we introduce the intensive margin among the regressors.

Related literature

- Measures of (under-) utilization along the intensive margin: Bell and Blanchflower (2011)(2019); Hong et al. (2018); Bulligan et al. (2017).
- From the theoretical perspective: Walsh (2005); Trigari (2006); Trigari (2009).
- Intensive margin and BC fluctuations: Fang (2009); Trapeznikova (2017); Kudoh et al. (2019); Cooper and Willis (2009; adjustment costs).

Preview of the results

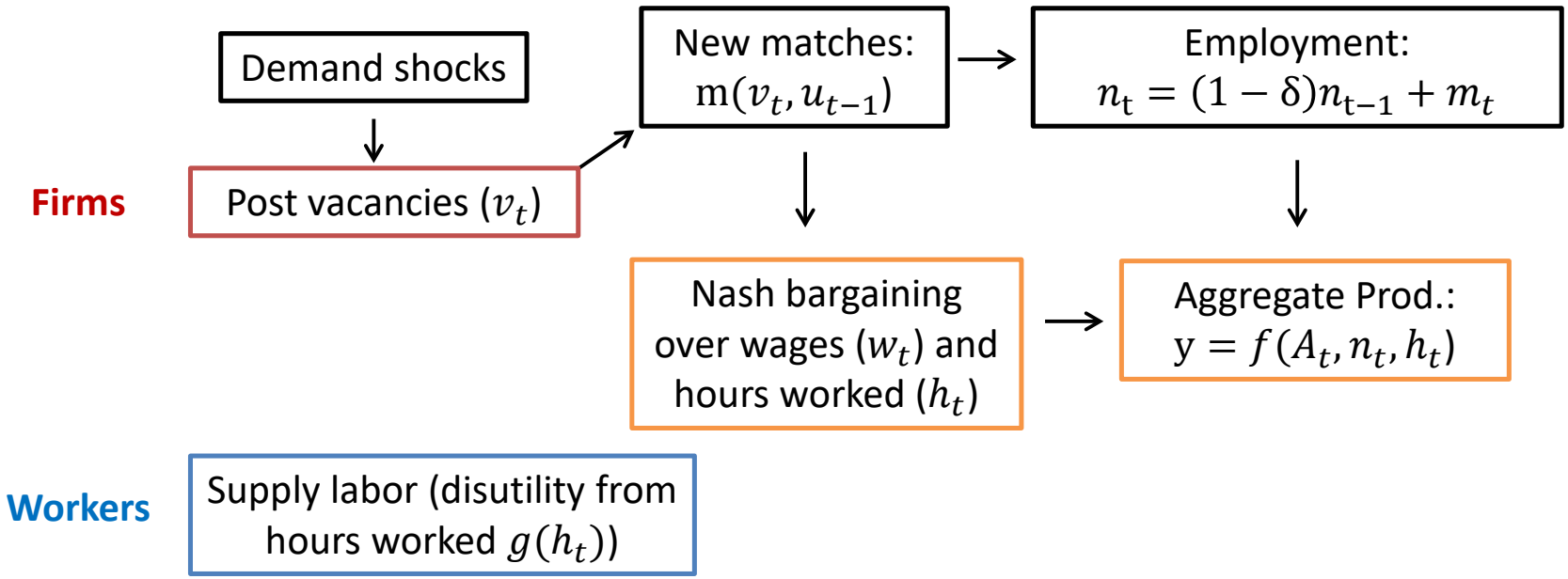
- Partial equilibrium job search model with intensive margin (as in Trigari, 2009) and adjustment costs along the extensive and the intensive margin (EM, IM).
- We derive a PC which depends on both the extensive and the intensive margin. The sign is a priori unknown; it depends on the relative cost of adjustment of the EM relative to IM.
- Calibration and synthetic data: the sign and the strength of the correlation may vary: higher and positive impact of the IM in the EA; not significant in the US. Calibration conducted to capture some features of the two economies (higher propensity of he US economy to adjust the EM relative to the IM);
- Real data: strong improvement of the PC estimates if we include the IM (Augmented PC); no impact in the US (as suggested by the model)

Model

Definitions and notation

- Exogenous separation rate δ.
- $m(v_t, u_{t-1}) = m_{0t} v_t^{\eta} u_{t-1}^{1-\eta}$
- Labor market tightness $\theta_t = v_t / u_{t-1}$
- Job filling rate $q(\theta_t) = \frac{m_t}{v_t} = m_{0t}(\theta_t)^{\eta-1}$
- Job finding probability $f(\theta_t) = \frac{m_t}{u_{t-1}} = \theta_t q(\theta_t)$.
- Production function: $y_i(A_t, h_{it})$
- Partial equilibrium: θ and P_t as gives
- Disutility of working $g(h_t)$.

Model scheme



Value functions - Firms

Value of the match:

$$J_t = P_t y_t - Q - w_t h_t - c_t(h_t) + \beta \mathbb{E}_t \left[(1 - \delta_{t+1}) J_{t+1} + \delta_{t+1} J^v_{t+1} \right]$$

Value of a vacancy:

$$J^v_t = -\kappa + q(\theta_t) J_t + (1 - q(\theta_t)) \beta \mathbb{E}_t J^v_{t+1}$$

Free entry: $J^v_t = 0, \ \forall \ t$

Job creating condition (adjustment along the extensive margin):

$$\frac{\kappa}{q(\theta_t)} = P_t y_t - w_t h_t - c_t(h_t) + \beta (1 - \delta) \mathbb{E}_t \left[\frac{\kappa}{q(\theta_{t+1})} \right]$$

Value functions - Workers

When employed:

$$W_t = w_t h_t - P_t g_t(h_t) + \beta \mathbb{E}_t \left[(1-\delta) W_{t+1} + \delta U_{t+1} \right]$$

When Unemployed:

$$U_t = b + \beta \mathbb{E}_t \left[f(\theta_{t+1}) W_{t+1} + (1 - f(\theta_{t+1})) U_{t+1} \right]$$

Surplus

- For firms: $S_t^f = J_t$, for worker $S_t^w = W_t - U_t$.
- Bargaining:

$$\max_{h_t, w_t} \left[S^w\left(h_t, w_t\right)\right]^{\gamma} \left[S^f\left(h_t, w_t\right)\right]^{1-\gamma}$$

$$P_t mph_t = c_t'(h_t) + P_t g_t'(h_t)$$

$$w_t h_t = (1-\gamma)\left(P_t g_t(h_t) + b\right) + \gamma\left[P_t y_t(A_t, h_t) - c_t(h_t) + \beta\kappa\mathbb{E}_t\theta_{t+1}\right]$$

Depending on the functional forms and the parameters' value, the relationship between hourly wages and working hours can thus be positive or negative.

Wage equation

Linearing around the steady steate:
$\hat{x}$ the log deviation of variable x from its steady state $\bar{x}$

$$\hat{w}_t = \beta_1^w a_t + \beta_2^w p_t + \beta_3^w \hat{h}_t + \beta_4^w \left[\mathbb{E}_t \hat{v}_{t+1} - \hat{u}_t\right]$$

1. $\beta_1^w = \frac{\gamma}{\bar{w}\bar{h}} \frac{\partial y}{\partial A}|_{\bar{A},\bar{h}}$,
2. $\beta_2^w = \frac{1}{\bar{w}\bar{h}} \left[\gamma \bar{y} + (1-\gamma) g(\bar{h})\right]$,
3. $\beta_3^w = \frac{1}{\bar{w}} \left[(1-\gamma) g'(\bar{h}) + \gamma \left(m\bar{p}h - c'(\bar{h})\right) - \bar{w}\right]$
4. $\beta_4^w = \frac{\gamma}{\bar{w}\bar{h}} \beta \kappa \bar{\theta}$

Calibration (1)

In order to simulate the model we adopt the following functional forms:

$$y_t = A_t h_t$$

$$m_t = m_0 v_t^{\eta} u_{t-1}^{1-\eta}$$

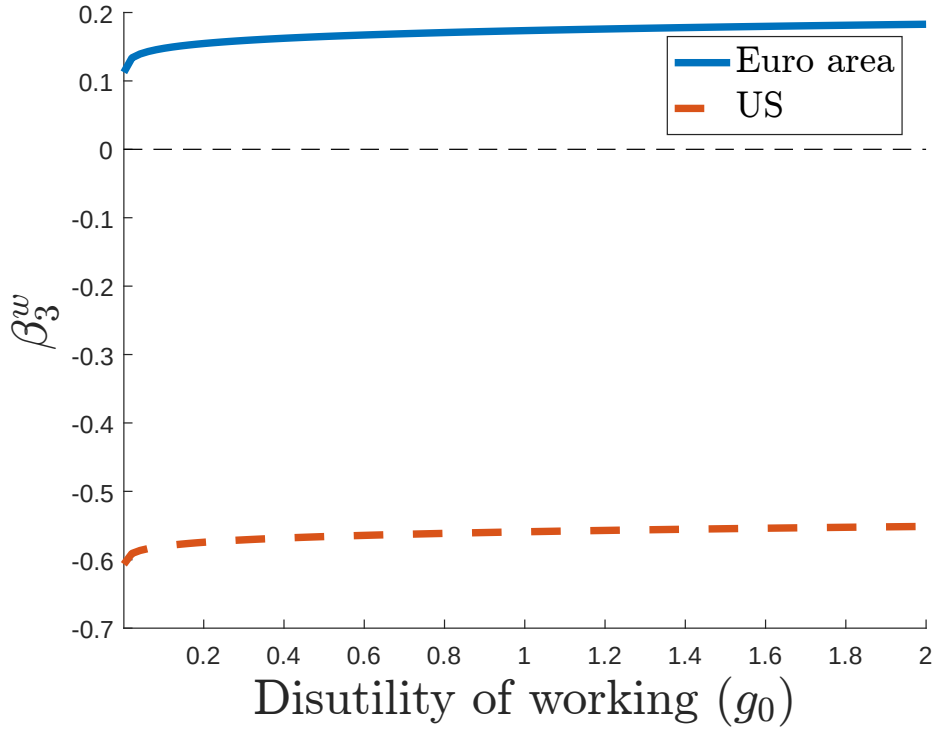
$$g_t(h_t) = g_0 \frac{h_t^{1+\phi}}{1+\phi}$$

$$c_t(h_t) = \frac{c_0 \bar{h}}{2} \left(\frac{h_t}{\bar{h}} \right)^2$$

Calibration (2)

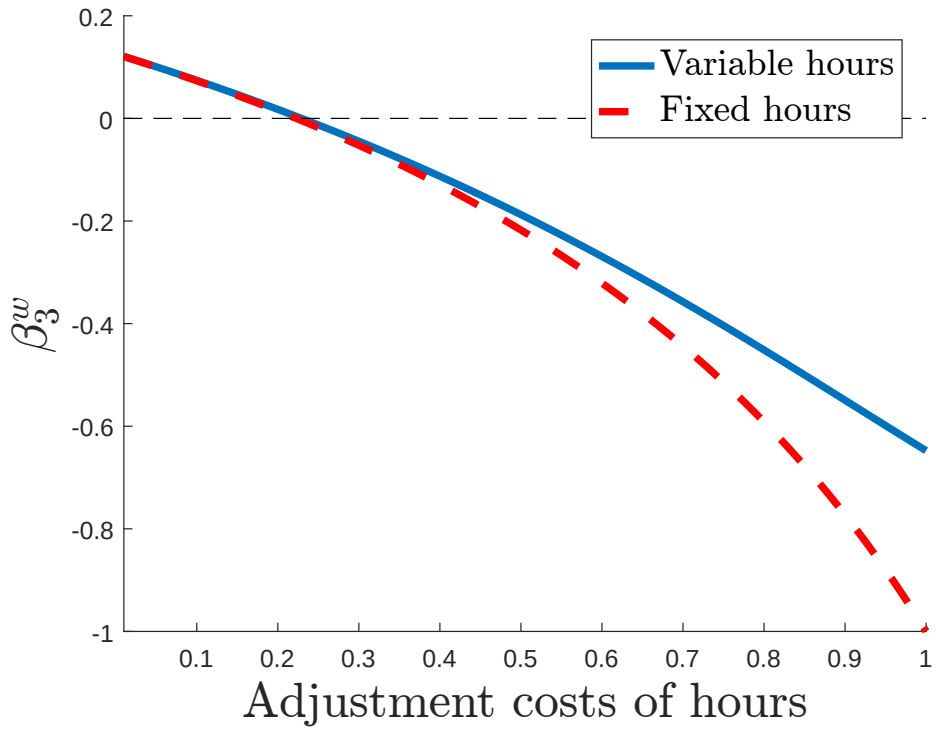
		Value	Source
Calibrated parameters			
Discount rate	β	0.996	$\backsimeq$ 4% int. rate
Elasticity of good demand w.r.t. price	β^y	6	Lit.
Elasticity of matching function	η	0.5	
Workers' bargaining power	γ	0.5	
Disutility of labour parameter	ϕ	10	Lit.
Targets euro area			
Unemployment rate	$\bar{u}$	9.6%	avg. unempl. (1999-2016)
Job finding rate	$f(\bar{\theta})$	0.18	
Replacement rate UB	$b/\bar{w}\bar{h}$	40%	OECD[a]
Working time	$\bar{h}$	1	
Vacancy cost as % of wage	$\kappa/\bar{w}\bar{h}$	4.5%	Lit.
Fixed cost as % of production	Q	10%	
Cost intensive margin	c_0	0	
Targets US			
Unemployment rate	$\bar{u}$	6.1%	avg. unempl (1968-2016)
Job finding rate	$f(\bar{\theta})$	0.58	Lit.
Replacement rate UB	$b/\bar{w}\bar{h}$	25%	OECD
Cost intensive margin	c_0	0.92	Total costs equal to EA

Elasticity of wages to hours worked: Disutility of labour



Elasticity of wages to hours worked (β_3^w) as function of the disutility of labour, for different values of adjustment costs of hours ($c(h)$), keeping constant the overall costs paid by the firm. The two lines correspond to $c(h) = 0$ for the EA and $c(h) = 0.8$ for the US.

Elasticity of wages to hours worked: Hours adjustment costs



Elasticity of wages to hours worked (β_3^w) as function of the adjustment costs of hours ($c(h)$), keeping constant the overall costs paid by the firm. The cost of varying the extensive margin (κ/q) adjusts so that the following condition holds: $(\kappa/q + c(h))/y = const$. Blu line: $_0$ constant at the level EA; red line $_0$ decreases to keep hours constant.

Exercises on synthetic data

1. Standard WPC: depends only on U
2. Augmented WPC: (1)$+\beta_h h_t$

Table: WPC estimates on simulated data (EA calibration)

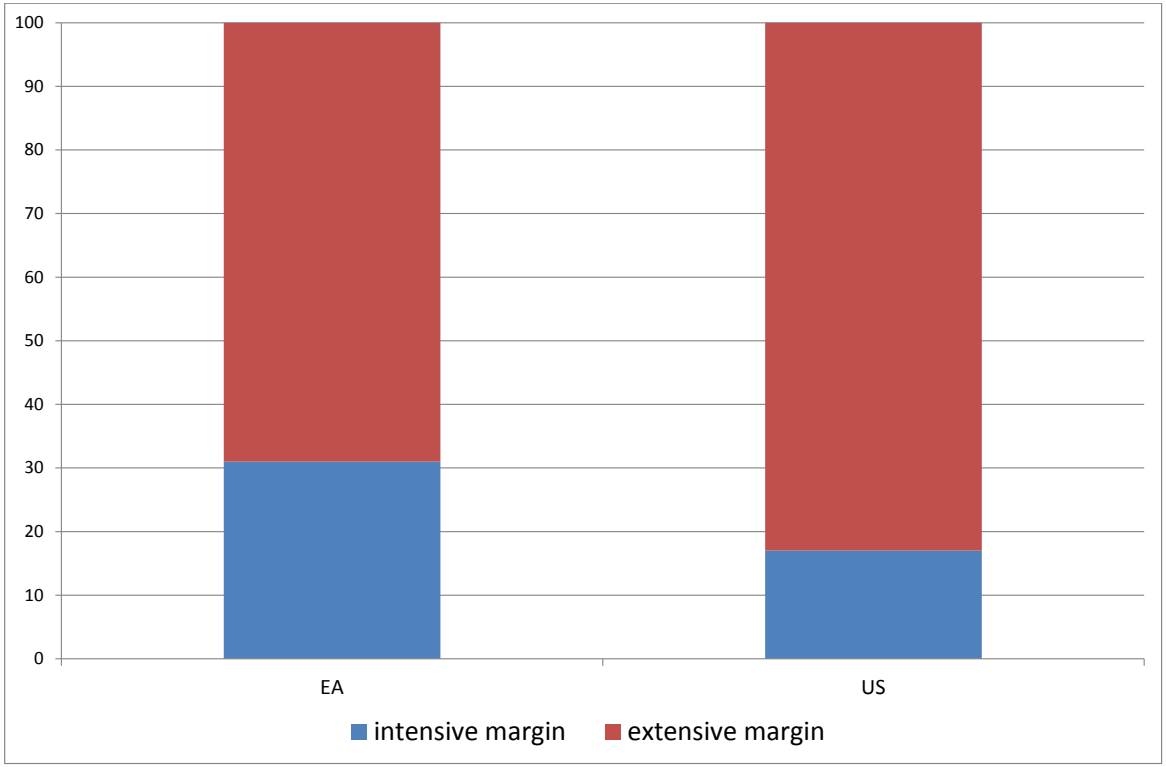
	Standard WPC	Augmented WPC
Unemployment	-1.1048 (0.0000)	-0.0016 (0.0000)
Productivity	0.0074 (0.2296)	0.0000 (0.9209)
Price index	-0.7032 (0.0007)	0.9432 (0.0000)
Hours worked	-	0.0937 (0.0000)
$\bar{R}^2$	0.72	1.00

Table: WPC estimates on simulated data (US calibration)

	Standard WPC	Augmented WPC
Unemployment	-1.1786 (0.0000)	-0.0061 (0.0000)
Productivity	0.0009 (0.8412)	0.0000 (0.7792)
Price index	-0.1833 (0.0612)	0.2064 (0.0000)
Hours worked	-	0.0315 (0.0000)
$\bar{R}^2$	0.96	1.00

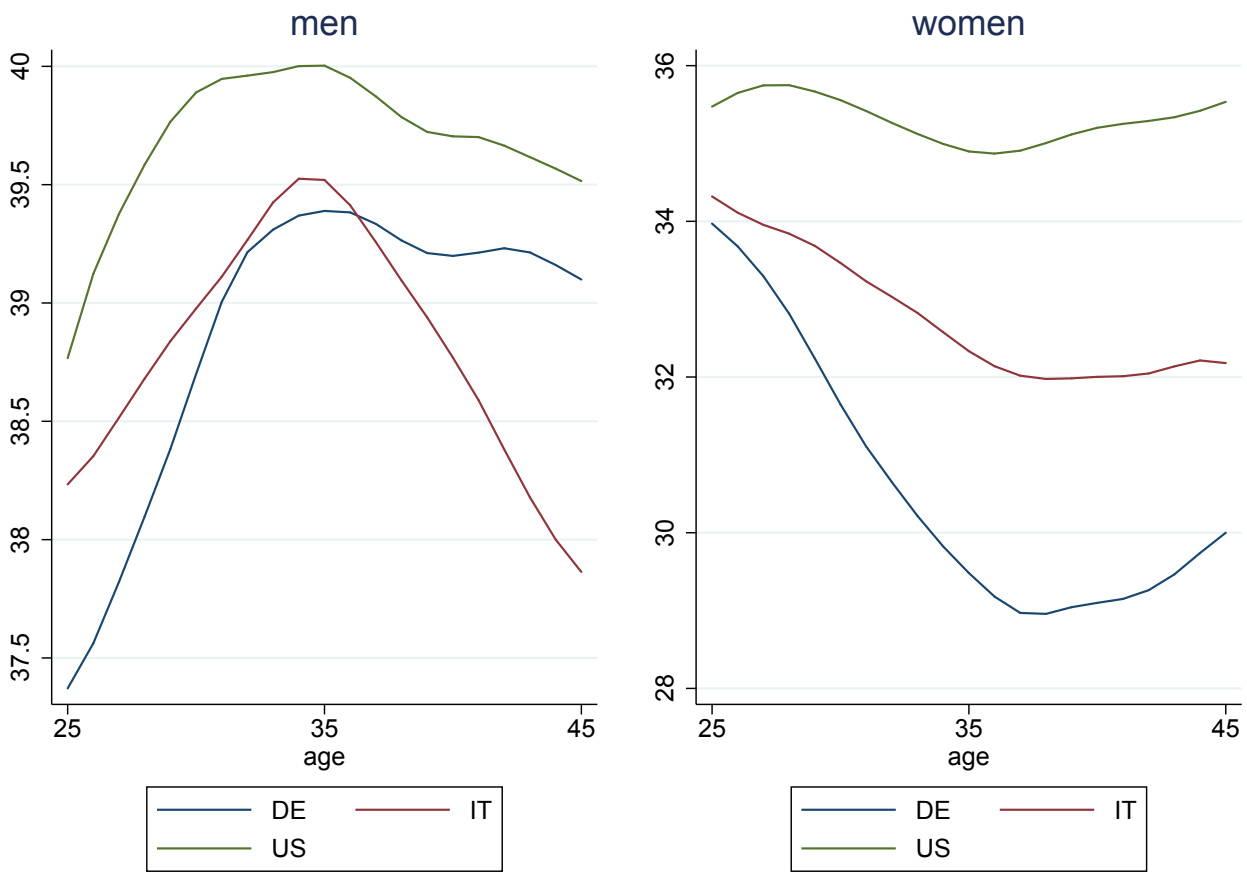
Results

The contribution of EM and IM to labour input adjustments



Kudoh et al. (2018). Relative contribution of the extensive and the intensive margin to variation in total hours.

Hours worked in US and some EA countries



The wage Phillips curve

Standard PC:

$$\pi^w = c + \rho\pi^w_{t-1} + \beta U_{t-p} + \gamma prod_t + \pi^e_{t+k} + \epsilon_t$$

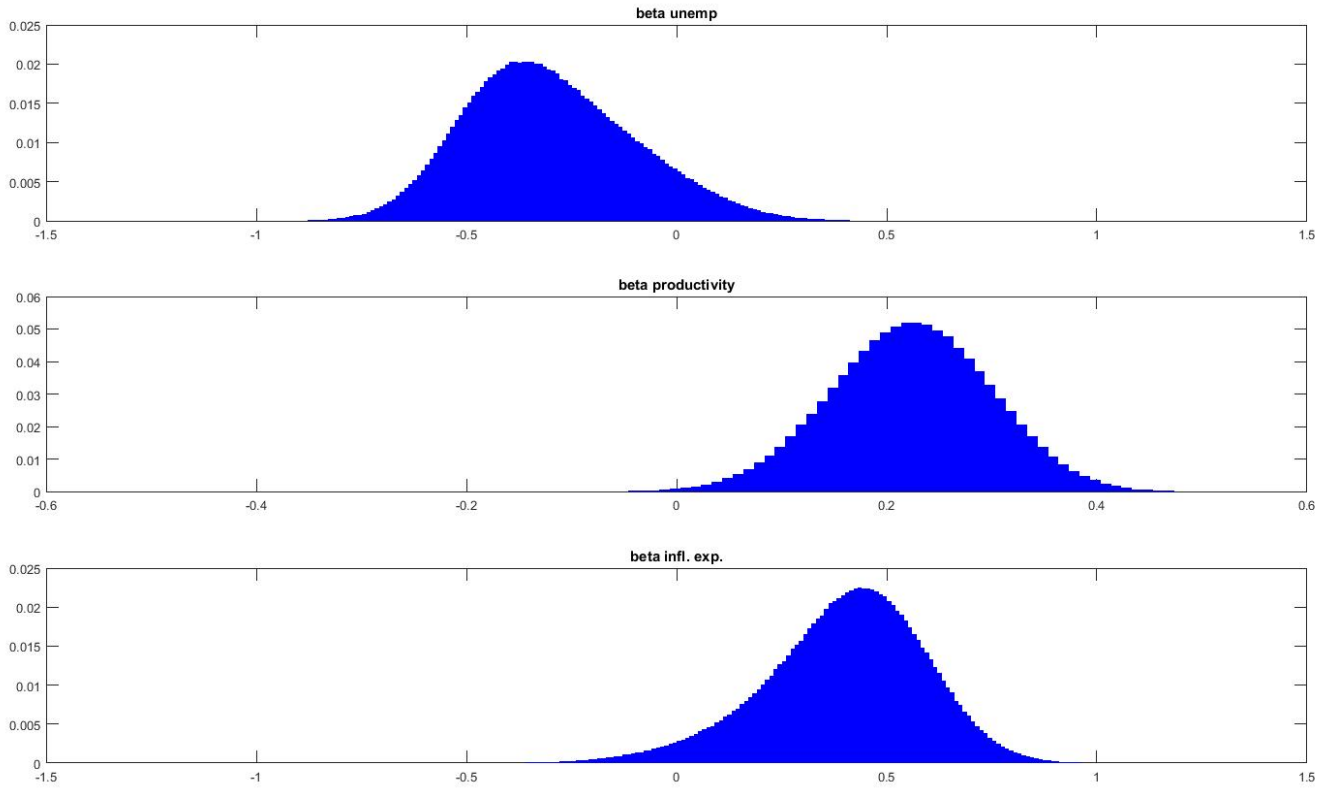
Augmented PC:

$$\pi^w = c + \rho\pi^w_{t-1} + \beta U_{t-p} + \alpha H_{t-l} + \gamma prod_t + \pi^e_{t+k} + \epsilon_t$$

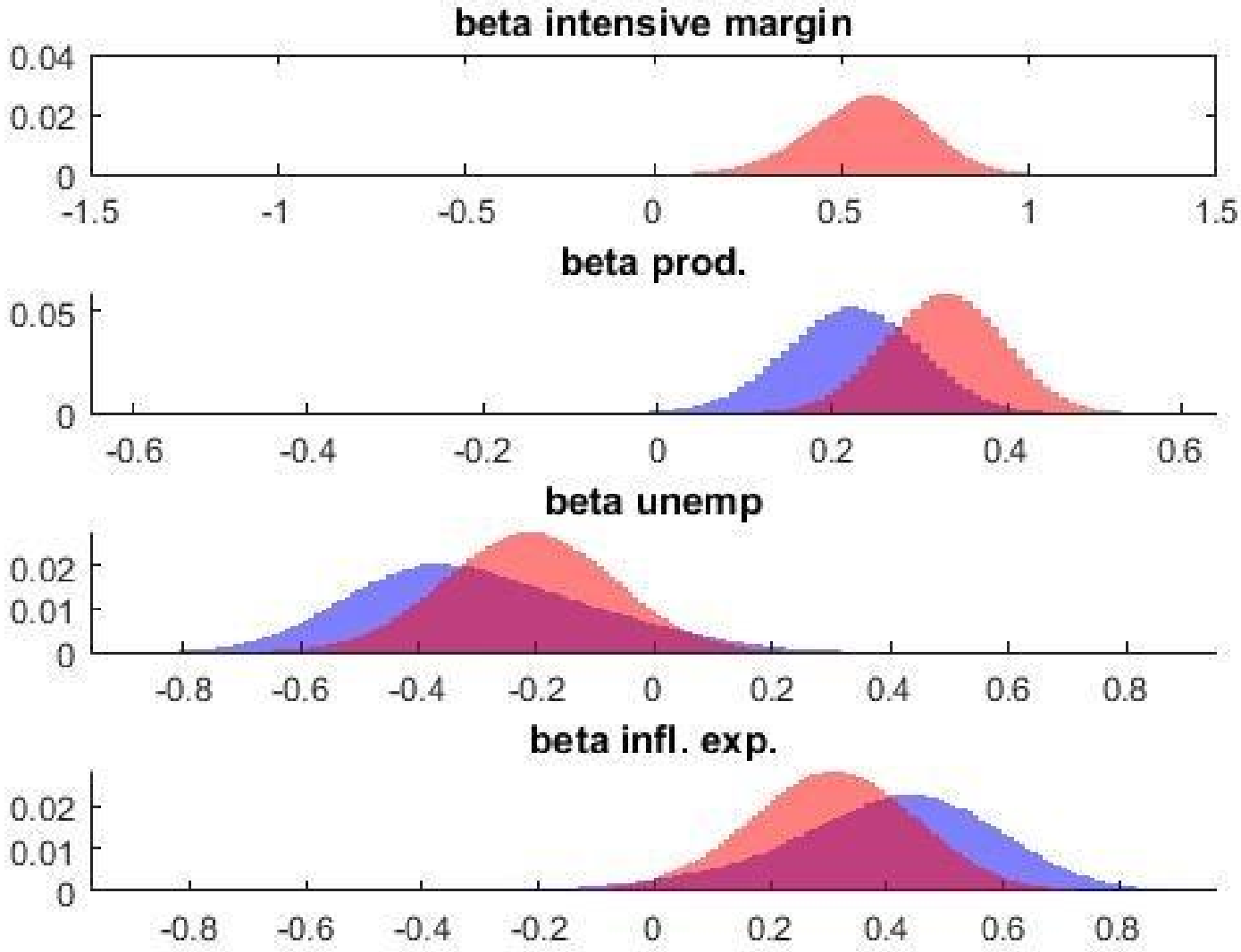
Variables used in the estimation exercise

Explanatory	**Proxy**	**Lag structure**
Slack along the extensive margin	Unemployment rate Unemployment gap	1 to 4
Productivity	Value added per hour worked	0
Inflation expectation	SPF 2 year ahead Consensus 6 quarter ahead Consumer survey Past HICP inflation Past Consumption deflator inflation	1 to 4
Slack along the intensive margin	Average Number of hours per employee	1 to 4

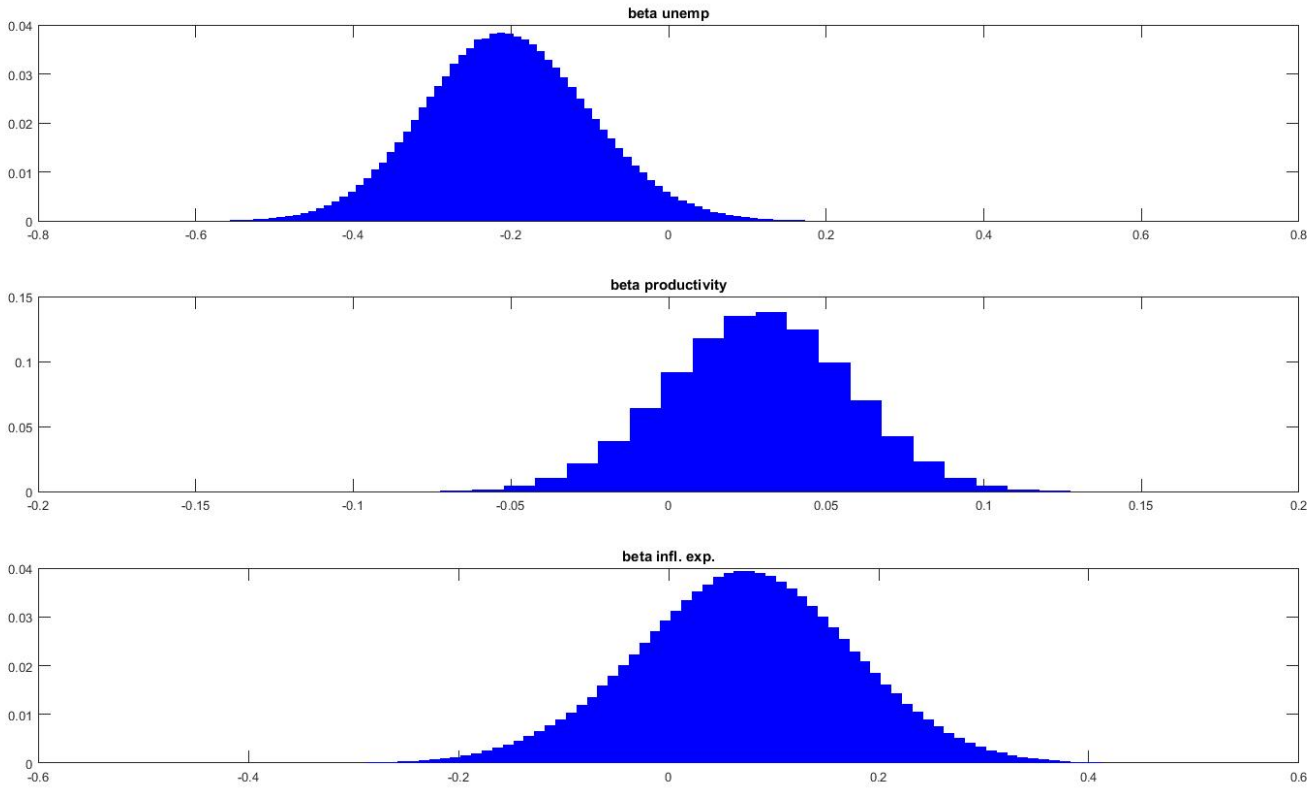
EA: Standard PC (extensive margin only)



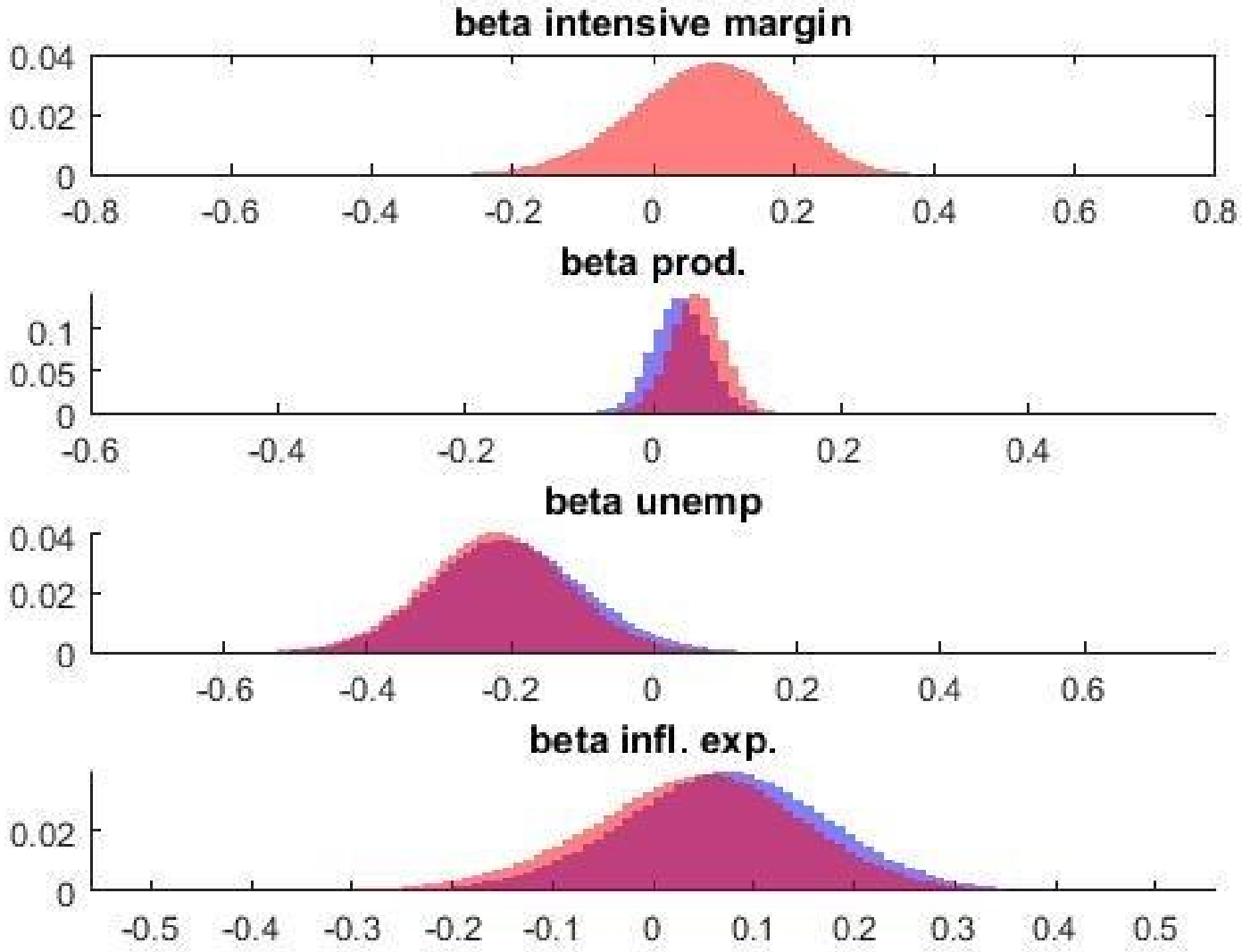
EA: Augmented PC (with intensive margin)



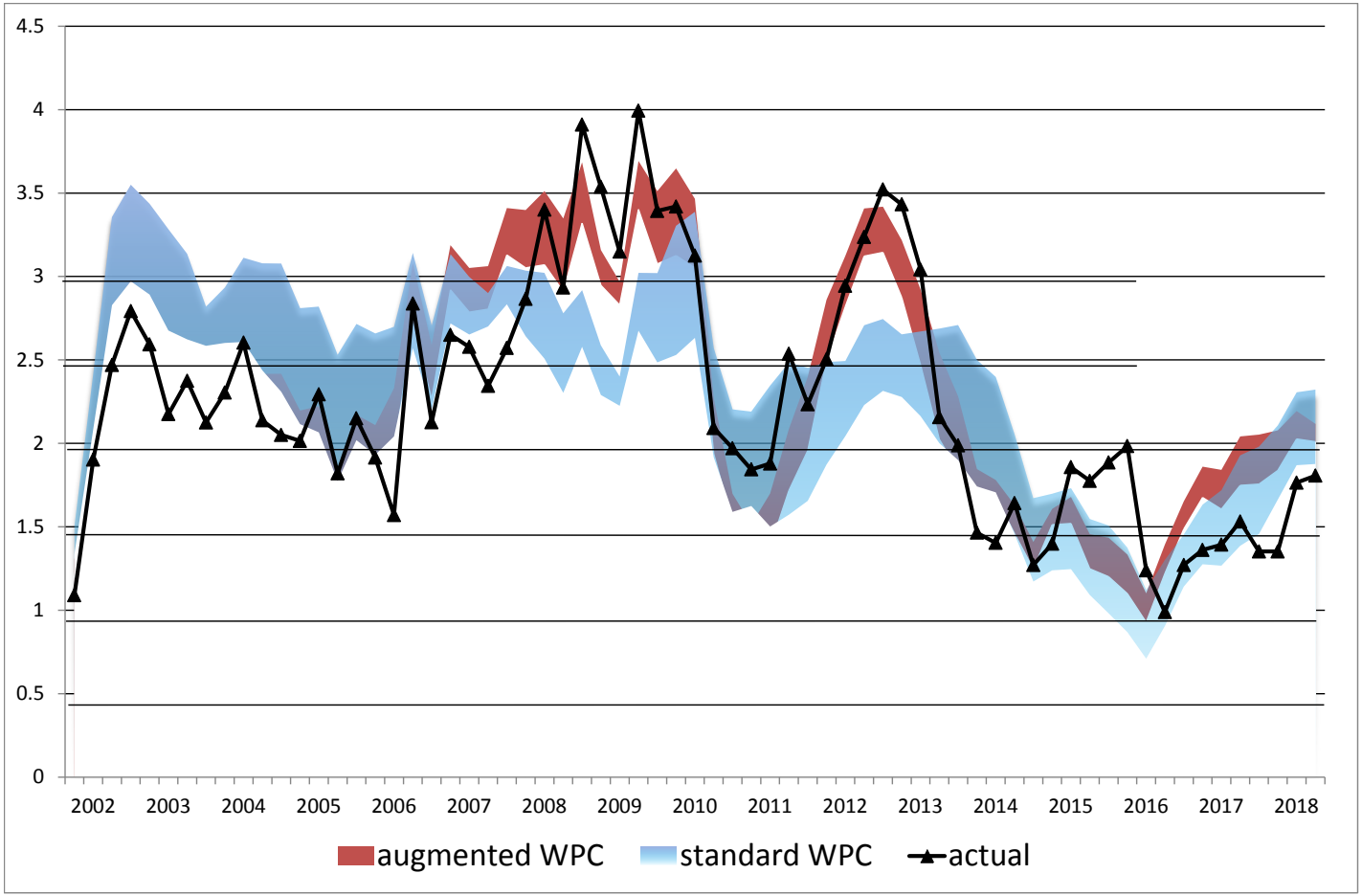
US: Standard PC (extensive margin only)



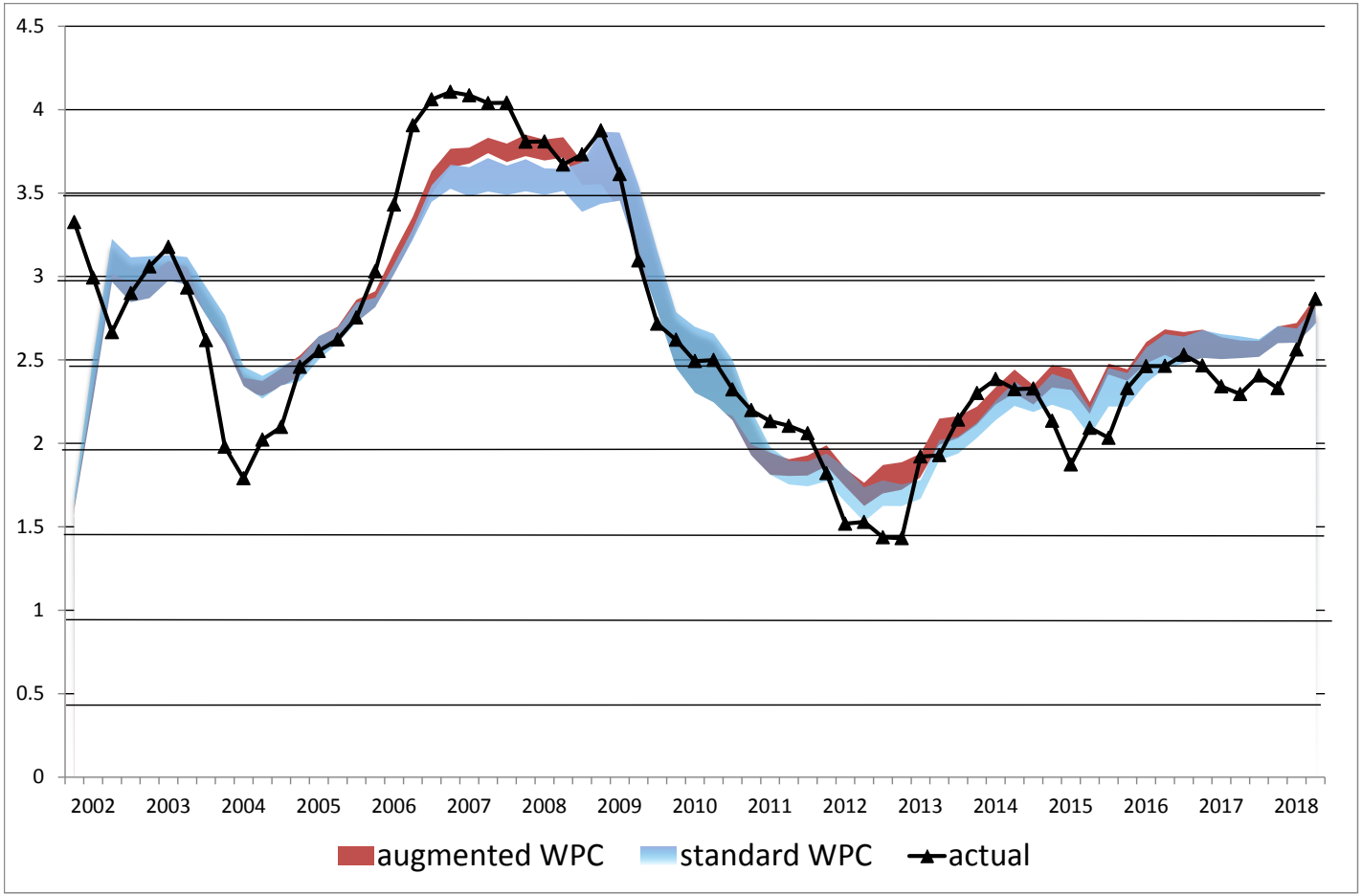
US: Augmented PC (with intensive margin)



EA. In-sample fit: standard and augmented PC)



US. In-sample fit: standard and augmented PC)



Conclusions

- In this paper we try to rationalize why in some countries firms adjust labour input mainly along the extensive margin and in others also along the intensive margin. What consequences for the PC?
- A simple partial equilibrium search model. The relative adjustment cost of the intensive vs. the extensive margin determines the amount of hours demanded. Households may differ for their disutility of work.
- Institutions may play a role in what are the determinant of wage growth. In our model higher volatility along the extensive margin in the US and of the intensive margin in the euro area (in relative terms).
- Another example of the 'one size does not fit all' paradigm.

Thank you for your attention