IS IT WORTH RAISING THE STATUTORY RETIREMENT AGE? A NEW MODEL TO ESTIMATE THE EMPLOYMENT EFFECTS

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Is it worth raising the statutory retirement age?

1-year increase in NRA	Effects on AALME (months)
Blöndal and Scarpetta, 1999	1.1 to 1.4
Gal and Theising, 2015	1.4
Égert and Gal, 2017	1.4
Grigoli, Koczan and Tapalova, 2018	2.3
Geppert et al., 2019	2.4
Turner and Morgavi, 2021	2.7-4.7

	Increase in NRA (months)	Effects on AALME (months)
Mastrobuoni, 2009 (USA)	2	1
Fehr, Kallweit and Kindermann, 2012 (DEU)	24	9-12
Hanel and Riphahn, 2012 (CHE)	24	7.7
Lalive and Staubli, 2015 (CHE)	12	7.9
Etgeton, 2018 (DEU)	24	8.4
Morris, 2021 (AUS)	60	9
Fodor, Roehn and Hwang, 2022 (SVK)	12	7.7

The base model

$$ER_{c,t} = \alpha_c + \alpha_P \cdot RA_{c,t} + \sum_j \alpha_j X_{j,c,t} + \varepsilon_{c,t}$$

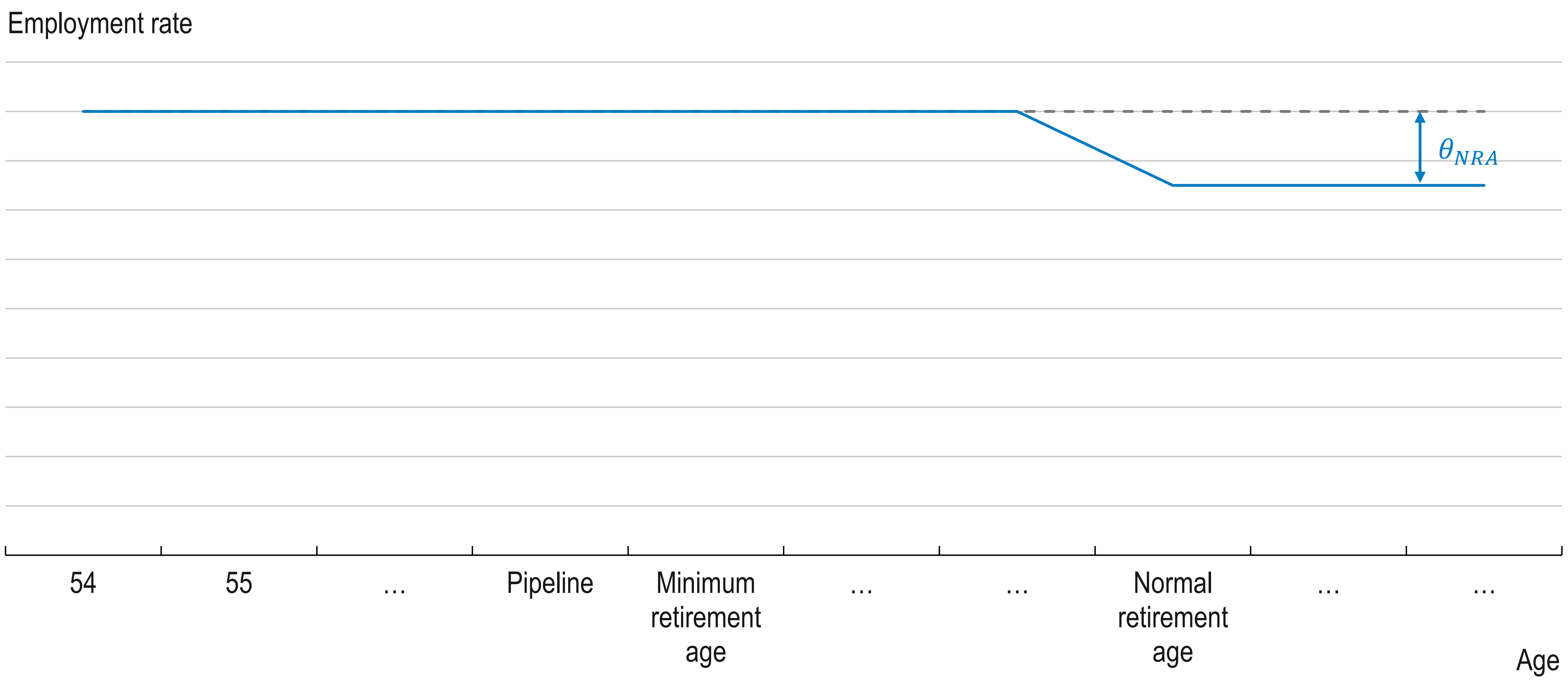
$$\Delta ER_{c,t} = \beta_c + \beta_t + \pi \cdot \hat{\varepsilon}_{c,t-1} + \beta_P \cdot \Delta RA_{c,t} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

where:

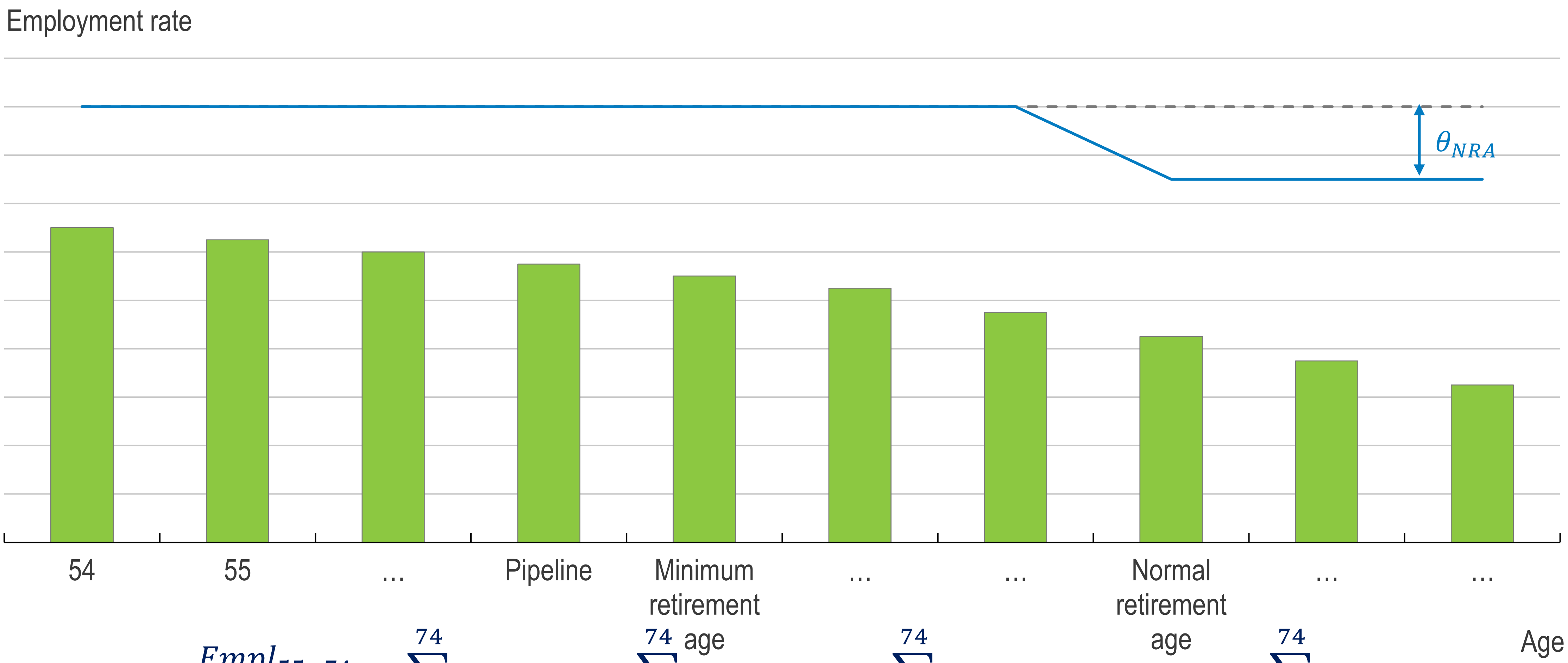
- $RA_{c,t}$ is the statutory retirement age of country c at time t,
- α_c and β_c are a set of country fixed effects;
- β_t are a set of time fixed effects;
- $X_{j,c,t}$ is a set of labour market policy variables and control variables

	Minimum	Median	Mean	Maximum	Standard deviation
ER 55-74	13.3	32.0	32.7	57.5	9.7
UBGR	1.9	26.7	23.5	55.5	12.7
ALMP	2.3	27.7	31.2	97.5	21.4
Average tax wedge	1.9	31.0	30.0	48.3	9.2
Excess coverage	-4.7	20.7	29.6	87.3	26.7
EPL	0.1	2.3	2.1	4.6	0.9
ETCR	0.5	1.8	2.1	5.4	1.0
ER 25-54	58.4	80.2	79.0	88.6	5.4
LE 65	74.4	93.4	92.9	115.0	8.1

A simple model

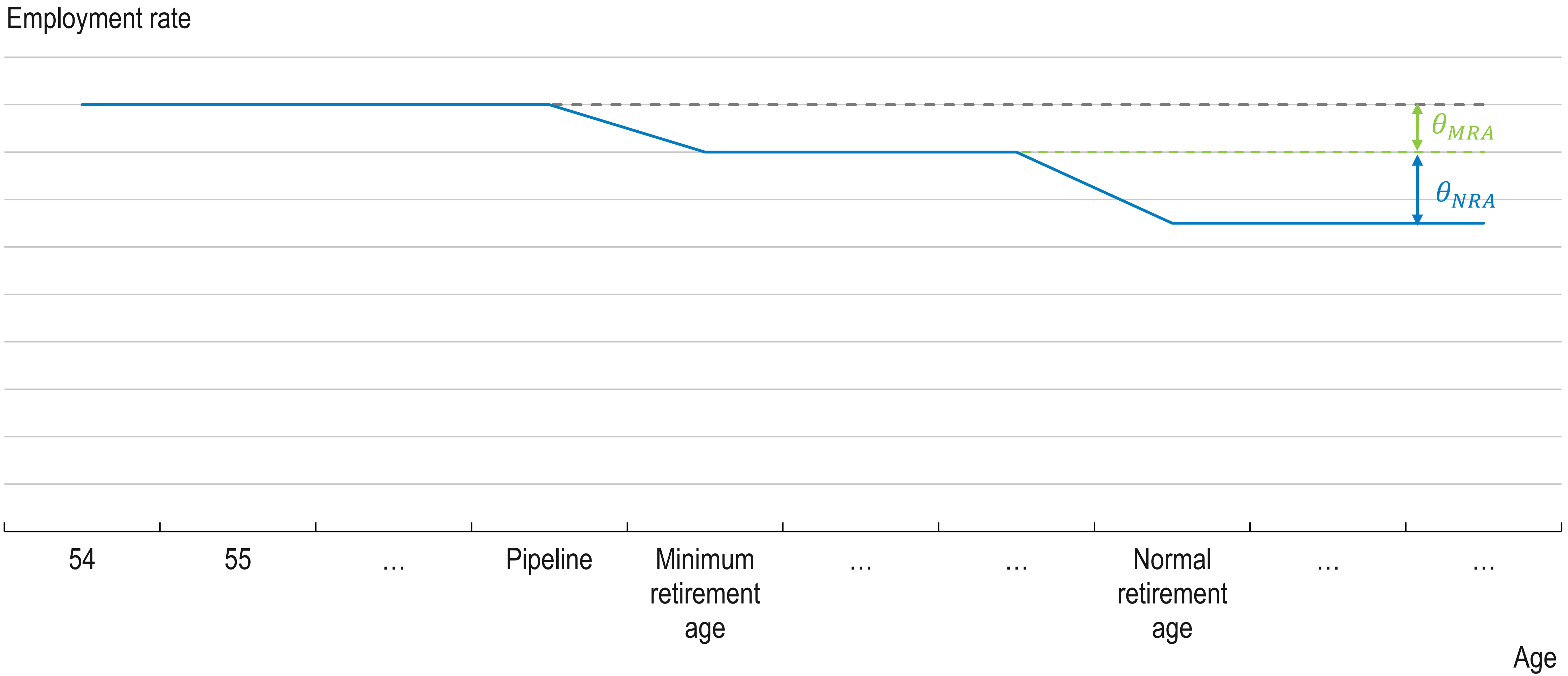


A simple model

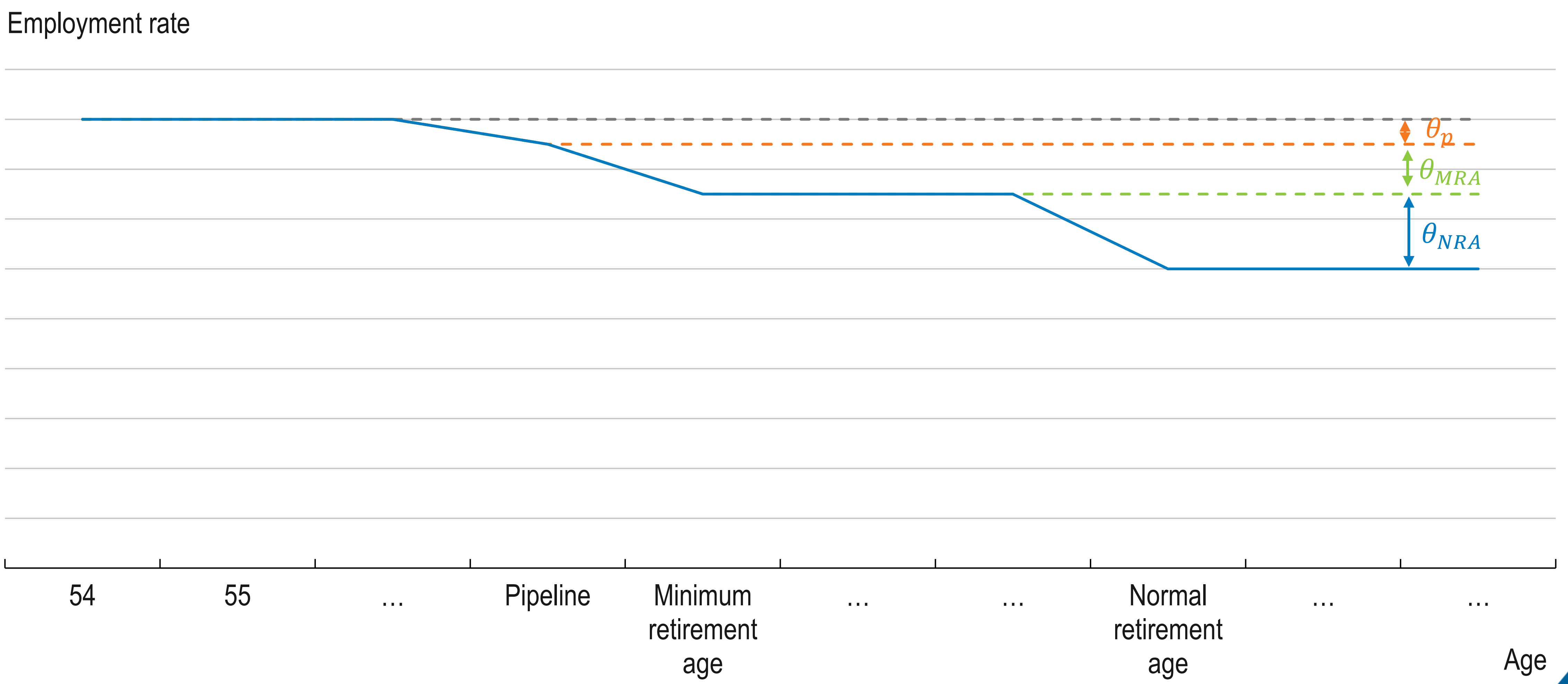


$$ER_{55-74} = \frac{Empl_{55-74}}{POP_{55-74}} = \sum_{a=55}^{74} P_a \cdot ER_a = \sum_{a=55}^{74} P_a \cdot \theta_0 + \theta_r \cdot \sum_{a=55}^{74} P_a \cdot RET_a = \theta_0 + \theta_r \cdot \sum_{a=R_a}^{74} P_a$$

A simple model



A simple model

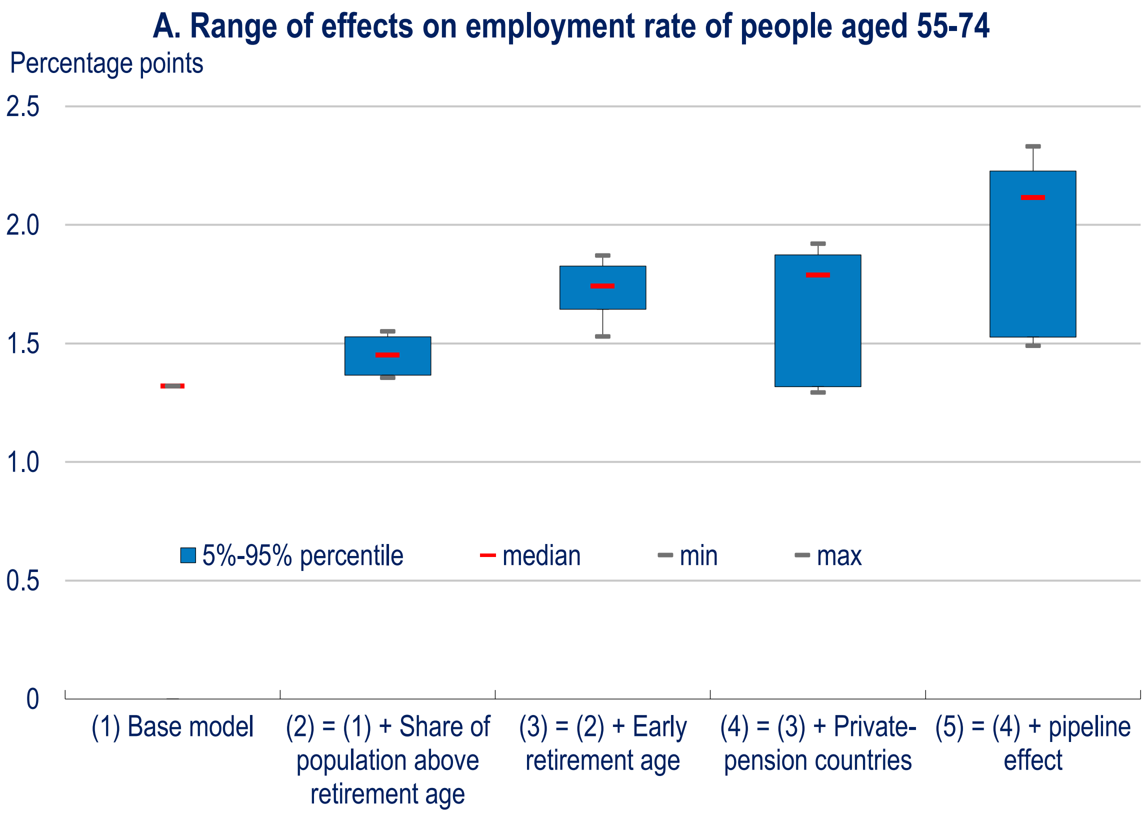


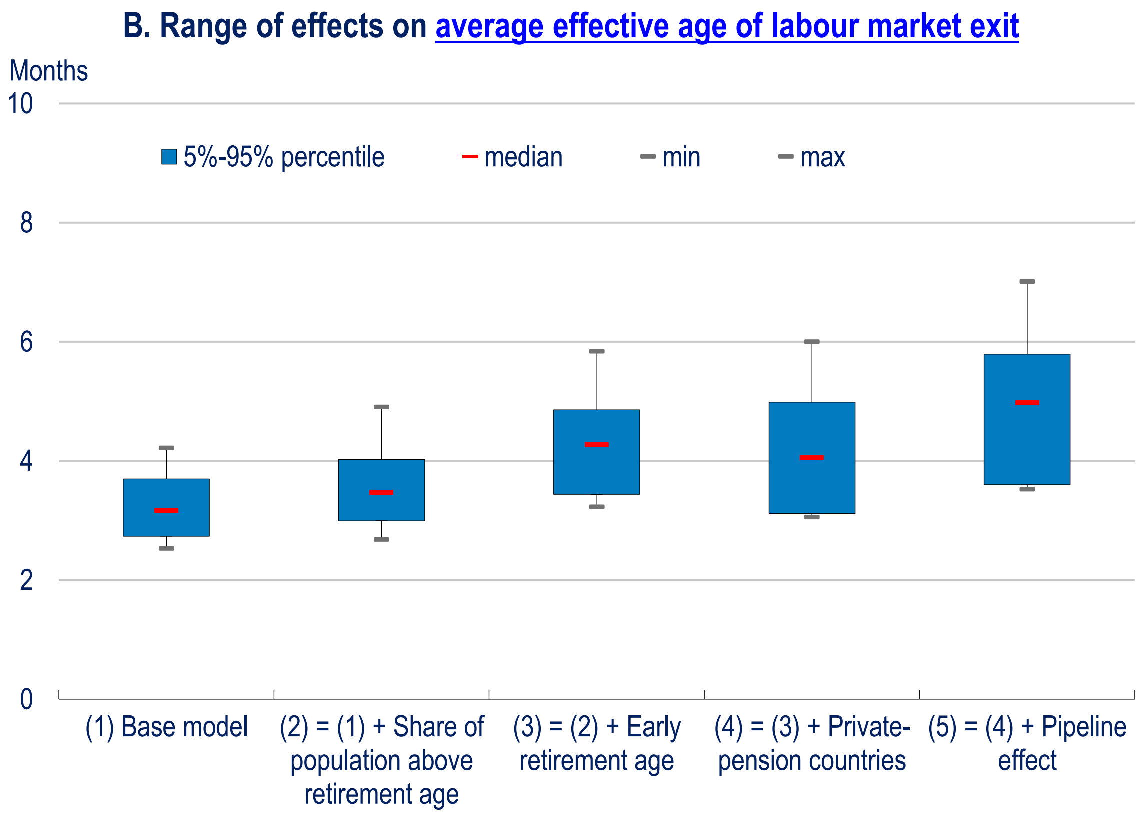
Long term equations

Dependent variable: employment rate of 55-74 age group

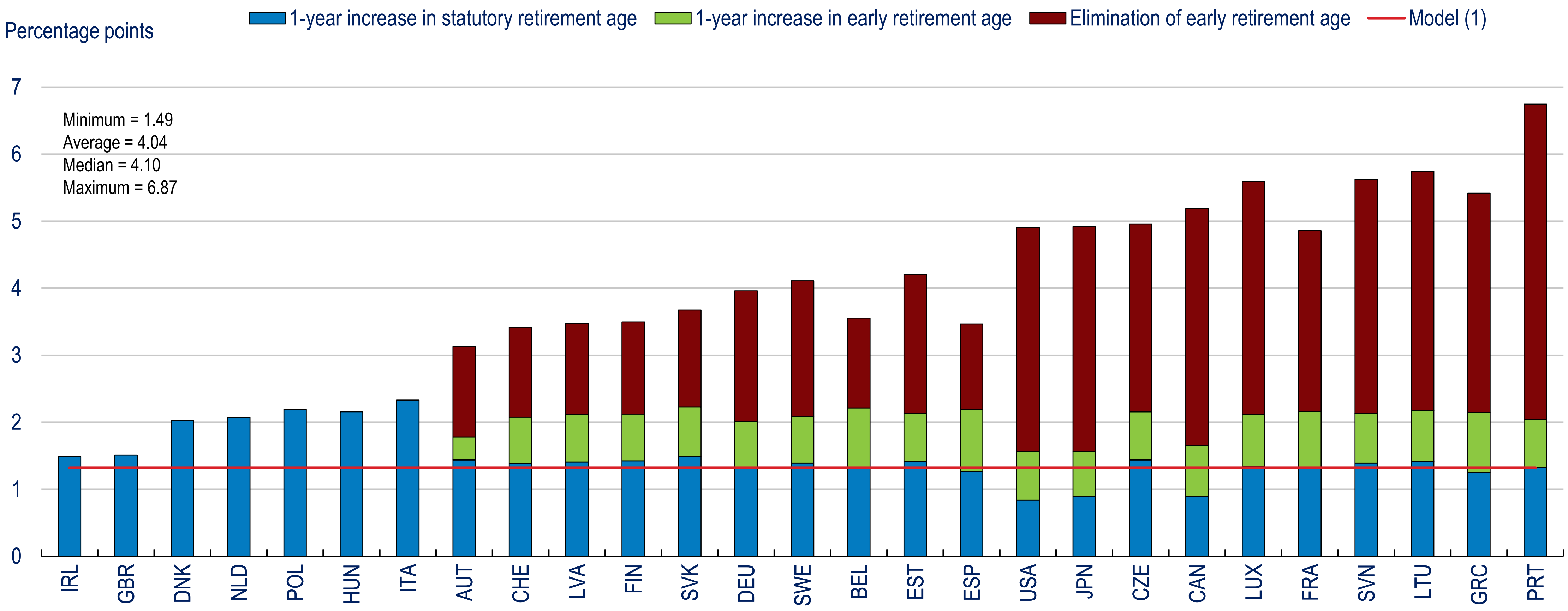
Explanatory variables			Variant equations		
	(1) Base model	(2) = (1) + % pop. above ret. age	(3) = (2) + Minimum retirement age	(4) = (3) + Private-pension countries	(5) = (4) + Pipeline effect
Labour and product market regulations					
EPL regular contracts	5.863**	6.283**	7.932**	8.138**	8.448**
Pension policies					
Statutory retirement age	1.320**				
Pipeline effect					-0.087
% pop. above early ret. age			-0.098	-0.095	-0.132
% pop. above statutory ret. Age		-0.286**	-0.243**		
% pop. above statut. ret. age (private pensions countries)				-0.172	-0.176
% pop. above statut. ret. Age (early exit countries)				-0.256**	-0.265**
% pop. above statut. ret. Age (other countries)				-0.256**	-0.275***
Other variables					
ER 25-54	0.615***	0.608***	0.586***	0.583***	0.606***
Life expectancy 65+	0.561***	0.538***	0.506***	0.516***	0.493***
RMSE	2.66	2.60	2.61	2.60	2.60
Adjusted R^2	91.8%	92.2%	92.1%	92.1%	92.1%
Obs.	522	522	522	522	522
Countries	27	27	27	27	27
Time coverage	1992-2019	1992 - 2019	1992-2019	1992-2019	1992-2019

Effects of raising the statutory retirement age

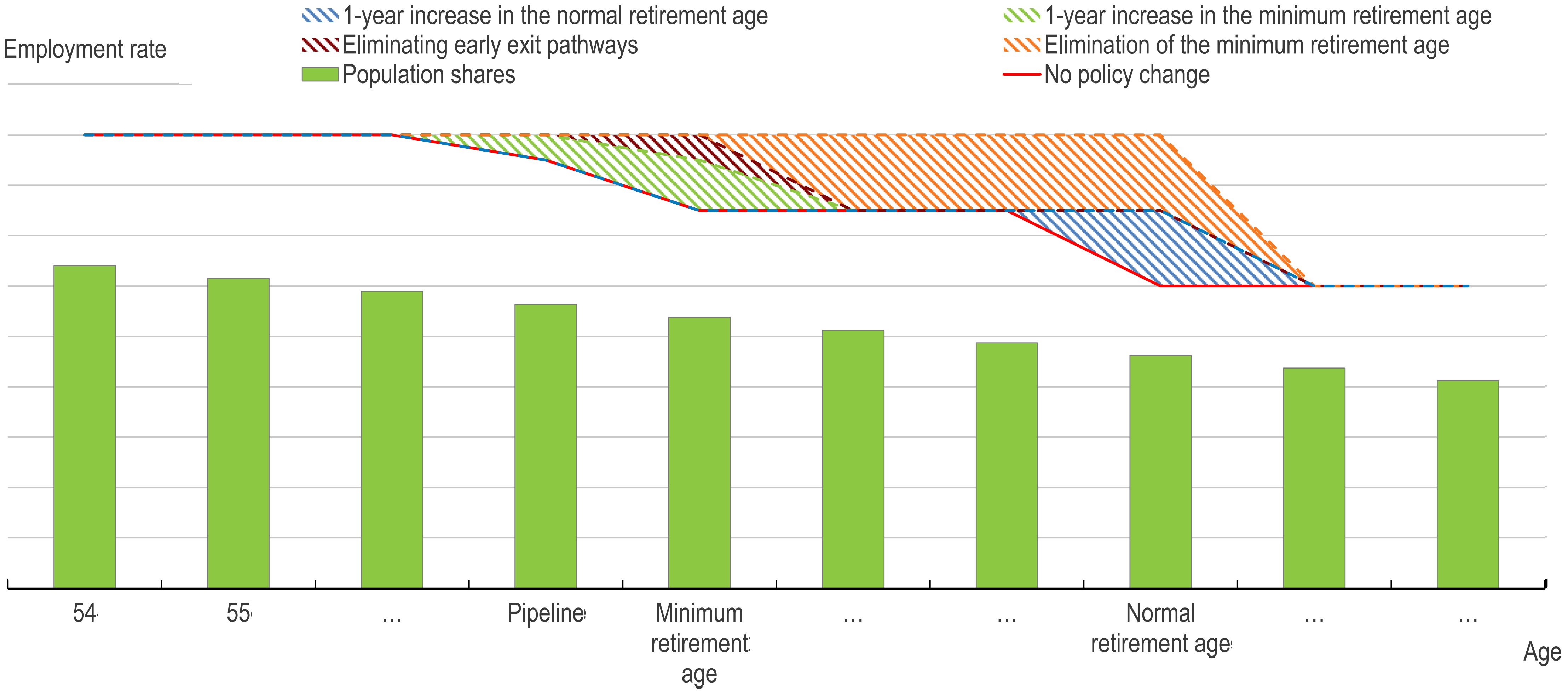




Policy simulation



Model visualisation



Conclusions

Key drivers of the older age employment rate:

- fiscal and activation policies,
- wage setting institutions
- labour and product market regulations
- **pension policies**
- **demographic dynamics**

Main innovations of the model:

- From statutory retirement age to share of population above the statutory retirement age
- Better fits the data and predicts more realistically the effects of pension reforms
- Heterogeneous estimated effects are different among countries
- Flexible and easily to generalise
- Policy simulations

Thank you!

Extra slides

- Short-term equations
- Employment rate 55-74 and retirement ages, year 2020
- Generalised logit fractional regression
- Non-linear error correction model

Underlying model

$$ER_{c,s,a,t} = \theta_c + \theta_t + \theta_r \cdot I\left(a \geq retirement\ age_{c,s,t}\right) + \sum_j \theta_j X_{j,c,t}$$

$$ER_{c,t} = \theta_c + \theta_t + \sum_s \theta_r \cdot P_{c,\left(a \geq retirement\ age_{c,s,t}\right),s,t} + \sum_j \theta_j X_{j,c,t}$$

$$ER_{55-74}(R_a) = \sum_{a=55}^{74} P_a \cdot ER_a = \sum_{a=55}^{74} P_a \cdot [\theta_0 + \theta_r \cdot RET_a] =$$

$$= \sum_{a=55}^{74} P_a \cdot \theta_0 + \theta_r \cdot \sum_{a=55}^{74} P_a \cdot RET_a = \theta_0 + \theta_r \cdot \sum_{a=R_a}^{74} P_a$$

$$ER_{55-74}(R_{a+1}) - ER_{55-74}(R_a) = \left(\theta_0 + \theta_r \cdot \sum_{a=R_a}^{74} P_a\right) - \left(\theta_0 + \theta_r \sum_{a=R_{a+1}}^{74} P_a\right) = -\theta_r P_{R_a}$$

Underlying model

If one assumes that all the population shares P_a are constant

$$ER_{55-74}(R_a) = \theta_0 + \theta_r \cdot \sum_{a=R_a}^{74} \frac{1}{20} = \theta_0 + \theta_r \cdot \frac{74 - R_a}{20} = \theta_0' + \theta_r' \cdot R_a$$

$$ER_{55-74}(R_{a+1}) - ER_{55-74}(R_a) = -\frac{\theta_r}{20}$$

Approximated effects on the average age of labour market exit

$$ER_{55-74} = \frac{Empl_{55-74}}{POP_{55-74}} = \frac{\sum_a Empl_a}{POP_{55-74}} = \frac{\sum_a ER_a \cdot POP_a}{POP_{55-74}} = \sum_a ER_a \cdot P_a$$

$$\Delta ER_{55-74} = \sum_{a=55}^{74} \Delta ER_a \cdot P_a = \Delta ER_{R_a} \cdot P_{R_a}$$

Ignoring deaths, assuming the age structure is stable, that nobody retires before age 55 and everyone retires by age 75, the average age of labour market exit can be calculated as

$$AALME = \sum_{a=55}^{74} a \cdot \frac{A_{a-1} \cdot P_{a-1} - A_a \cdot P_a}{A_{54} \cdot P_{54}}$$

Where:

- $AALME$ is the average age of labour market exit
- A_a is the participation rate at age a

Approximated effects on the average age of labour market exit

$$\Delta AALME = \frac{1}{A_{54}\cdot P_{54}} \cdot \left[(\Delta A_{54}\cdot P_{54} - \Delta A_{55}\cdot P_{55})\cdot 55 + \cdots + \left(\Delta A_{R_a-1}\cdot P_{R_a-1} - \Delta A_{R_a}\cdot P_{R_a}\right)\cdot R_a + \left(\Delta A_{R_a}\cdot P_{R_a} - \Delta A_{R_{a+1}}\cdot P_{R_a+1}\right)\cdot \mathrm{R}_{\mathrm{a+1}} + \cdots + (\Delta A_{73}\cdot P_{73} - \Delta A_{74}\cdot P_{74})\cdot 74\right]$$

If one assumes that there is no unemployment and therefore all the active population is employed

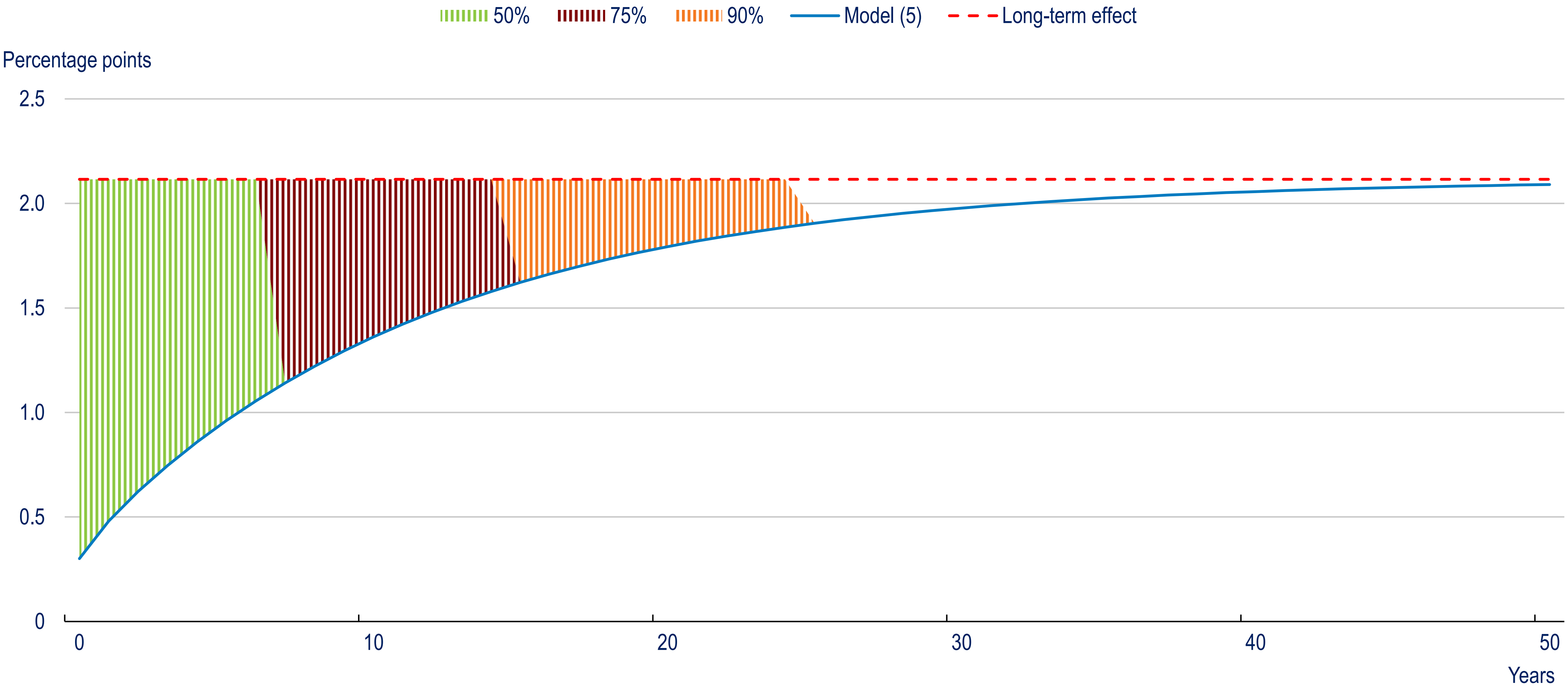
$$\Delta AALME = \frac{1}{A_{54}\cdot P_{54}} \cdot \left[(\Delta ER_{54}\cdot P_{54} - \Delta ER_{55}\cdot P_{55})\cdot 55 + \cdots + \left(\Delta ER_{R_a-1}\cdot P_{R_a-1} - \Delta ER_{R_a}\cdot P_{R_a}\right)\cdot R_a + \left(\Delta ER_{R_a}\cdot P_{R_a} - \Delta ER_{R_{a+1}}\cdot P_{R_a+1}\right)\cdot R_{a+1} + \cdots + (\Delta ER_{73}\cdot P_{73} - \Delta ER_{74}\cdot P_{74})\cdot 74\right]$$

$$= \frac{1}{A_{54}\cdot P_{54}} \cdot \left[(0\cdot P_{54} - 0\cdot P_{55})\cdot 55 + \cdots + \left(0\cdot P_{R_a-1} + \Delta ER_{earR_a-1} P_{R_a}\right)\cdot R_a + \left(\Delta ER_{R_a}\cdot P_{R_a} - 0\cdot P_{R_a+1}\right)\cdot (R_a+1) + \cdots + (0\cdot P_{73} - 0\cdot P_{74})\cdot 74\right] = \frac{1}{A_{54}\cdot P_{54}}\cdot \Delta ER_{R_a}\cdot (R_{a+1} - R_a)\cdot P_{R_a} = \frac{\Delta ER_{R_a}}{A_{54}\cdot P_{54}}\cdot P_{R_a} = \frac{\Delta ER_{55-74}}{A_{54}\cdot P_{54}}$$

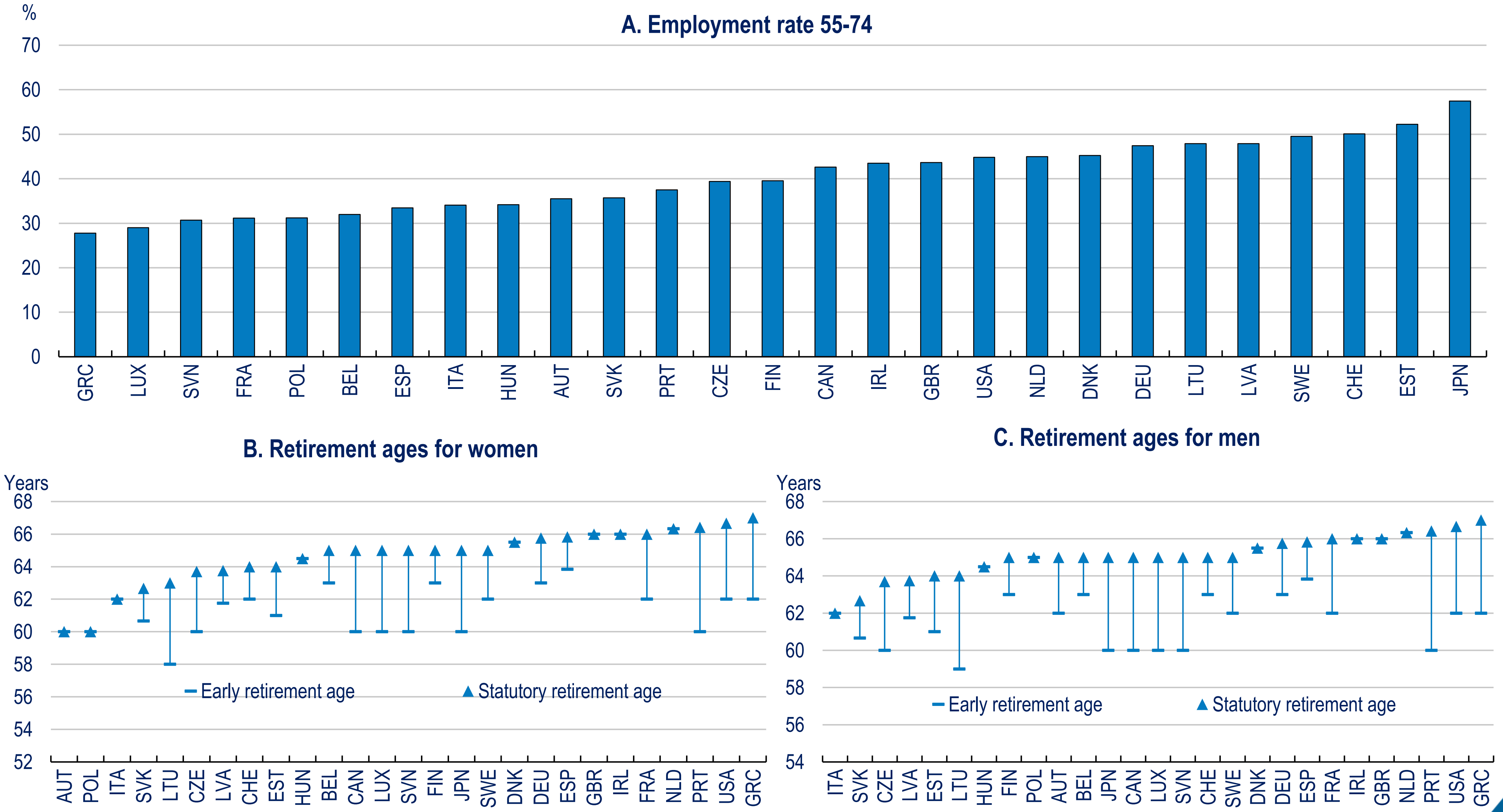
Short-term equations

Explanatory variables	Dependent variable: ΔER 55-74				
	(1) Base model	(2) = (1) + Share of population above retirement age	(3) = (2) + Early retirement age	(4) = (3) + Private-pension countries	(5) = (4) + Pipeline effect
EC-term	-0.042***	-0.047***	-0.052***	-0.053***	-0.054***
Tax-benefit and activation policies					
ΔALMP spending on employment (detrended), % of GDP per capita			0.056*	0.056*	
Wage setting institutions					
ΔExcess coverage	0.024**	0.023**	0.025**	0.024**	0.024*
Labour and product market regulations					
ΔETCR	0.555*	0.555*	0.593**	0.593**	0.552*
Pension policies					
ΔStatutory retirement age	0.216**				
Δ% pop. above the statut. ret. age		-0.046***	-0.044**		
Δ% pop. above the statut. ret. age ^ private pensions				-0.028	-0.028
Δ% pop. above the statut. ret. age ^ early exit				-0.046**	-0.037
Δ% pop. above the statut. ret. age ^ other countries				-0.046**	-0.06**
Other variables					
ΔER 25-54	0.34***	0.34***	0.325***	0.326***	0.336***
ΔER 55-74(t-1)	0.23***	0.225***	0.215***	0.215***	0.222***
RMSE	0.705	0.702	0.699	0.699	0.701
Adjusted R-squared	51.9%	52.3%	52.8%	52.8%	52.4%
Obs.	485	485	485	485	485
Countries	27	27	27	27	27
Time coverage	1993-2020	1993-2020	1993-2020	1993-2020	1993-2020

Short-term equations



Employment rate 55-74 and retirement ages, year 2020



Robustness check: Generalised logit fractional regression

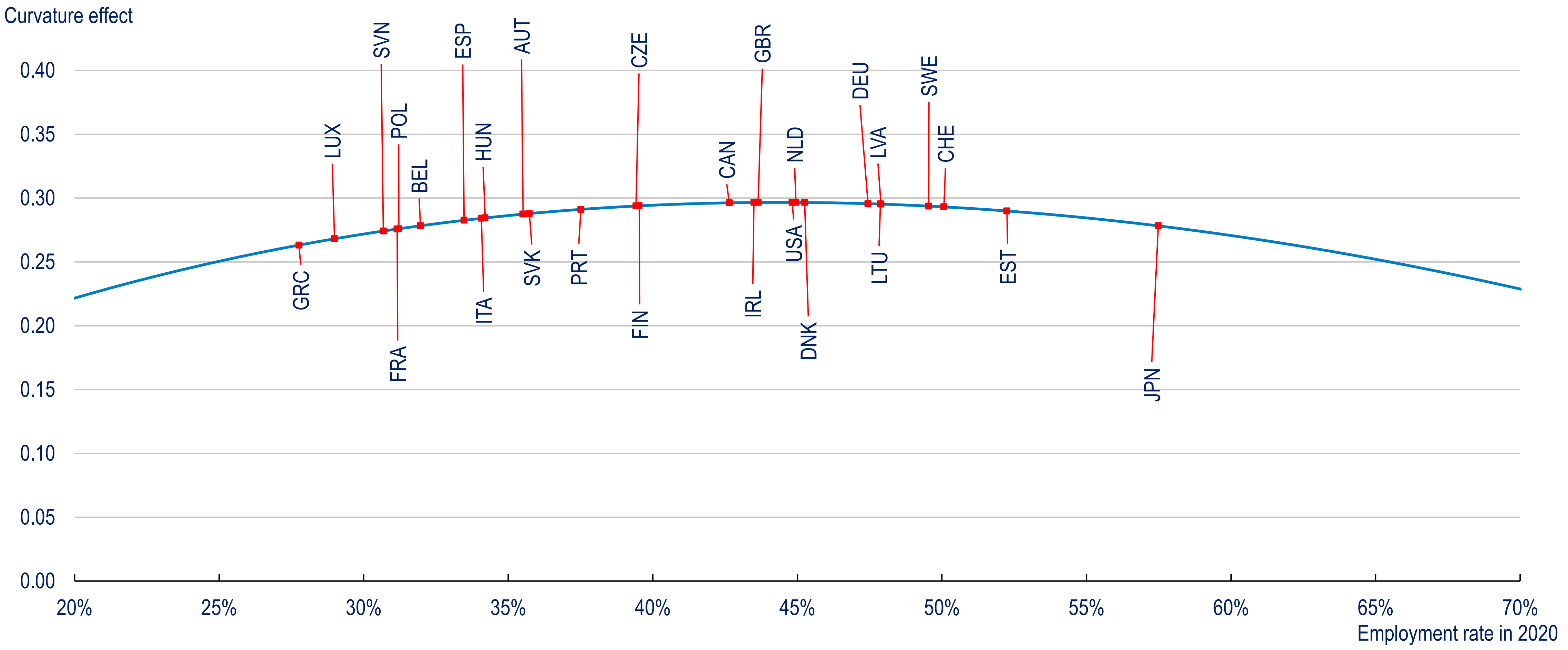
$$ER_{c,t} = \frac{1}{\left(1 + e^{-\left(\alpha_c + \alpha_r \cdot PSR_{c,t} + \sum_j \alpha_j X_{j,c,t}\right)}\right)^R} + \varepsilon_{c,t}$$

$$\Delta ER_{c,t} = \beta_c + \beta_t + \pi \cdot \hat{\varepsilon}_{c,t} + \beta_r \cdot \Delta PSR_{c,t} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

$$\frac{\partial ER_{c,t}}{\partial PSR_{c,t}} = \alpha_r \cdot R \cdot ER \cdot \left(1 - ER^{\frac{1}{R}}\right)$$

$$ER^* = \left(\frac{R}{1+R}\right)^R$$

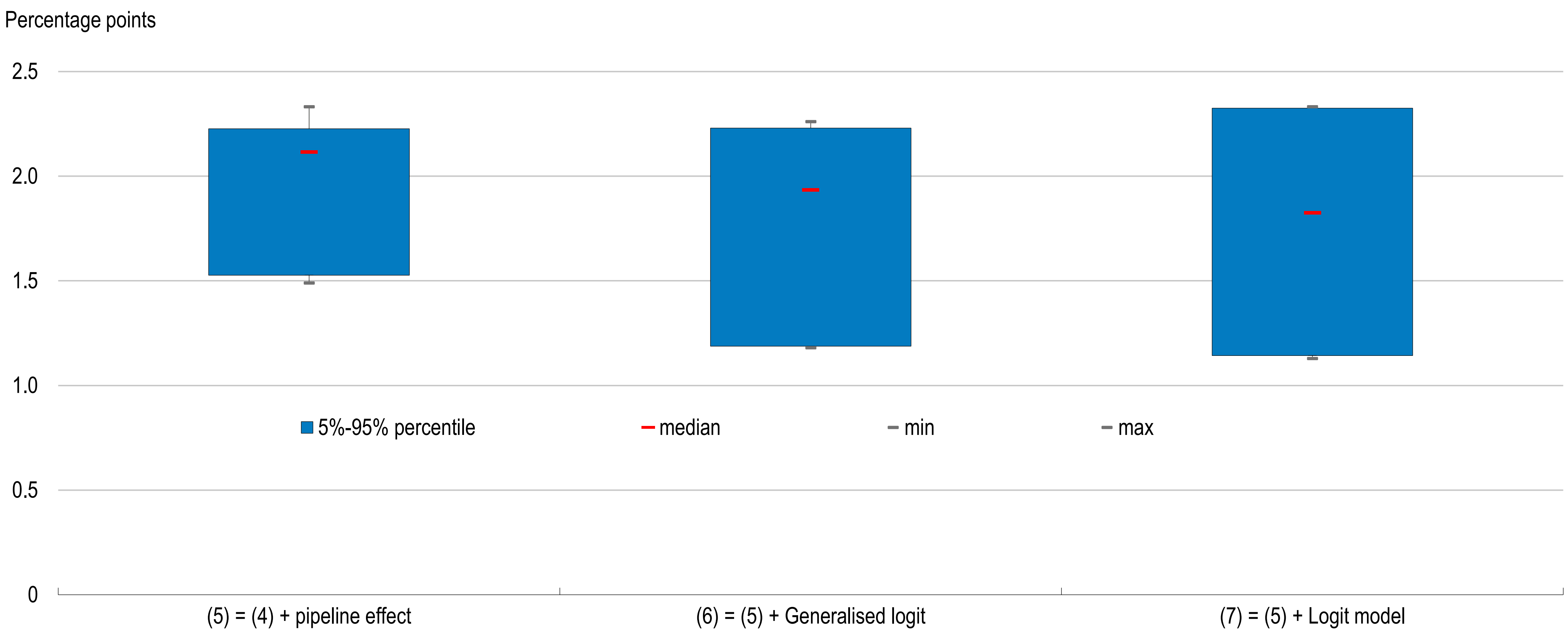
Robustness check: Generalised logit fractional regression



Robustness check:
Generalised logit fractional regression

Explanatory variables	Dependent variable: ER 55-74			
	(5) = (4) + Pipeline effect	(5) = (4) + pipeline effect	(6) = (5) + Generalised logit	(7) = (5) + Logit model
Labour and product market regulations				
EPL regular contracts	8.448**	10.832***	0.251***	0.307***
Pension policies				
Statutory retirement age				
Pipeline effect	-0.087	-0.105***	-0.005**	-0.007***
% pop. above the early retirement age	-0.132	-0.196***	-0.003**	-0.004**
% pop. above the statutory retirement age		-0.204***		
% pop. above the statutory retirement age (private pensions)	-0.176	0.204***	-0.005**	-0.005*
% pop. above the statutory retirement age (early exit)	-0.265**		-0.009***	-0.01***
% pop. above the statutory retirement age (other countries)	-0.275***		-0.011***	-0.014***
Other variables				
ER 25-54	0.606***	0.567***	0.027***	0.034***
Life expectancy 65+	0.493***	0.498***	0.017***	0.022***
R			2.013	
RMSE	2.60	2.60	2.69	2.70
Adjusted R-squared	92.1%	91.9%		
Obs.	522	495	594	594
Countries	27	27	27	27
Time coverage	1992-2019	1992-2018	1990-2020	1990-2020

Robustness check:
Generalised logit fractional regression



Robustness check: Non-linear error correction model

- **Quadratic:**

$$\Delta ER_{c,t} = \beta_c + \beta_t + \boldsymbol{\pi} \cdot \left|\hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}}\right| \cdot \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}} + \beta_P \cdot \Delta RA_{c,t} + \beta_d \cdot \Delta ER_{c,t-1} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

- **Kernel**

$$\Delta ER_{c,t} = \beta_c + \beta_t + \boldsymbol{\pi} \cdot \left[\mathbf{1} - \frac{\boldsymbol{\phi}\left(\hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}}, \mathbf{0}, \boldsymbol{\sigma}\right)}{\boldsymbol{\phi}(\mathbf{0}, \mathbf{0}, \boldsymbol{\sigma})}\right] \cdot \boldsymbol{sign}\left(\hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}}\right) + \beta_P \cdot \Delta RA_{c,t} + \beta_d \cdot \Delta ER_{c,t-1} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

Where $\phi(x, \mu, \sigma)$ is the normal density function of mean μ and standard deviation σ for the value x.

- **Logit**

$$\Delta ER_{c,t} = \beta_c + \beta_t + \boldsymbol{\pi} \cdot \frac{\mathbf{1}}{\mathbf{1} + \boldsymbol{exp}\left(\boldsymbol{\sigma} \cdot \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}} + \boldsymbol{\mu}\right)} \cdot \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}} + \beta_P \cdot \Delta RA_{c,t} + \beta_d \cdot \Delta ER_{c,t-1} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

- **Exponential**

$$\Delta ER_{c,t} = \beta_c + \beta_t + \left[\mathbf{1} - \boldsymbol{exp}\left(\boldsymbol{\sigma} \cdot \hat{\boldsymbol{\varepsilon}}^{\mathbf{2}}_{\boldsymbol{c,t-1}}\right)\right] \cdot \hat{\boldsymbol{\varepsilon}}_{\boldsymbol{c,t-1}} + \beta_P \cdot \Delta RA_{c,t} + \beta_d \cdot \Delta ER_{c,t-1} + \sum_j \beta_j \cdot \Delta X_{j,c,t} + \eta_{c,t}$$

Robustness check: Non-linear error correction model

Explanatory variables	Dependent variable: ΔER 55-74				
	Linear	Quadratic	Kernel	Logit	Exponential
π	-0.061***	-0.009***	-0.197***	-0.074	
μ				-1.881	
σ			0.617*	-0.175	0.00102**
Tax-benefit and activation policies					
ΔALMP			0.077*	0.086**	0.079*
Wage setting institutions					
ΔExcess coverage	0.024*	0.025*	0.025*	0.024*	0.027**
Pension policies					
Δ% pop. above the statutory retirement age (private pensions)	-0.028	-0.032	-0.027	-0.033	-0.037
Δ% pop. above the statutory retirement age (early exit)	-0.037	-0.039	-0.036*	-0.036*	-0.038***
Δ% pop. above the statutory retirement age (other countries)	-0.06**	-0.06**	-0.06**	-0.064***	-0.06**
Other variables					
ΔER_{25-54}	0.336***	0.344***	0.334***	0.334***	0.35***
$\Delta ER_{55-74,t-1}$	0.222***	0.223***	0.156***	0.156***	0.153***
RMSE	0.701	0.709	0.684	0.686	0.694
Adjusted R-squared	52.4%	51.3%	68.3%	68.1%	52.9%
Obs.	485	485	504	504	504
Countries	27	27	27	27	27
Time coverage	1993-2020	1993-2020	1993-2020	1993-2020	1993-2020

Robustness check: Non-linear error correction model

Path of convergence toward the long-term equilibrium according to alternative ECM