Wpływ demografii na politykę pieniężną w małej gospodarce otwartej

Marcin Bielecki* Michał Brzoza-Brzezina** Marcin Kolasa**

Departament Badań Ekonomicznych, Narodowy Bank Polski

*Uniwersytet Warszawski **Szkoła Główna Handlowa

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Outline

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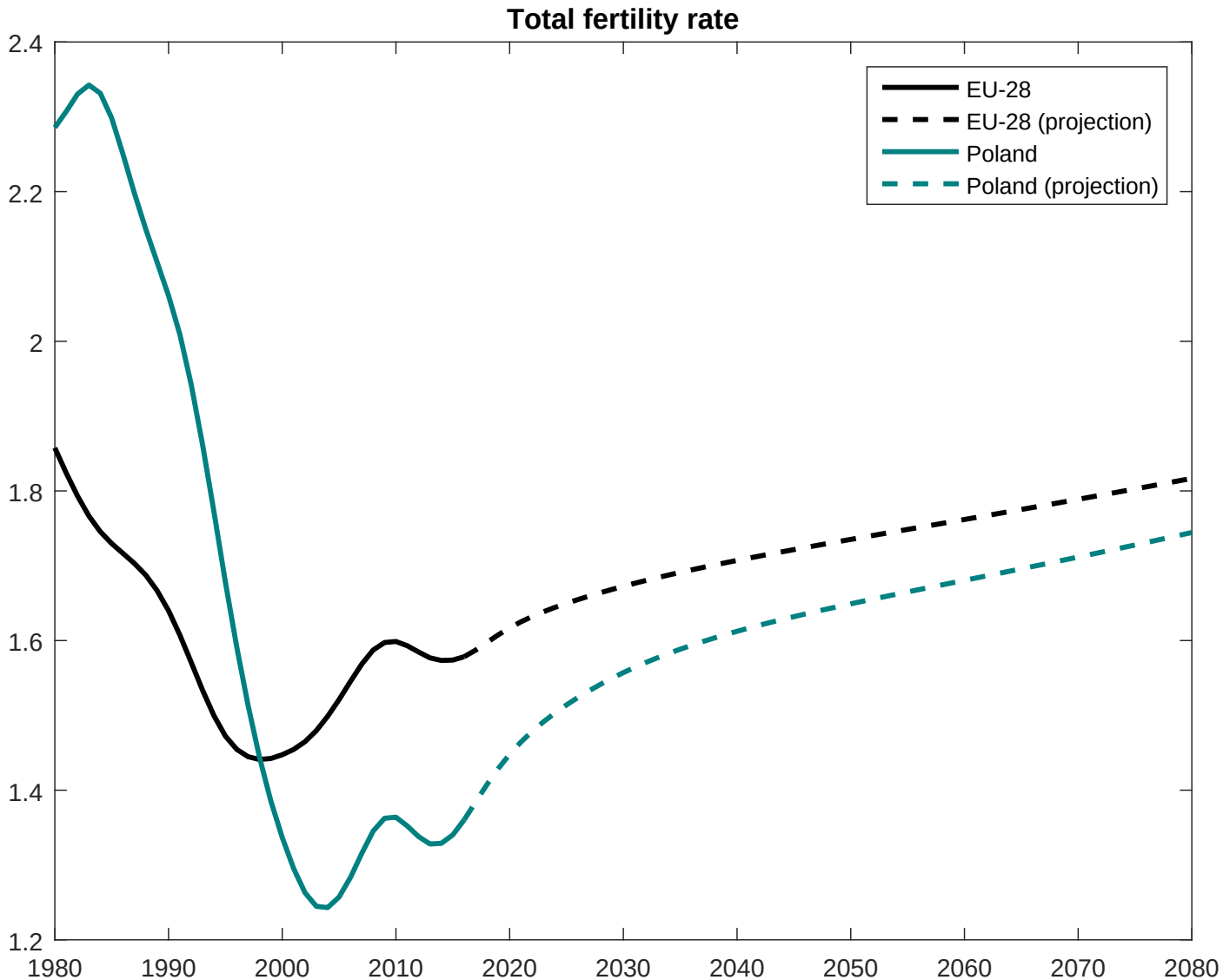
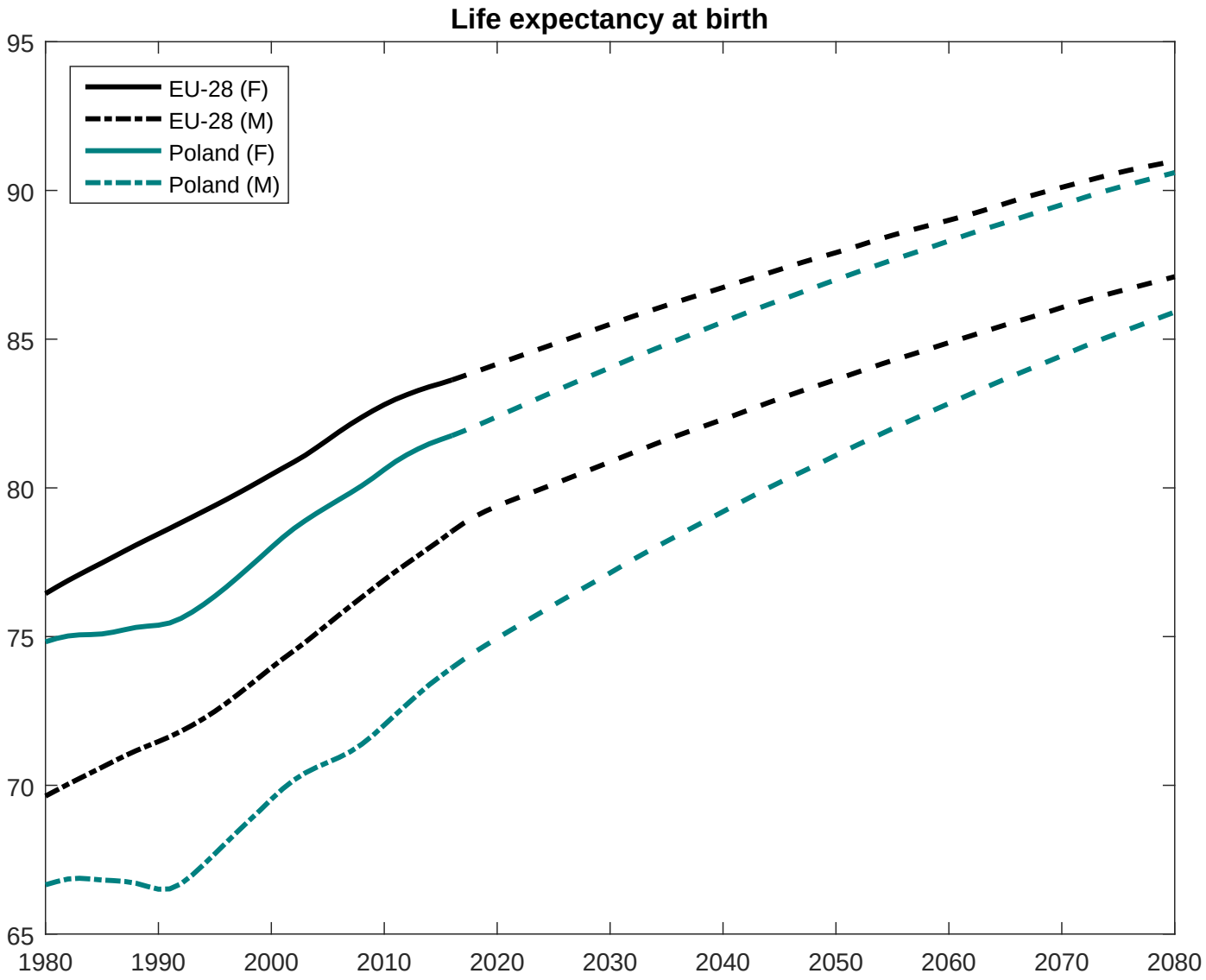
Motivation

- Demographic transition (ageing):
  - Low (sub-replacement) fertility
  - Increasing life expectancy
- Observed in many economies
- Speed and timing differs accross countries
- Poland particularly affected

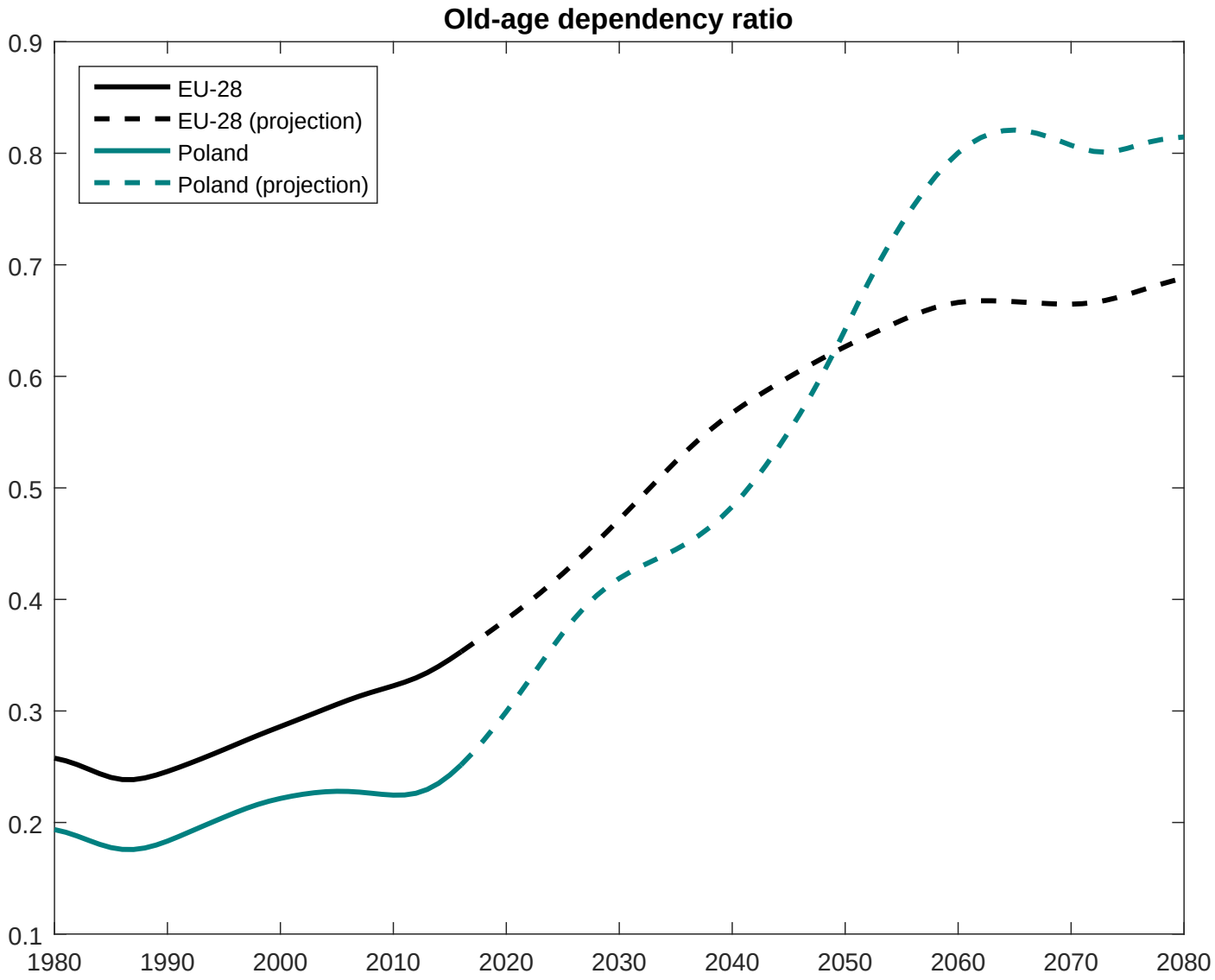
Demography: fertility rate



Demography: life expectancy



Demography: old-age dependency ratio



Macroeconomic implications of ageing

- Economic growth
- Pension system sustainability
- Size and composition of fiscal expenditures
- Housing market
- ...
- Monetary policy

Possible implications for monetary policy

- Drop in the natural real rate of interest (NRI)
  - Adjustment in external balances
  - Changes in transmission of monetary policy and shocks
  - Increased probability of hitting the zero lower bound (ZLB)
  - Shift in preferences towards inflation-output volatility trade-off

This paper

1. Quantitative impact of ageing, especially on NRI
2. Role of foreign demography
3. Importance of observing NRI in real time by the central bank
4. Quantitative implications for ZLB

Main findings

- Impact of ageing on NRI substantial:
  - Decline by 1 p.p. in Euro Area between 2010 and 2030
  - Decline by 1.8 p.p. in Poland between 2010 and 2050
  - Life expectancy more important than fertility
- Important to account for fall in NRI in real time.
  Slow learning results in prolonged period of low inflation:
  - Estimated bias up to 0.8 p.p.
- Implications for ZLB risk:
  - Moderate under perfect information
  - Significant under learning
- Role of foreign spillovers limited, domestic demography is key

Literature

- Closed economy, focus on NRI decline:
  - Kara and von Thadden (2016); Carvalho et al. (2016); Eggertson et al. (2017)
- Open economy, focus on capital flows, world rate of return and distribution effects:
  - Boersch-Supan et al. (2006); Krueger and Ludwig (2007)
- Impact on social preferences towards inflation-output volatility trade-off:
  - Bullard et al. (2012) and Vlandas (2016) vs Juselius and Takats (2015)
- Monetary policy effectiveness:
  - Imam (2015); Wong (2016); Gagnon et al. (2016)
- ZLB risk and impact of learning:
  - ???

Outline

Model structure: overview

- Small open economy New Keynesian model with life-cycle features:
  - 80 cohorts of overlapping generations of households (age 20-99)
  - Age and time-dependent mortality risk
  - Age-specific productivity and disutility of labor
- Rigidities: sticky prices, investment adjustment costs
- Monetary policy: Taylor-like rule, ZLB
- Exogenous processes:
  - Deterministic: growth rate of initial young, mortality risk (home and abroad)
  - Stochastic: productivity, time preference, monetary policy, international risk premium, foreign shocks

Households

- Maximize expected lifetime utility

$$E_t \sum_{i=0}^{J-j} \left[\beta^i \frac{N_{j+i,t+i}}{N_{j,t}} \exp\left(\varepsilon_{u,t}\right) \left(\ln c_{j+i,t+i} - \phi_{j+i} \frac{h_{j+i,t+i}^{1+\varphi}}{1+\varphi} \right) \right]$$

  subject to

$$c_{j,t} + a_{j+1,t+1} = w_t z_j h_{j,t} + \frac{R_t^a}{\pi_t} a_{j,t} + beq_t$$

- Assets managed by investment funds

Key equations for impact of demography on NRI

- First order condition of a household affected by the time- and age-dependent **mortality risk** $\omega_{j,t}$

$$1 = \beta \left(1 - \omega_{j,t}\right) E_t \left[\frac{c_{j,t}}{c_{j+1,t+1}} \frac{R^a_{t+1}}{\pi_{t+1}} \right]$$

- Expected real rate of return on asset portfolio equals the expected rate of return on capital

$$E_t \left[\frac{R^a_{t+1}}{\pi_{t+1}} \right] = E_t \left[\frac{r^k_{t+1} + \left(1 - \delta\right) q_{t+1}}{q_t} \right]$$

- Changes in **fertility** affect population growth rate n through capital per worker accumulation

Investment funds

- Balance sheet

$$A_{t+1} = q_t K_{t+1} + B_{t+1} + s_t B^*_{t+1} + \int_0^{N_{t+1}} p^d_t(i) D_{t+1}(i) di$$

- Maximize expected gross return

$$E_t \frac{1}{R_t} \left[\begin{array}{l} \left(r^k_{t+1} + (1-\delta) q_{t+1}\right) K_{t+1} + \frac{R_t}{\pi_{t+1}} B_{t+1} + s_{t+1} \frac{\Gamma_t R^*_t}{\pi^*_{t+1}} B^*_{t+1} \\ \\ + \int_0^{N_{t+2}} p^d_{t+1}(i) D_{t+1}(i) di + \int_0^{N_{t+1}} F_{t+1}(i) D_{t+1}(i) di \end{array} \right]$$

- International risk premium

$$\Gamma_t = 1 + \gamma \left[\exp\left(-\frac{s_t B^*_{t+1}}{p_{H,t} GDP_t} \right) - 1 \right] + \exp(\varepsilon_{\Gamma,t})$$

Producers

- Final goods produced using domestic and imported components

$$C_t + I_t = \left[\eta^{\frac{1}{\phi}} Y_{H,t}^{\frac{\phi-1}{\phi}} + (1-\eta)^{\frac{1}{\phi}} Y_{F,t}^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}$$

- Capital good producers face investment adjustment costs

$$K_{t+1} = (1-\delta) K_t + \left[1 - S_k \left(\frac{I_t}{I_{t-1}} \right) \right] I_t$$

- Intermediate goods firms employ capital and labor to produce differentiated products

$$Y_{H,t}(i) + Y_{H,t}^*(i) = \exp(\varepsilon_{z,t}) K_t(i)^{\alpha} H_t(i)^{1-\alpha}$$

- Calvo-type price stickiness and local currency pricing (also for imports)

Monetary policy

Feedback rule

$$R_t = \max\left\{1, R_{t-1}^{\gamma_R}\left[\tilde{R}_t^e\left(\frac{\pi_t}{\pi}\right)^{\gamma_\pi}\left(\frac{g_t}{\tilde{g}_t^e}\right)^{\gamma_y}\right]^{1-\gamma_R}\exp\left(\varepsilon_{R,t}\right)\right\}$$

where

- $g_t \equiv \frac{GDP_t}{GDP_{t-1}}$ and $\tilde{g}_t^e \equiv \frac{G\tilde{D}P_t}{G\tilde{D}P_{t-1}}$ denote growth rates of actual and potential (flexible price) output
- $\tilde{R}_t^e$ is perceived natural (flexible price) interest rate
- Both the perceived potential output growth and NRI can be:

observed in real time (baseline)	gradually learned (learning)
$\tilde{R}_t^e = \pi\tilde{r}_t$	$\tilde{R}_t^e = \tilde{R}_{t-1}^e + \lambda\left(\pi\tilde{r}_{t-1} - \tilde{R}_{t-1}^e\right)$
$\tilde{g}_t^e = \frac{G\tilde{D}P_t}{G\tilde{D}P_{t-1}}$	$\tilde{g}_t^e = \tilde{g}_{t-1}^e + \lambda\left(\frac{G\tilde{D}P_{t-1}}{G\tilde{D}P_{t-2}} - \tilde{g}_{t-1}^e\right)$

Market clearing

- Standard market clearing conditions for goods, capital and labor markets
- Financial markets:
  - Domestic bonds

$$B_t = 0$$

  - NFA law of motion

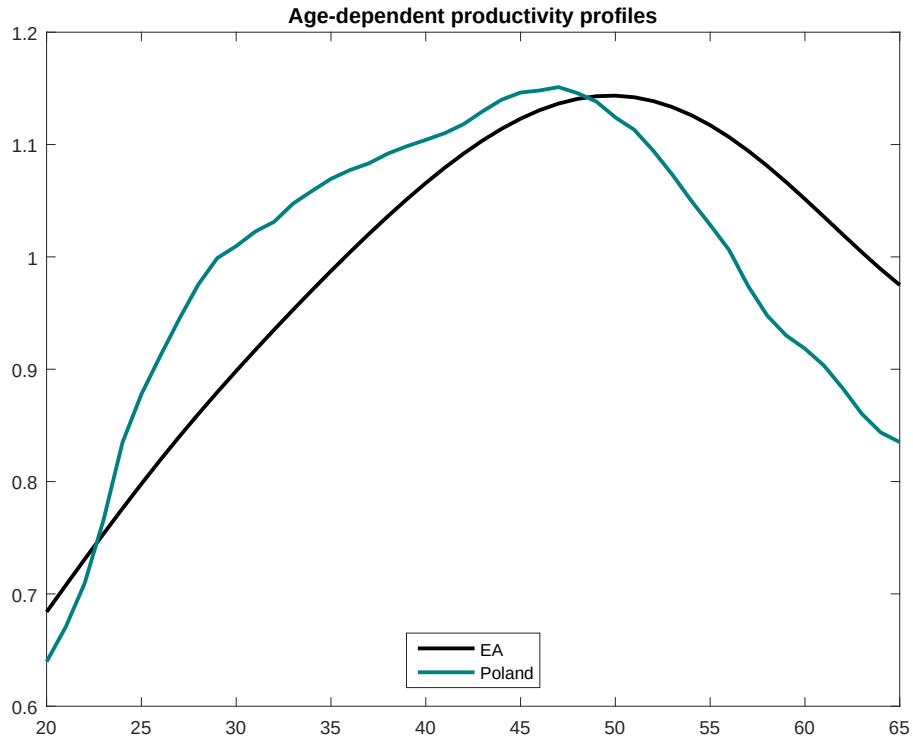
$$s_t B^*_{t+1} = s_t \frac{\Gamma_{t-1} R^*_{t-1}}{\pi^*_t} B^*_t + \underbrace{s_t p^*_{H,t} Y^*_{H,t} - p_{F,t} Y_{F,t}}_{\text{net export}}$$

Solution

- Deterministic simulations:
  - Simulate EA (closed)
  - Use solution for EA to simulate PL (small open)
- Stochastic simulations:
  - First-order approximation around points on the deterministic path
  - Allowing for ZLB: Dynare OBC (Holden, 2016)

Calibration and data I

- Demographic data:
  - PL: Eurostat (1990-2015) and EUROPOP 2013 (2016-2080)
  - EA: Eurostat (1986-2015) and EUROPOP 2013 (2016-2080)
- Age-specific productivity:



Poland: A. Kolasa (2016); EA: Gourinchas and Parker (2002) estimates for US

Calibration and data II

- Estimated outside of the model:
  - Taylor rule parameters
  - EA VAR
- Other structural parameters taken from literature or matched to means observed in data:
  - Real interest rate:
    - PL: 2.1% (2003-2012)
    - EA: 1.2% (1999-2008)
  - Foreign debt to GDP ratio in PL: 55% (2003-2012)
- Speed of learning set to $\lambda = 0.08$
  - Branch and Evans (2006); Milani (2011); Malmendier and Nagel (2016)
- Or to $\lambda = 0.2$, reflecting the difference between two- and one-sided Laubach-Williams estimates for the EA

Moment matching

- Stochastic shocks:
  - Foreign shocks: estimated VAR for EA
  - Other shocks: to match moments

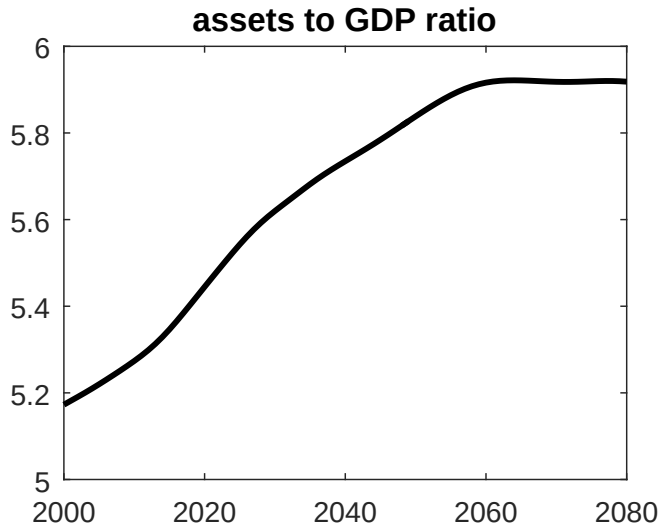
Variable	Standard dev.		Autocorrelation		Corr. with GDP	
	Model	Data	Model	Data	Model	Data
GDP	1.77	1.84	0.77	0.68	1.00	1.00
Inflation	1.50	1.77	0.25	0.37	0.39	0.72
Interest rate	1.97	1.97	0.34	0.34	0.40	0.57
Real exchange rate	5.52	5.55	0.36	0.22	0.03	0.31

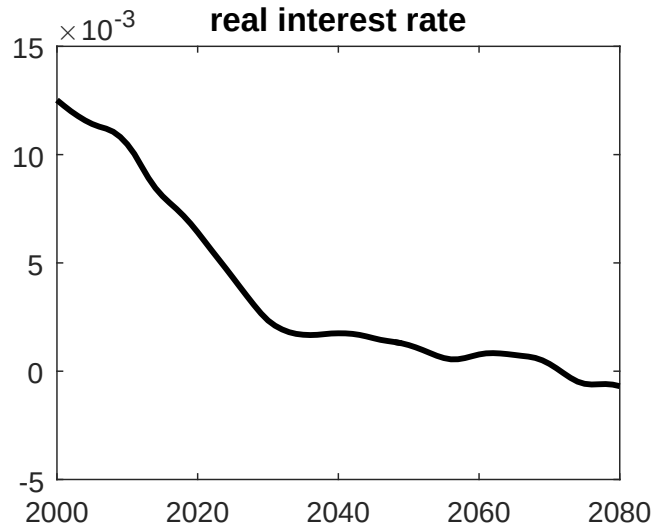
Outline

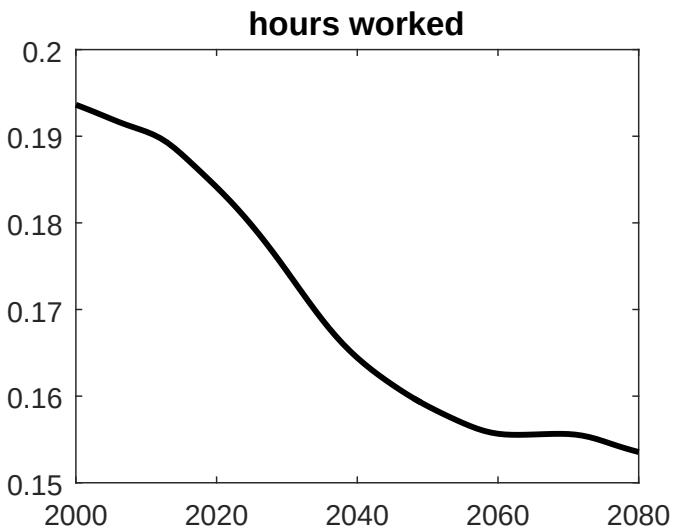
Overview of simulations

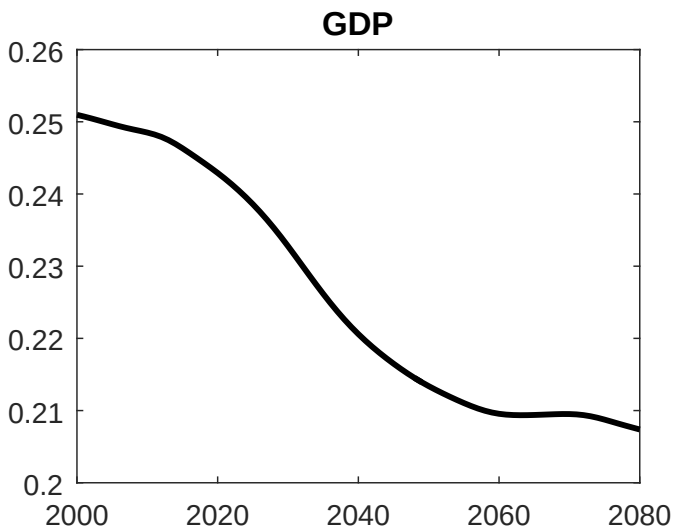
- Impact of demographic transition:
  - Euro Area
  - Poland
- Consequences for monetary policy:
  - Inflation
  - ZLB risk
- Spillovers from foreign demography

Impact of demographic transition: Euro Area

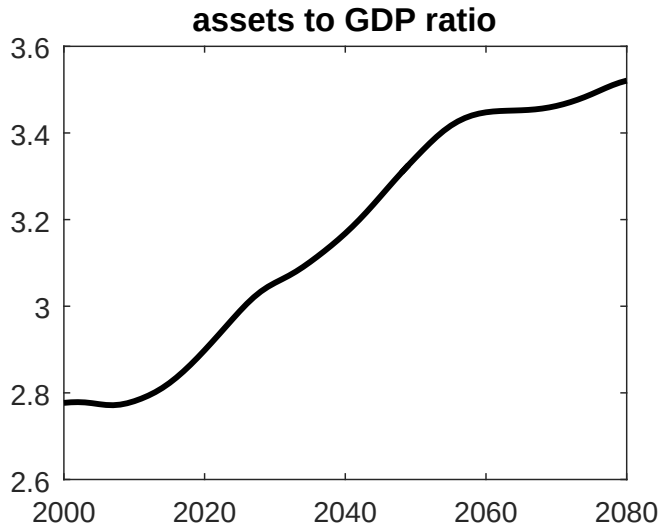


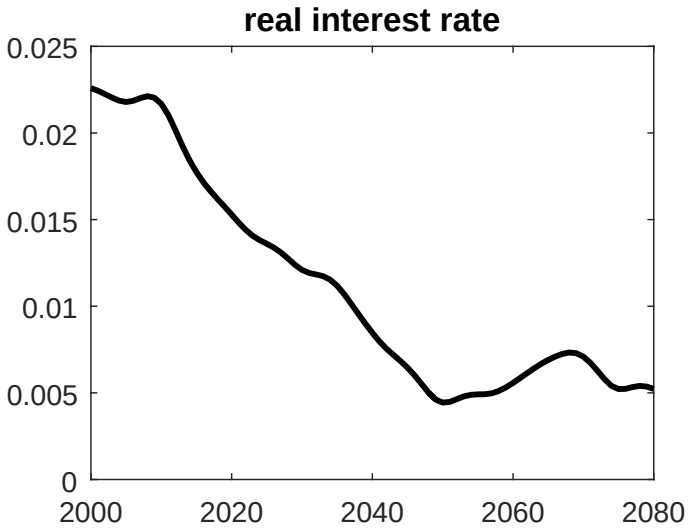


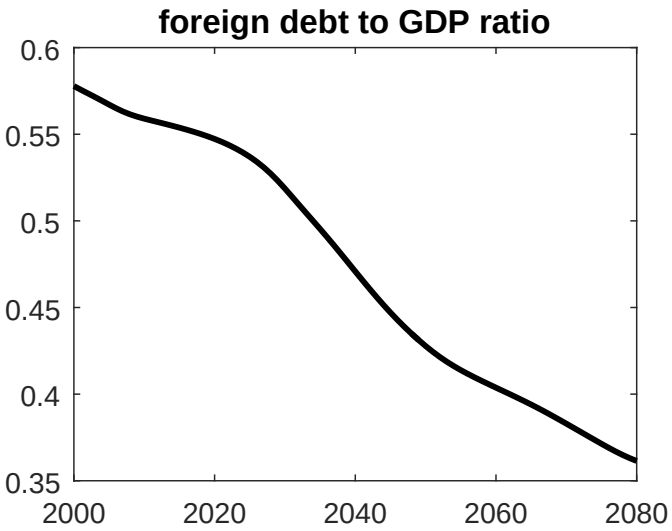


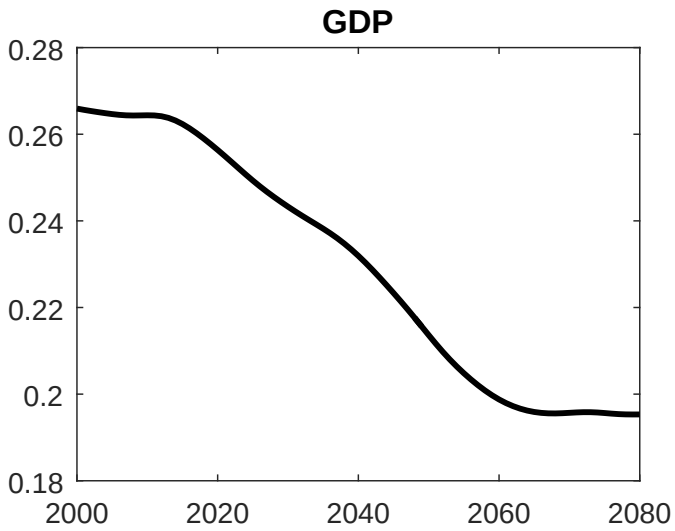


Impact of demographic transition: Poland





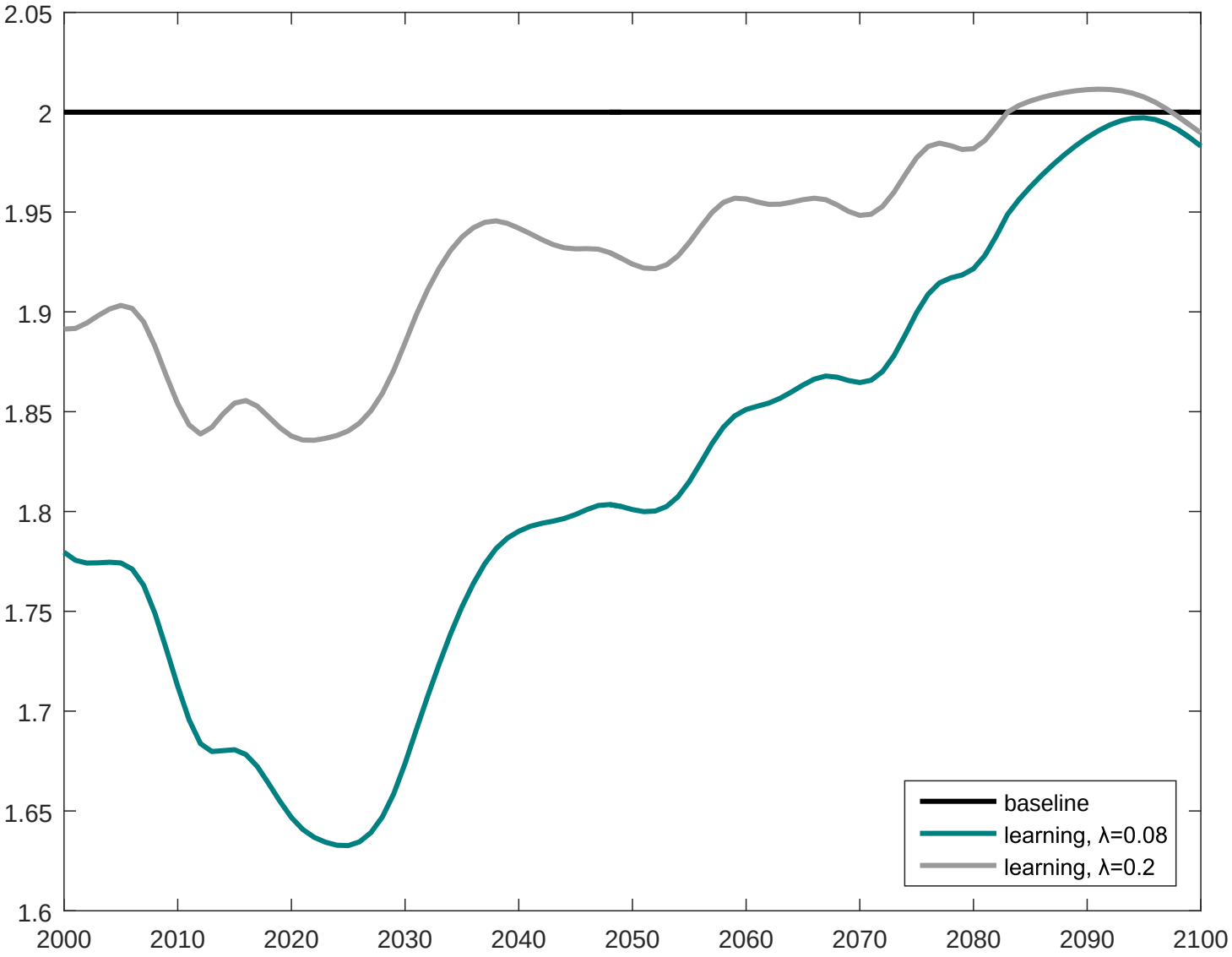




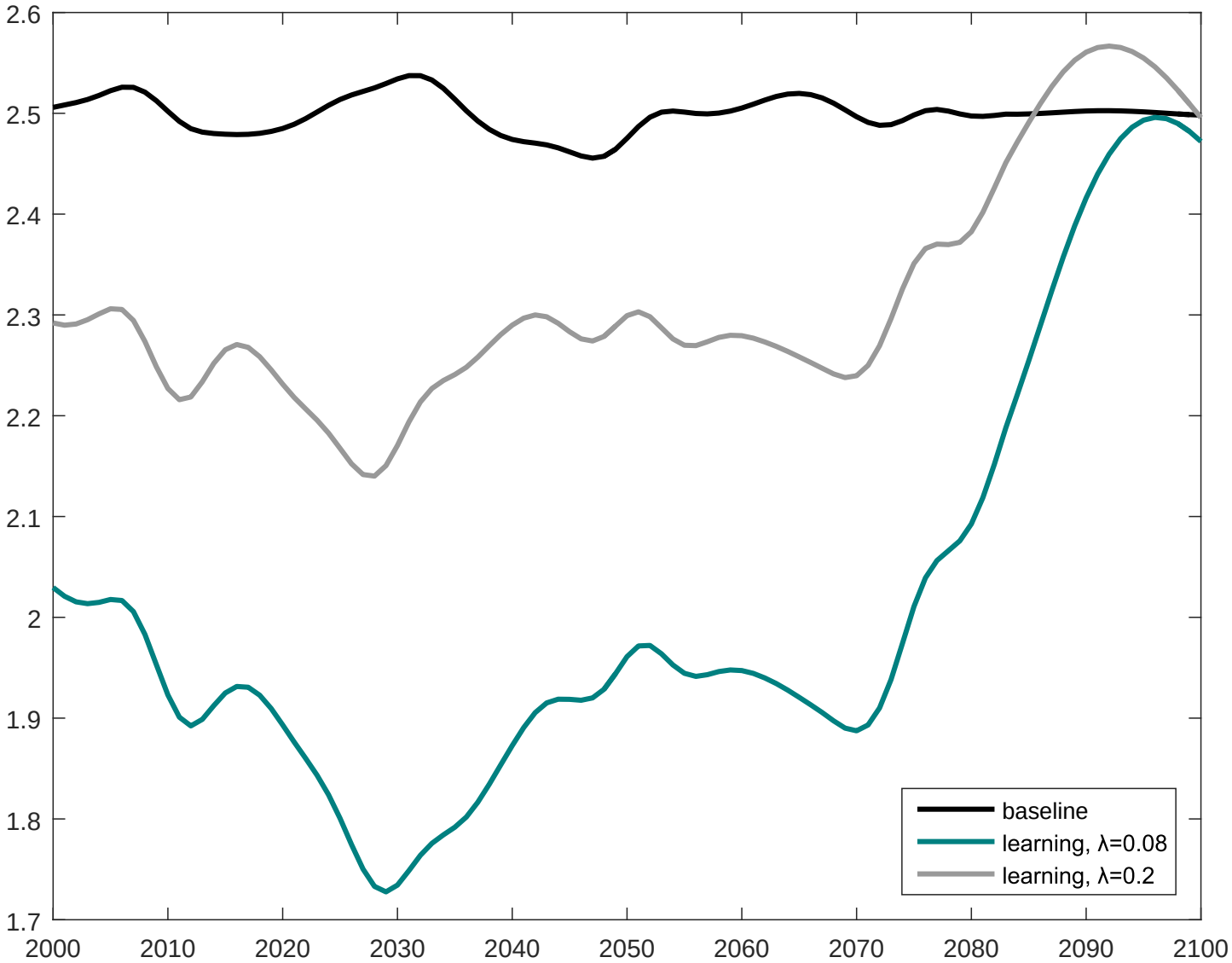
Decomposition of changes in NRI: Euro Area

Decomposition of changes in NRI: Poland

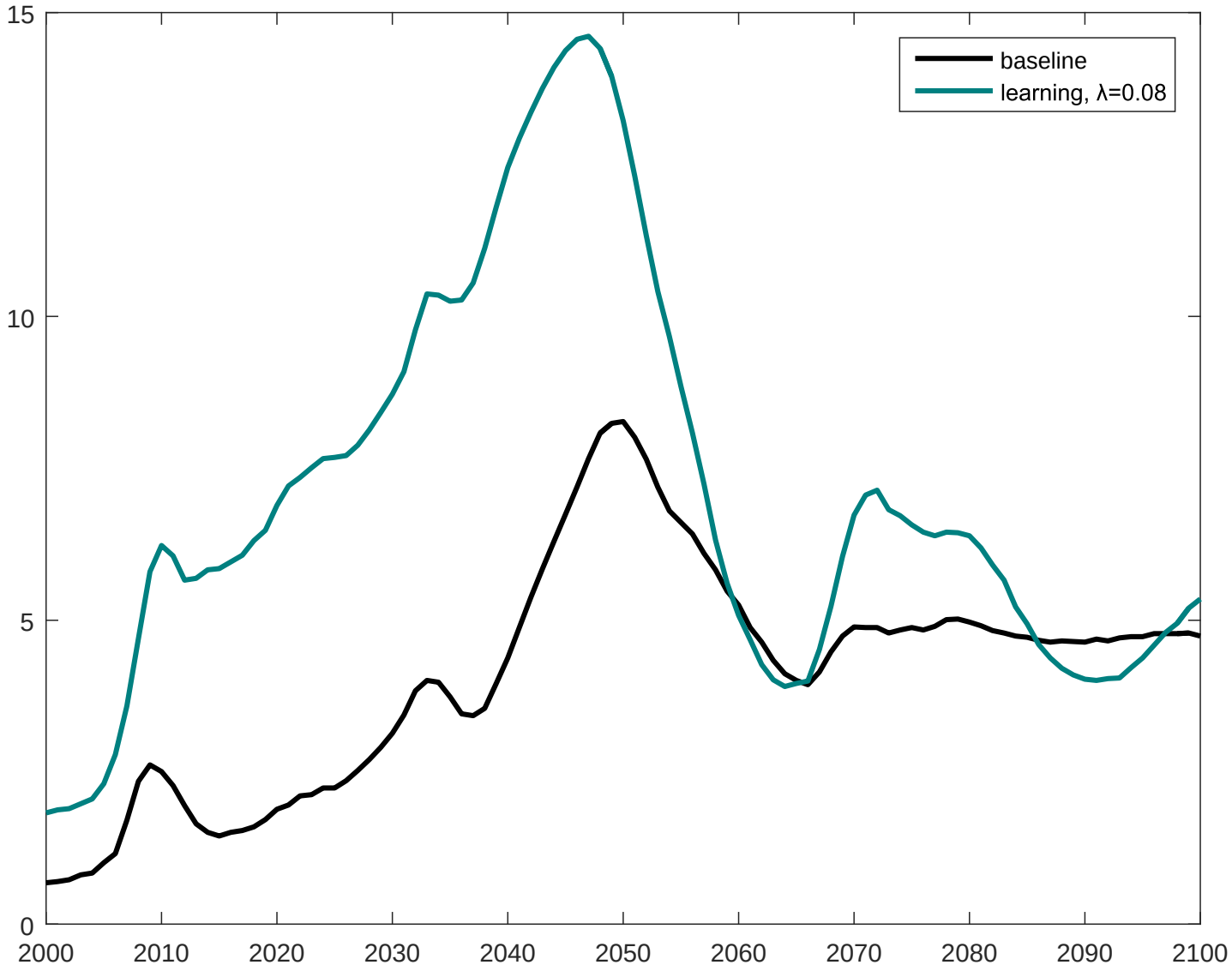
Inflation rate: Euro Area



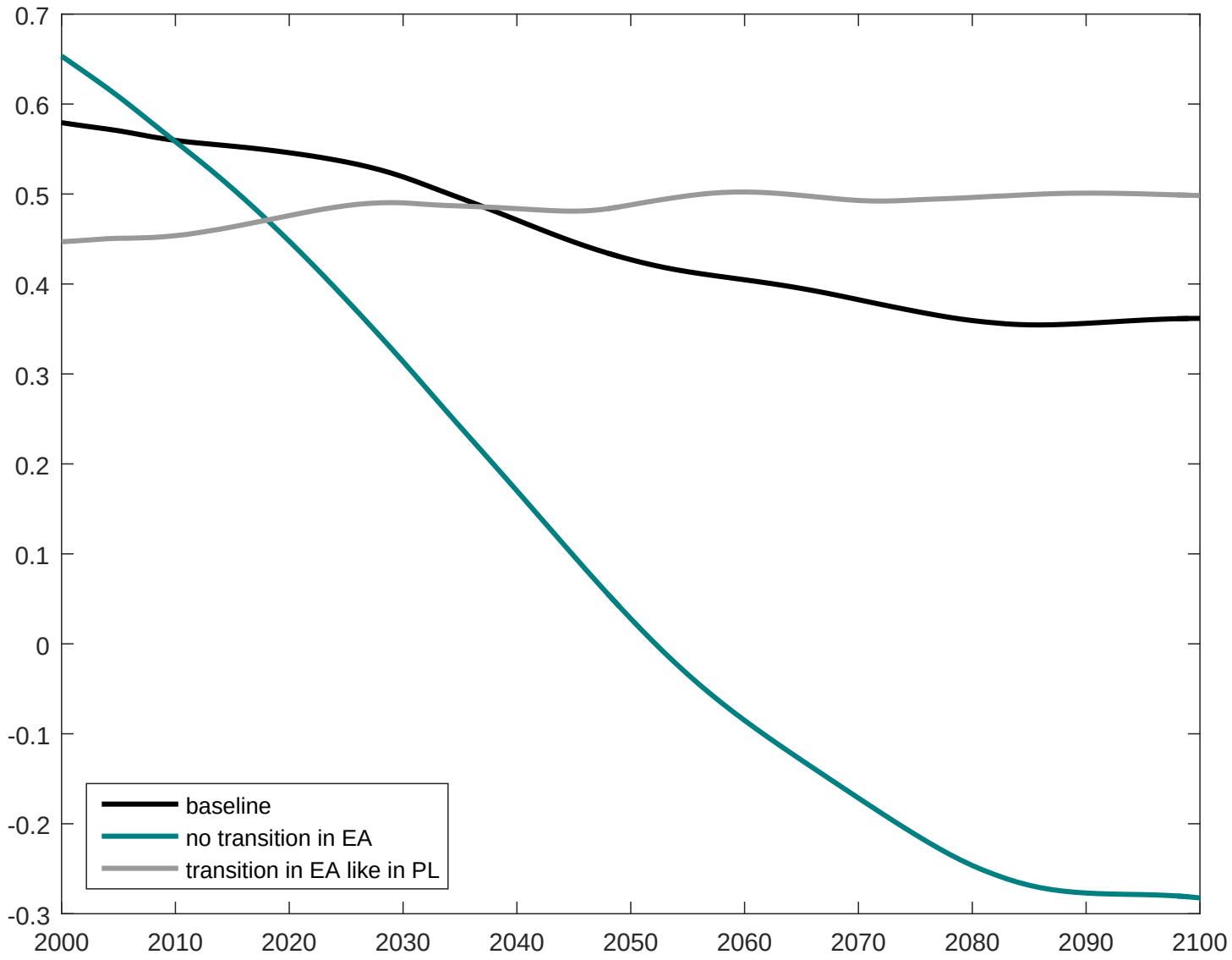
Inflation rate: Poland



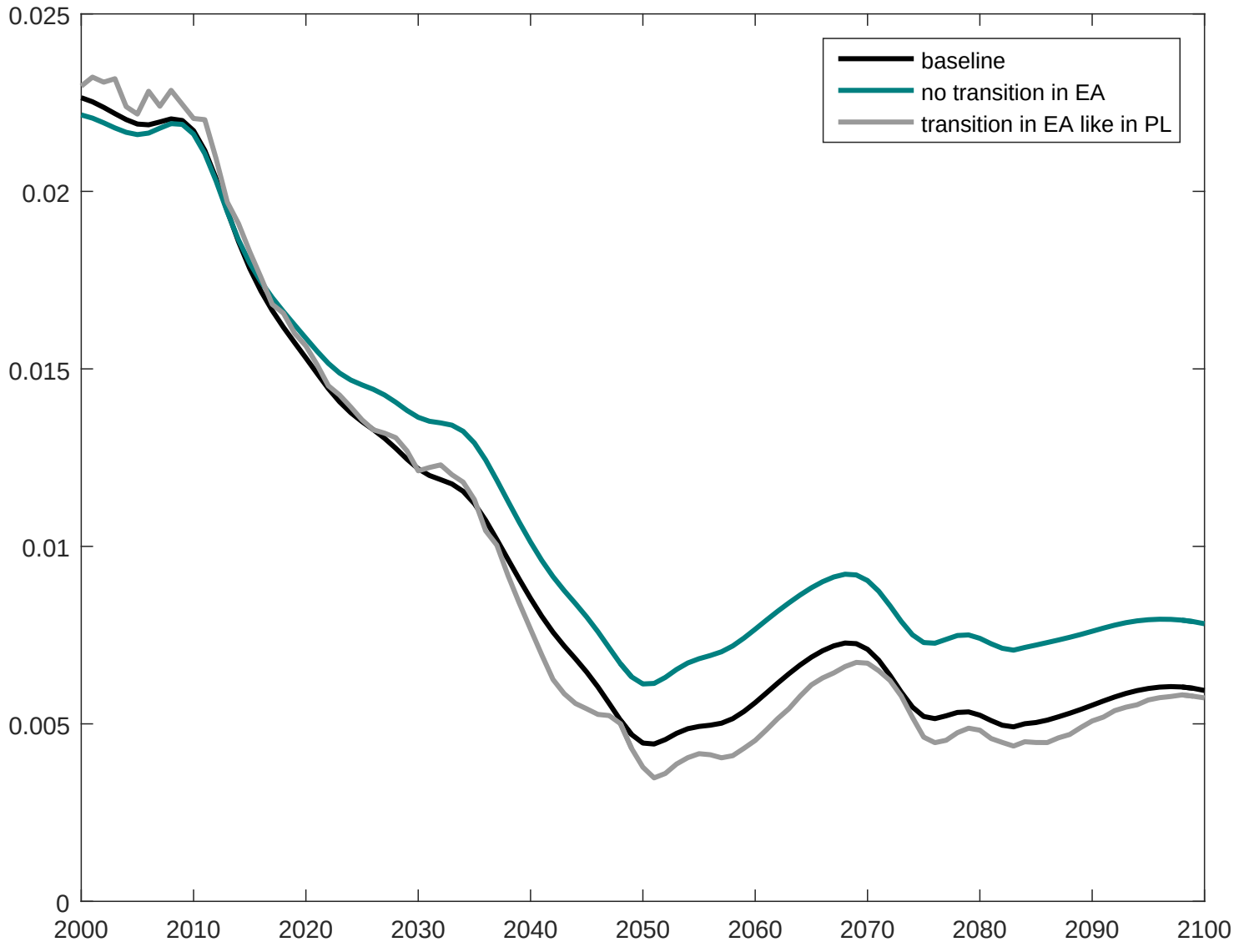
Probability of hitting ZLB: Poland



Role of foreign demography: Foreign debt to GDP ratio



Role of foreign demography: Real interest rate



Outline

Conclusions

- Impact of ageing on NRI substantial:
  - Decline by 1 p.p. in the Euro Area between 2010 and 2030
  - Decline by 1.8 p.p. in Poland between 2010 and 2050
- Despite "glacial" rate of demographic changes, important to account for fall in NRI in real time:
  - Avoid deflationary bias
  - Reduce ZLB risk
- Ageing abroad important for current account, less so for NRI in Poland