What drives r* and how to raise it:
Productivity, retirement age, and the green transition

Robert Holzmann
Governor, Oesterreichische Nationalbank

MIT, October 29, 2024

www.oenb.at

Motivation

- **Let's assume we have tamed inflation in the Euro Area, US, and similar places in a few months/years down the road**

    - Can we go back to conventional monetary policy (CMP) before 2008, when short-term policy interest rates (and reserve requirements) dominated the MP tool box?

    - Or do we have to apply again recent unconventional monetary policy (UMP) – with learnings from recent past and perhaps new unconventional instruments to address too low inflation?

    - The answer will depend on the prospects for the natural rate of interest (r^*) that has fallen in recent decades toward zero, with recent estimates signaling modest re-increase

    - Without a re-rise in the natural rate, we seem to be confined to resort to UMP in the current or revised and hopefully less distortionary format, with main challenges for central banks

    - What would be economic policies, in particular structural policies, to affect a relevant re-increase of the natural rate?

- ❖ **This lecture offers selected considerations about these options and their prospects**

The sobering experience and the prospect of UMP to remain with us ...

1. The shift from conventional und unconventional monetary policy was dictated by the binding effective lower bound in interest setting becoming relevant by the falling equilibrium interest rate r*

2. The applied new instruments of unconventional monetary policy included negative interest rates, quantitative easing, funding for lending, and forward guidance in all advanced economies with limited variation

3. The available empirical evidence suggests that the policy instruments were broadly effective to address the immediate goals of monetary policy, but the intended mechanisms were accompanied by conjectured unintended side-effects of diverse nature, including consumer and asset inflation, and zombie firms

4. There is limited research on the unintended effects of UMP, especially on income and wealth distribution and on distortions in resource allocation

5. There is essentially no empirical research on the contribution of QE and FFL, i.e. monetary expansion, to the inflation that emerged in 2021, starting in the Global North (except Borio et al. 2023, 2024)

6. The consequences of unconventional monetary policy include balance sheet issues for most central banks, with projected negative equity till the 2030s (or even 2040s), potentially undermining central bank´ independence

7. The proposed conventional monetary alternatives are limited in number and promise, and include make-up strategies, asymmetric reaction functions, and a higher inflation goal

8. An alternative policy approach would be efforts to re-increase r*, and promising approaches include its main conjecture drivers through structural reforms

The equilibrium interest rate r*, its development in recent decades (and centuries), and its conjectured main drivers

Selected structural policy interventions for discussion:

A. Total factor productivity (TFP) and its key drivers (e.g. "creative destruction" a la Schumpeter),
- promoting digitalization and artificial intelligence (AI),
- addressing climate change and harnessing the TFP potentials of energy transition

B. The combined effects from an increase in the effective retirement age due to
- an increase in effective labor supply, a reduction in the effective old-age dependency ratio, and a reduction in public deficit effects on public debt to GDP ratio

C. Via capital account openness and financial flows (especially North-South) to reduce any savings glut in the global north while financing investments in wind and sun in the global south

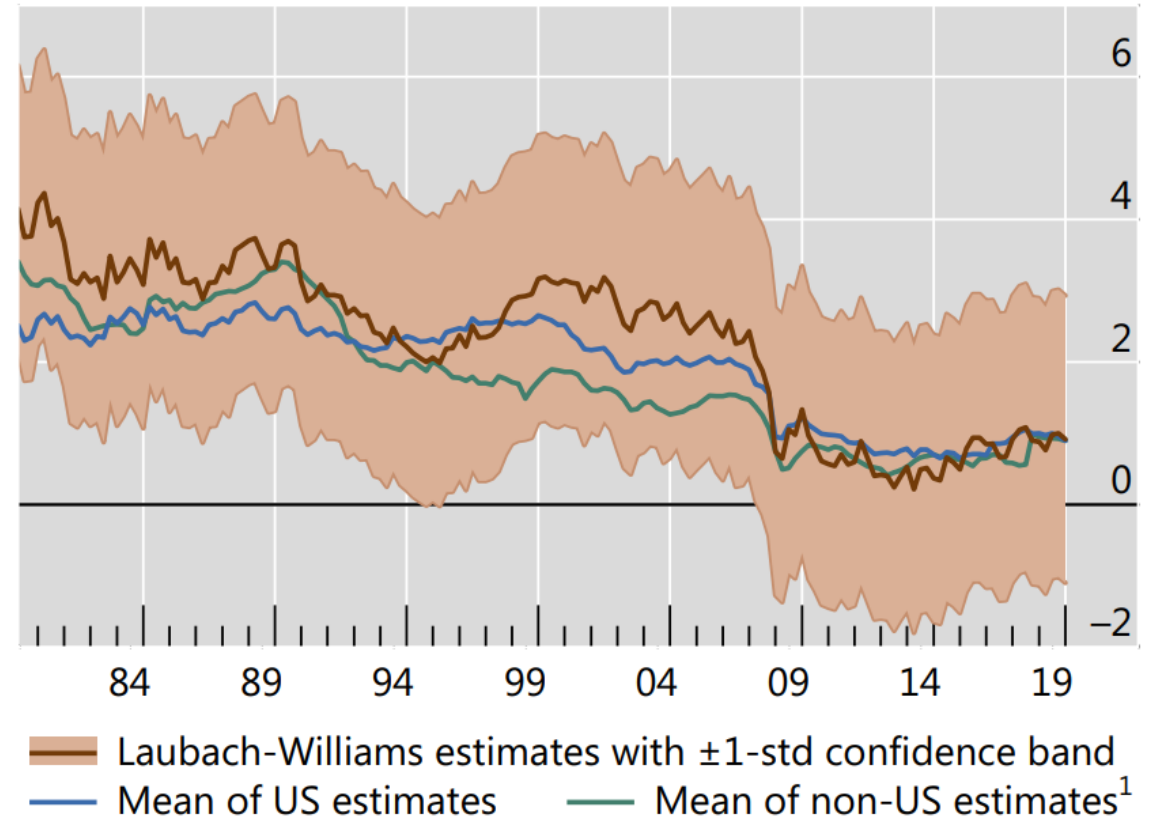# THE (MYSTIC) EQUILIBRIUM INTEREST RATE R*

a. The Equilibrium Interest Rate r*: concept and trend

The natural rate of interest—the real interest rate that neither stimulates nor contracts the economy—is important for both monetary and fiscal policy; it is a reference level to gauge the stance of monetary policy and a key determinant of the sustainability of public debt (IMF, WEO 2023, Chapter 2)

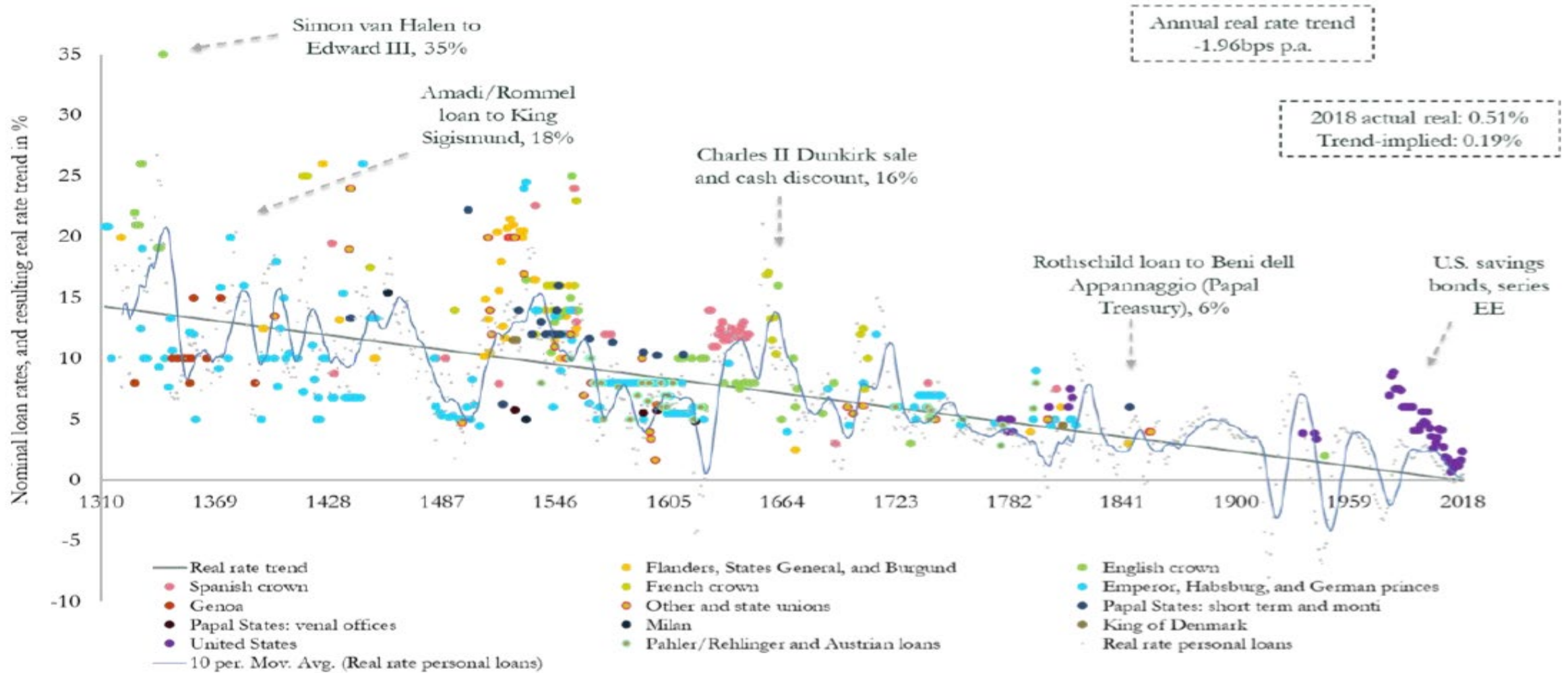**Explanations for decline in real rates** include

- Slowdown in trend productivity growth

- Shifts in demographics

- Global factors affecting real interest rate
    - Premium on safe and liquid assets
    - Lower economic growth
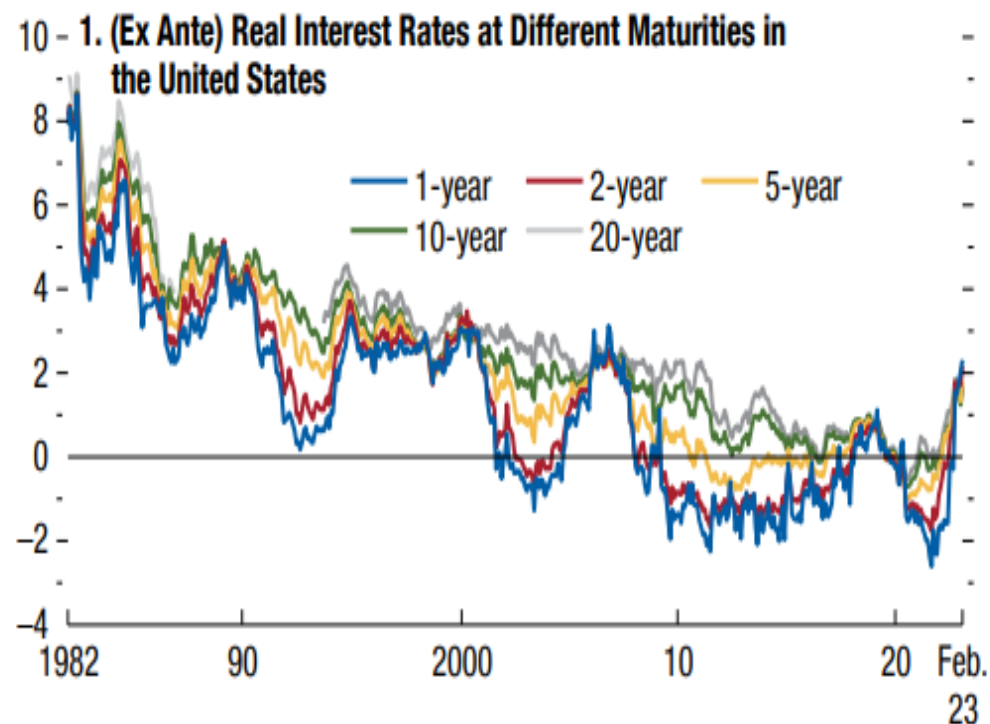
Average r* estimates over time (in percent)

Laubach-Williams estimates with ±1-std confidence band
Mean of US estimates — Mean of non-US estimates[1]

Source: Borio (2021, BIS)

Source: Bank of England.

c. Ex-Ante and Ex-Post Real Market Interest Rates: confirming the trend

1. (Ex Ante) Real Interest Rates at Different Maturities in the United States

Legend: 1-year, 2-year, 5-year, 10-year, 20-year

2. (Ex Post) Real Short-Term Interest Rates in Selected Advanced Economies

Legend: United States, Japan, Germany, United Kingdom, France

Source: WEO, April 2023, Differences between 3-month interbank rates and average of realized CPI inflation over the next 3 months for each country
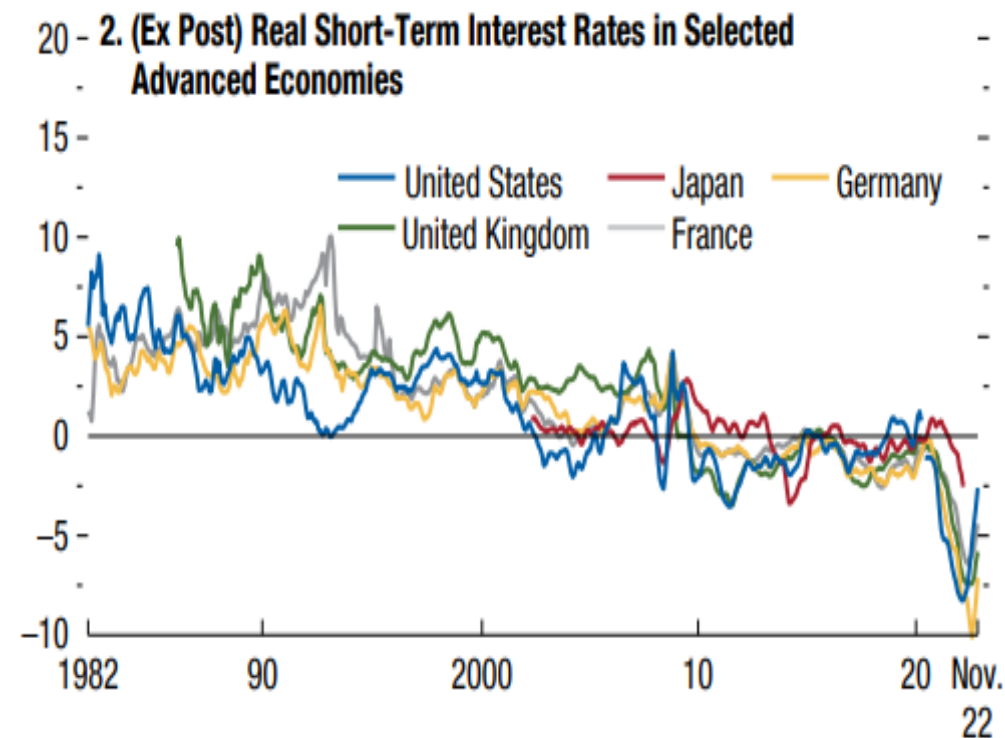
Source: WEO, April 2023, Difference between US Treasury rate at each horizon and the Cleveland Federal Reserve measure of inflation expectations over the same horizon

d. Background to proposed structural interventions:
Conjectured drivers of r* (unilateral) and their graphical relationship

⊖NB

a. Old-age dependency ratio

b. Life expectancy at birth

c. Population growth

d. Relative price of capital

e. TFP growth

f. Real GDP trend growth

g. Public debt to GDP

h. Inequality

i. Capital account openness
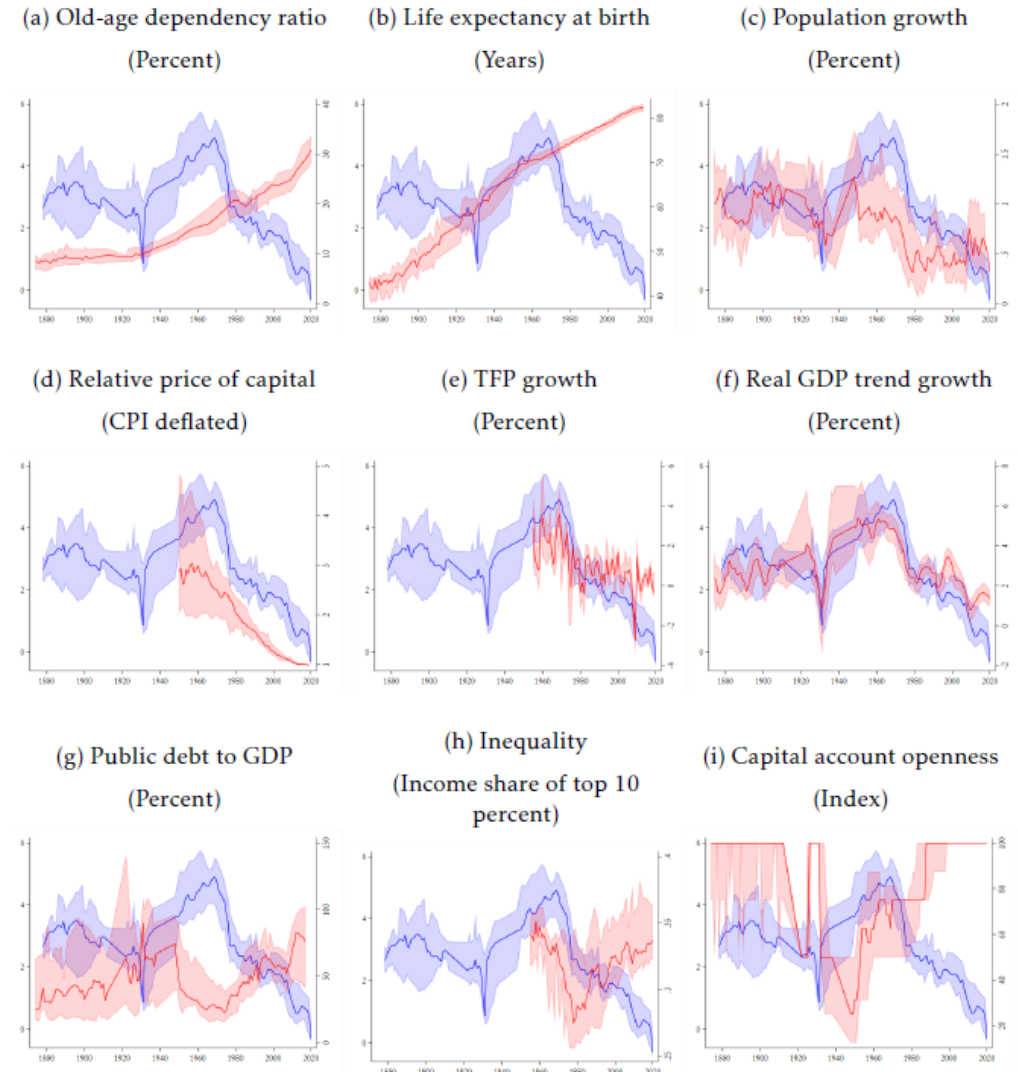
Source: Grigoli, Platzer, and Tietz (2023), IMF

- *16 advanced countries*

- *From 1878 to 2019*

- *Holston, Laubach and Williams (2017) model*

(a) Old-age dependency ratio (Percent)

(b) Life expectancy at birth (Years)

(c) Population growth (Percent)

(d) Relative price of capital (CPI deflated)

(e) TFP growth (Percent)

(f) Real GDP trend growth (Percent)

(g) Public debt to GDP (Percent)

(h) Inequality (Income share of top 10 percent)

(i) Capital account openness (Index)

e. Selected policy interventions for discussion

a. **via total factor productivity (TFP)** and its key drivers (e.g. creative destruction a la Schumpeter), e.g. by (see OeNB, 2022)
    - promoting digitalization and artificial intelligence (AI),
    - addressing climate change and harnessing the TFP potentials of energy transition

b. **via the combined effects from an increase in the effective retirement age due to**
    - an increase in effective labor supply, a reduction in the effective old-age dependency ratio, and a reduction in public deficit effects on public debt to GDP ratio

c. **via capital account openness and financial flows** (especially North-South) to reduce any savings glut in the global north while financing investments in wind and sun in the global south

INCREASING R*

VIA TOTAL FACTOR PRODUCTIVITY (TFP) AND ITS KEY DRIVERS

A1 Boosting TFP by promoting digitalization

- Positive link between digitalization and firm/industry-level productivity is well documented (Syverson, 2011, Gal et al., 2019)

- **Productivity impacts** are relatively **stronger in manufacturing, routine-intensive activities** and for already **more productive firms** and relatively weaker in the presence of skill shortages (Gal et al., 2019)

- So far digitalization **hasn't been a gamechanger or "one-size-fits-all" strategy** to improve productivity for all firms (Anderton et al. 2023)

- **Concentration of effects** and productivity slowdown despite rapid developments in IT suggest **diffusion problem**

- **Digital adoption in the EU is still low and lags behind the US** (ECB Strategic Review, 2021)

- **Complementary investments** (skills, organisation capital, intangibles) **and framework conditions** (market access, competition and efficient resource reallocation environment) are important for adoption (Andrews et al., 2018)

- **Policies for digital transformation** (OECD, 2019) should aim at fostering diffusion via upgrading **managerial and ICT skills**, enabling **innovative and financial capacity**, providing a high-speed internet **infrastructure** and promoting an **efficient reallocation of resources**

A2 Generative AI: Potentially large productivity gains

- **Computing** to train AI models **doubled every 5-6 months** since 2016 (Sevilla et al. 2022)

- AI (LLMs) could affect **50% of tasks of 50% of US workforce** (Eloundou et al. 2023)

- Case studies show **high productivity potential for cognitive tasks**

  - **Writing tasks** using ChatGPT **40% faster** with lower output inequality (Noy and Zhang, 2023)

  - **Software developers** using AI-assistant **55.8% faster** (Peng et al. 2023)

  - **Customer support agents with AI-assistant** improved **productivity by 14%** on average and 34% for novice and lower skilled (Brynjolfsson, Li and Raymond, 2023)

- **Increase in productivity level** (case studies above) **and productivity growth** via higher research productivity (Baily, Brynjolfsson and Korinek 2023)

- **Measured productivity increase** of cognitive workers **likely underestimated**

- **Adoption** may be **much faster** this time (ChatGPT gained 100 million users in 2 months)

- Many of **highest paying occupations affected** but also **productivity of lowest-skilled lifted**

A3 Applications of AI methods in central banking

- **Central banks are early adopters of AI** methods like machine learning (Araujo et al., 2024)

- **Main fields of adoption of Machine Learning methods in central banks**
  - information collection
  - macroeconomic and financial analysis to support monetary policy
  - oversight of payments systems
  - supervision and financial stability

- **Advantages of machine learning**
  - can easily process large/granular and unstructured data sets
  - can reflect complex non-linearities and outliers
  - can markedly raise staff productivity

- **Risks and issues**
  - data privacy, dependence on a few external providers of models (cyber attacks!)
  - black box, discrimination bias (gender, race) and 'hallucination problem'

ΘNB

- Higher **R&D** spending and more **innovation** could yield higher productivity growth (a.k.a. "*Porter Hypothesis*").

- But a **disorderly transition** might lead to sudden stops of carbon intensive production and produce **stranded assets**, reducing capital stock and productivity.

- The **development** and the **diffusion** of green innovations depend on the level of the carbon price. A temporary R&D subsidy can efficiently complement the carbon tax (Acemoglu et al. 2012).

- Higher energy efficiency can induce firms to employ more energy intensive processes (a.k.a. **rebound effect**). Empirically, this effect consumes 25% to 40% of the initial saving (Gillingham et al. 2016)

- To avoid "picking the winners" problems, the focus of subsidies should be on **basic research** or **infrastructure** projects (Aghion et al. 2014).

- **Knowledge spillovers** are higher for green innovations than for "dirty" innovations as can be seen in patent citations (Dechezleprêtre et al. 2014).

- An envisaged **circular economy** that reuses most of prior inputs to produce output depends effectively much on energy prices that are moving close to zero … that suggest energy generation well beyond wind and sun (e.g. new nuclear methods and material) and that has **truly Schumpeterian effects (of creative destruction, Schumpter 1942, Aghion et al 2021).**

INCREASING R*

BY INCREASING THE EFFECTIVE RETIREMENT AGE TO INCREASE EFFECTIVE LABOR SUPPLY, REDUCE THE EFFECTIVE OLD-AGE DEPENDENCY RATIO, AND REDUCE FISCAL DEFICIT AND DEBT

B Increasing the effective retirement age

Increasing the effective retirement age allows to address three main channels that have been identified by theoretical literature and empirical studies to depress interest rates and more generally r* - see inter alia Samuelson (1958), Carvalho, Ferrero and Nechio (2016), Eggertson, Mehrotra and Robbins (2019), Bielecki, Bzoza-Brzezina and Kolasa (2020), Fuhrer and Herger (2021), OeNB Occasional Paper No. 1 (2022), Grigoli, Platzer and Tietz (2023).

(1) **Demographic growth/labor supply** and, relatedly, the **old-age dependency ratio** matter for the magnitude of the interest rate to be paid (theoretically and empirically): The ratio between savers and dis-savers is altered: aging of population due to a low reproduction rate reduces labor force growth which can depress the demand for loans (as the marginal product of capital decreases) and increase loan supply (because of expected longer retirement periods). Moreover, a rising old-age dependency ratio increases the safe asset demand, putting further pressure on r*.

   - Increasing the effective retirement age can neutralize or temporarily even reverse these effects on labor supply and on the ratio between savers and dis-savers.

(2) Public pension schemes are typically fiscally expensive and most run deficits that are government financed and thus contribute to a rising public debt level (in Austria to the tune of some 2 percent p.a.).

   - Increasing the effective retirement age may allow to **eliminate the deficit** and thus **contribute to a reduction or at least stabilization of the sovereign debt level.**
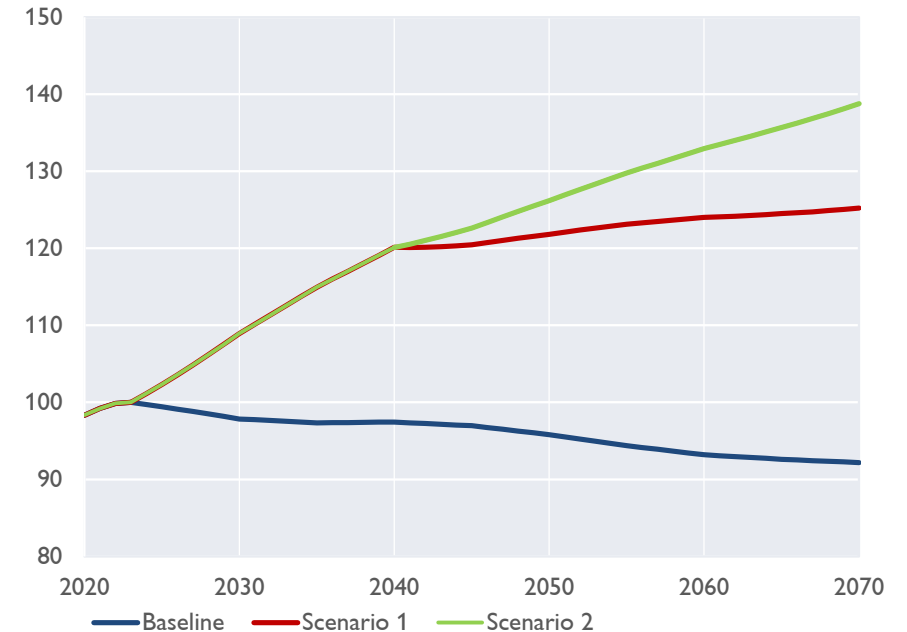
Scenario

Simulations for Austria:

- Scenario 1 : Marked increase in the the effective pension entry age from 2024 (61.0 years) to 2040 (68.4 years) so that the pension system becomes self-sustainable (net pension gap becomes zero).

- Scenario 2: Scenario 1 plus from 2040 onwards increase pension age further in line with development of life expectancy at 65.

Results:

- Labor force growth would be particularly strong in the next two decades (some 1 percent on average). This is about the same growth as in the first two decades of this century. Labor force growth would slow down from 2040 on but would remain positive.

- The effective old-age dependency ratio (retirees to contributors) would decrease markedly till 2040 and continue to decrease slowly thereafter.

- The annual deficit of the pension scheme would be gradually eliminated till 2040 and marginal thereafter.

Development of the labor force

2024=100

Baseline — Scenario 1 — Scenario 2

Source: Eurostat, OeNB.

Labor force growth under different scenarios

	Baseline	Scenario 2
2023-2030	−0,3	1,2
2031-2040	−0,0	0,9
2041-2050	−0,2	0,5
2051-2060	−0,2	0,5
2061-2070	−0,1	0,4
2023 - 2070	−0,2	0,7

Quelle: OeNB.

Aging, labor productivity growth and innovation

- Acemoglu and Restrepo (2017, 2022) show that for **OECD** countries and the period **1990-2015 productivity was positively correlated with aging as countries more exposed to aging are more likely to adopt robots**

- Among **US-states** an **increase in the share of 60+ by 2.4 pp** (1980-2010) **decreased per capita GDP by 5.5%** with **1/3 attributable to slower employment growth and 2/3 to slower labor productivity growth**. Aging reduced GDP per capita growth rate by 0.3 pp per year during 1980-2010 (Maestas, Mullen and Powell 2023).

- Evidence from a **quasi-natural experiment in Norway** (a pension reform that radically improved the incentives to stay in work after 62) suggests a positive impact on wages, no significant effect on labor productivity and a negative impact on new hirings (Hernæs, Kornstad, Markussen and Røed 2023).

- Aging **slows down the innovativeness** and in particular research at the frontier: The rate of patenting peaks at the age of 40 and as inventors age they produce less disruptive patents (Kaltenberg, Jaffe and Lachman 2023).

- An aging workforce **decreases new business formation (dampening creative destruction)** by preventing younger workers to move up and acquire necessary business experience (Liang, Wang and Lazear, 2018).

- Overall, the empirical evidence is **inconclusive** wrt to the **effects of population aging** on **labor productivity growth** but finds **mainly negative effects on innovation and reallocation.**

INCREASING R*

VIA CAPITAL FLOWS FROM THE GLOBAL NORTH TO THE GLOBAL SOUTH

Capital flows from the Global North to the Global South

Historical determinants of capital flows:

- 19th and early 20th century: **North-South** → British investment in government bodies and railroad, raw material extraction less important; also German and French

- Before global financial crisis: **East-West**

  ➢ Why does capital flow from poor to rich countries? (Lucas paradox, 1990)

  ➢ Savings glut hypothesis (Bernanke, 2005)

- After financial crisis: Some rebalancing

  ➢ Lower levels of flows and change of composition, EA important net lender
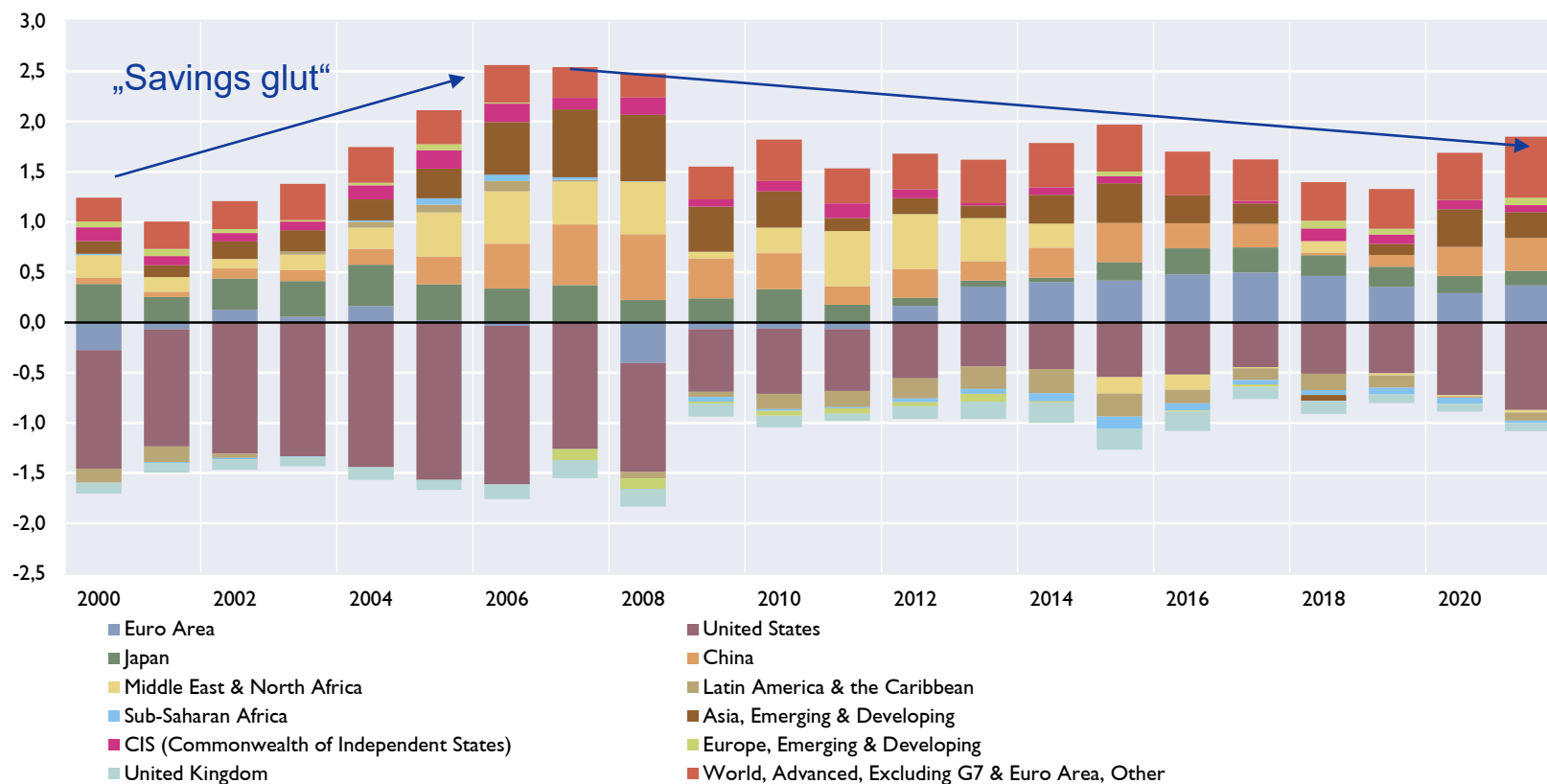
How to redirect capital flows from North to South to raise productivity?

- Investment in green energy sources, green-tech transfers (huge potential for wind and sun in South)

- USD 2 trillion p.a. climate finance needed in emerging and developing economies by 2030

- Between 80% and 90% private (IMF, 2023)

Lucas paradox (1990): why does capital flow from poor to rich countries?

World: Current account balances
in % of world GDP

Quelle: IWF.

Legend:
- Euro Area
- United States
- Japan
- China
- Middle East & North Africa
- Latin America & the Caribbean
- Sub-Saharan Africa
- Asia, Emerging & Developing
- CIS (Commonwealth of Independent States)
- Europe, Emerging & Developing
- United Kingdom
- World, Advanced, Excluding G7 & Euro Area, Other

„Savings glut"

Savings glut hypothesis (Bernanke, 2005):
Rising demand for FX reserves and safe assets (China, oil exporters)

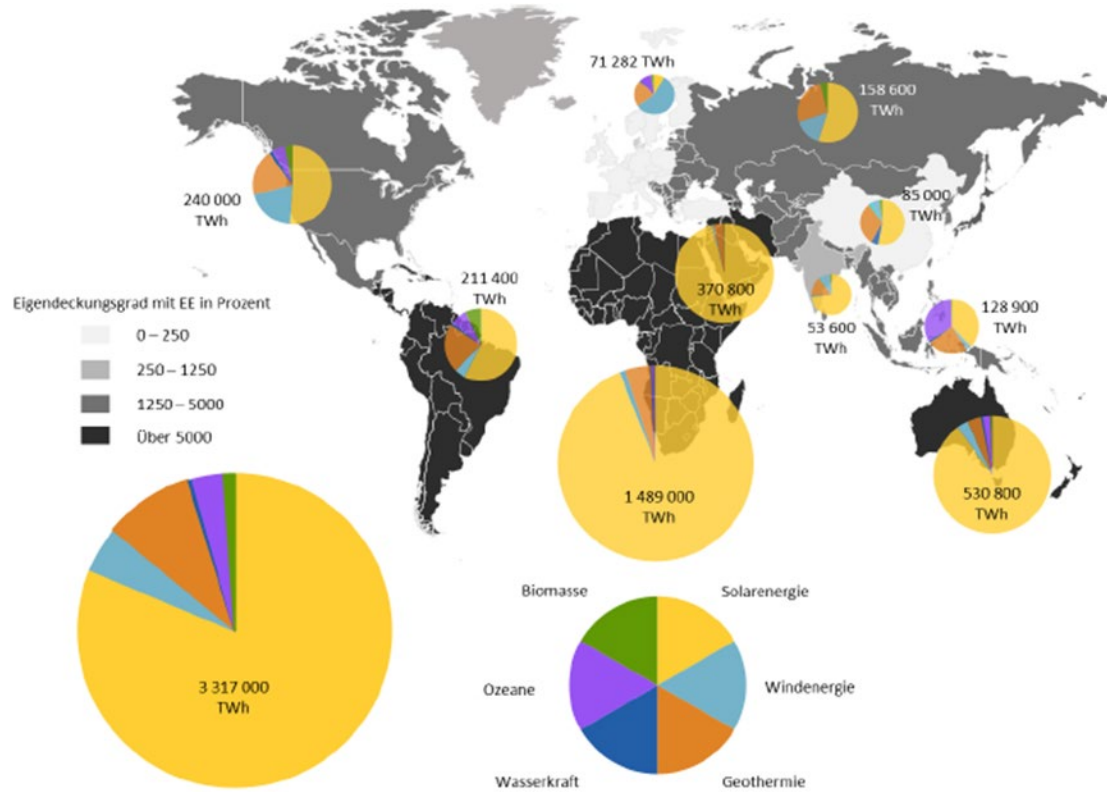**Before global financial crisis:**
UK + US absorbed most of global savings → credit boom, asset price inflation

Since global financial crisis:
Levels declined significantly, EA important net lender (with huge internal heterogeneity)

Can green-tech transfer & clean energy trade raise productivity in North & South?

Half of global clean energy potential in Africa

Eigendeckungsgrad mit EE in Prozent
- 0 – 250
- 250 – 1250
- 1250 – 5000
- Über 5000

240 000 TWh
71 282 TWh
158 600 TWh
211 400 TWh
85 000 TWh
370 800 TWh
53 600 TWh
128 900 TWh
1 489 000 TWh
530 800 TWh
3 317 000 TWh

Biomasse · Solarenergie · Windenergie · Geothermie · Wasserkraft · Ozeane

Quellen: IPCC 2011, FfE 2017, Shell 2022, Eurostat 2022

- **Cost advantage of Global South in clean energy, but:**
  - Huge financing needs (public and private)
  - Technological, legal and security constraints
  - Transformation losses of green hydrogen
- **North-South transfer of capital and technology:**
  - Improve absorption capacity (investment security)
  - Green-tec transfer via trade, FDI, licensing
  - Cover increasing energy needs (population growth) with own clean energy sources; account for fears of "green imperialism"
  - Move energy-intensive production (e.g. steel) to clean-energy-rich countries (e.g. iron pellets)
- Cheaper clean energy, less uncertainty, higher returns → **productivity rises**

Can Ricardo help to reduce emissions, create trade gains, and push TFP?

ӨNB

- A **global CO2 tax above current level** should change the comparative advantages (Ricardo) of countries and create incentives to re-allocate production to the benefits of all through

    ➤ a relevant reduction in CO2 emissions than otherwise, and

    ➤ trading gains creating real income effects (i.e. TFP) then otherwise

- The Ricardo effect of such global CO2 tax can be considered created by **three effects**, namely (Le Moigne et al, 2024)

    (i) a reduction in the scale of global production (scale effect),

    (ii) a shift in economic activity towards greener sectors (composition effect), and

    (iii) a shift in economic activity towards greener countries (green sourcing effect).

- While the scale and composition effects also operate in a closed economy, the green sourcing effect exploits a margin that is only available with international trade and thus captures the **environmental gains from trade**

- The greening effects of the measure are **large** even with a moderate global CO2 tax and grow little with a higher tax rate (next slide)

- The conjectured implicit TFP i.e. real income effects have not yet been modelled and calculated

Aggregate greening effects of carbon taxes
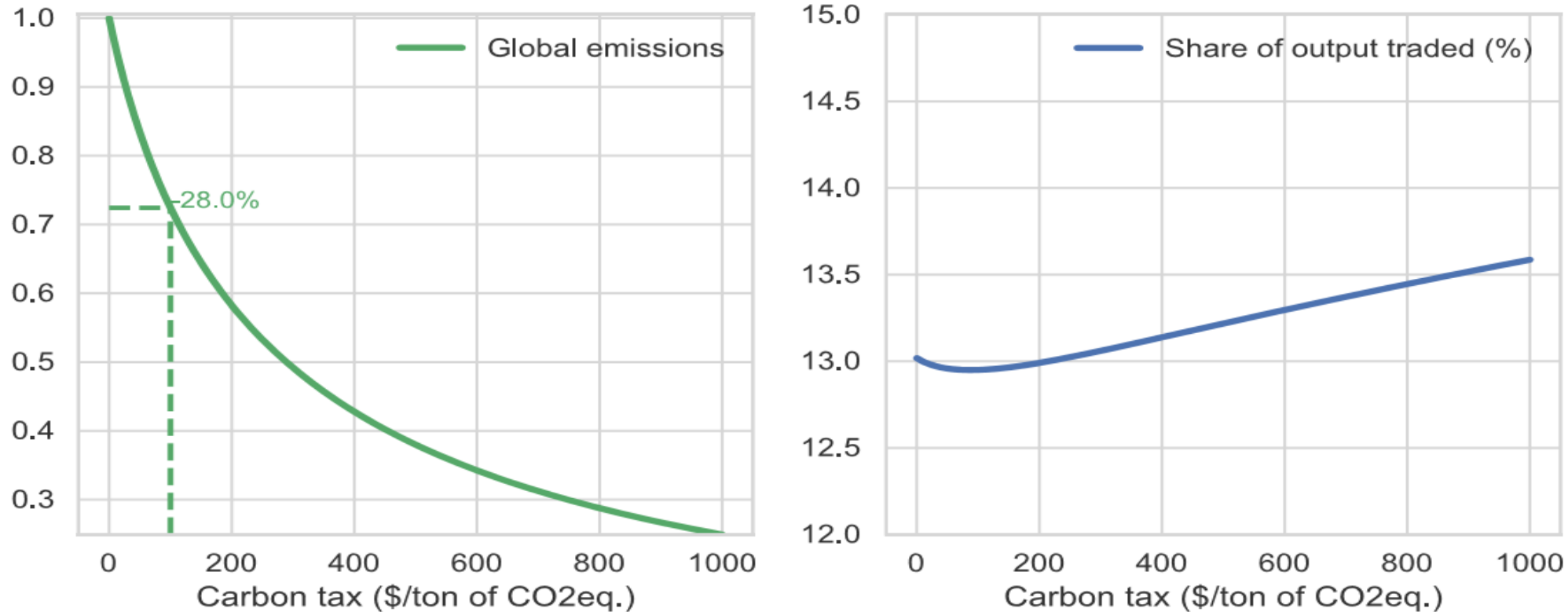
Note: The left panel shows the proportional reduction in global greenhouse gas emissions for varying levels of carbon taxes. The right panel shows world trade as a share of gross production.

Source: Le Moigne et al, 2024

References under finalization

Holzmann, R., A. Stelzer, Karen Spisso, and T. Zörner. 2024. Central Banking beyond 2021: Analyzing unconventional policies and preparing for future challenges, OeNB Occasional Papers – Policy, under finalization

Holzmann, R. 2024. Unconventional Monetary Policy under Review: Past, present and future challenges, OeNB Occasional Papers – Policy, under finalization

Holzmann, R., A. Breitenfellner, W. Pointner, A. Raggl, R. Sellner, M. Silgoner, A. Stelzer, A. Stiglbauer. 2024. How can a decline in r* be reversed? Productivity, retirement age and the green transition. OeNB Occasional Papers – Policy, under finalization

Le Moigne, M., S Lepot, R., R. Ossa, M. Ritel, D. Simon (2024), Greening Ricardo: Environmental Comparative Advantage and the Environmental Gains From Trade, unpublished manuscript, to be discussed at the 2024 IMF-World Bank annual Meeting

Danke für Ihre Aufmerksamkeit

Thank you for your attention

www.oenb.at

oenb.info@oenb.at

@nationalbank_oesterreich

@nationalbankoesterreich

Oesterreichische Nationalbank

@oenb

OeNB