Aggregate and Distributional Implications of a Military Buildup

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Motivation

- Last June, NATO members raised core defense spending target from **2%** to **3.5%** of GDP
  Chart
- In some countries, e.g. France, this occurs against the backdrop of **limited fiscal space**
- Raises questions about the **aggregate** and **distributional** implications of the buildup
  - Who is taking the hit?
  - Does this matter for aggregate outcomes?
  - Is there a tradeoff between aggregate consumption crowding out vs inequality?
- Revisit macro effects of large gov't spending shocks in neoclassical economies
  [Braun McGrattan 1993, Baxter King 1993, Ohanian 1997, Ramey Shapiro 1998, Burnside et al. 2004 . . .]

Framework

- Quantitative **OLG-HA** model ⇒ **bottom-up** approach
  - Choices of activity, consumption, portfolio over the life cycle
  - Individual productivity affected by **skill group** + **age** + **luck**
  - Neoclassical production; perfect competition; flexible prices
- Match micro and macro moments; simulate gradual, permanent buildup $\approx +1.3\%$ of $\frac{G}{Y}$ (calibration for France but mostly based on international datasets)
- Financed via changes in
  - Pension system: ↑ legal retirement age, ↓ benefits
  - tax system: ↑ tax on labour (level vs progressivity), capital, consumption
  - Consider each instrument in isolation, then (more realistic) mixed reforms

Households

Survivor of group ω, age j, status $o\_$ and portfolio (b,k) draws z

HH draws labour taste shocks χs and choses $o \in \{E, I\}$

HH gets income and chooses consumption c and portfolio (b', k')

Stage 2:

$$V_t(s) = \max_{o \in \{I,E\}} \left\{ W_t(\bullet, I) + \chi_t(I)\,,\; W_t(\bullet, E) - \kappa_{j,t} + \chi_t(E) \right\}$$

Stage 3:

$$W_t(\bullet, o) = \max_{c,b',k' \geq 0} \left\{ u_t(c, b', k') + \beta \psi_{j+1} \mathbb{E}_{z'} V_{t+1}(s') \right\}, \quad \text{s.t.}$$

$$(1+\tau_t^C)c + b' + k' = \underbrace{(1 + r_{b,t})(b + \xi_t^b(s))}_{\text{gov't bonds}} + \underbrace{(1 + r_{k,t})(k + \xi_t^k(s))}_{\text{capital claims}} + \underbrace{\mathbb{I}_E (1 - \tau_t^N)(h_j w_t e_j \omega z)^\zeta}_{\text{labour earnings}} + \underbrace{\mathbb{I}_I \mathsf{tr}_t(s)}_{\text{transfers}}$$

Flow utility:

$$u_t(c, b', k') = \frac{\left(c + \frac{\alpha b'}{1+\tau_t^C}\right)^{1-\sigma}}{1-\sigma} + \nu_a(1-\psi_{j+1})\Gamma_t^{\varphi-\sigma}\frac{\left(\underline{a}\Gamma_t + \frac{k'+(1-\alpha)b'}{1+\tau_t^C}\right)^{1-\varphi}}{1-\varphi}$$

- Bequest motive ($\nu_a > 0, \varphi < \sigma$) $\Rightarrow$ non-homothetic preferences a la Straub (2019)
- Liquidity motive ($\alpha > 0$) $\Rightarrow$ conv. yield a la Krishamurthy Vissing-Jorgensen (2012)
- Rescaled by $1 + \tau_t^C$ to reflect valuation of actual (post-tax) consumption

Firms

- Let H_t be total hours, N_t effective hours, and $\mathcal{E}_t = \frac{N_t}{H_t}$ labour efficiency (**endogenous**)

- **Prod. function:**

$$Y_t = ZK_{t-1}^{\theta}(\Gamma_t N_t)^{1-\theta} = K_{t-1}^{\theta}(\Gamma_t \mathcal{E}_t H_t)^{1-\theta}$$

and

$$K_t = (1-\delta)K_{t-1} + I_t$$

- **Factor demands:**

$$\theta \frac{Y_t}{K_{t-1}} = (1+\tau^K) r_{k,t} + \delta, \qquad (1-\theta)\frac{Y_t}{N_t} = w_t$$

where τ^K = corporate tax Details

Government

- Pays out guaranteed income ($\phi^I w_t$) and pensions ($\phi_t^R(\omega) w_t$)
- Implements constant debt-to-GDP ratio $\frac{B_{t-1}}{Y_t} = s_b$ and exogenous spending path $\{\frac{G_t}{Y_t}\}_{t=0}^{\infty}$
- Satisfies gov't BC:

$$G_t + \mathsf{Tr}_t + (1 + r_{b,t}) B_{t-1} = \tau_t^C \int c_{j,t} dj + \tau^K r_{k,t} K_{t-1} + \mathcal{T}_t^N + B_t$$

  where $\mathcal{T}_t^N$ is revenue from labour taxation

- After a shock, social-security ($J^R, \phi_t^R(\omega)$) or tax instruments ($\tau_t^C, \tau_t^K, \tau_t^N, \zeta$) must give

Calibration I

Demography			
n	Pop. growth rate	0.5%	UN 2024 World Pop. Prospects
μ_j, ψ_j	Pop. shares, surivival rates		UN 2024 World Pop. Prospects
Preferences			
β	Time discount factor	0.99	Wealth/GDP $\hat{A}/\hat{Y} = 4.2$
σ	CRRA	2	Standard
η	bequests curvature	1.45	Distrib. of bequests (Allegre, 2007)
ν^a	Bequests scaling factor	3.1	Bequests-GDP ratio $\hat{\Xi}/\hat{Y} = 9\%$
α	Liquidity preference	0.03	Real interest rate $r_b = 1\%$, Eurostat
Labor market			
e_j	Trend age-productivity Details		Hourly wages by age, Eurostat
h_j	Hours worked by age Details		Hours by age group, Eurostat
ρ^P	Inter-generational persistence	0.6	Lefranc (2018)
Γ^P	- standard deviation	0.57	Imputed from GRID
ρ^T	Idiosyncratic persistence	0.88	Imputed from GRID
Γ^T	- standard deviation	0.37	Imputed from GRID
p_j^{emp}	Job-finding probabilities		Unemploym. rate by age, Eurostat
κ_j	Participation costs Details		Participation rate by age, Eurostat

Calibration II

Production			
$1-\theta$	Labor share	62%	FRED
γ	Labor productivity growth	0.9%	2004-2019 trend (LTP database)
K/Y	capital-output ratio	310%	Eurostat
δ	Depreciation rate	4.1%	$MPK - \delta = 8\%$
Government : fiscal policy			
G	Public consumption	24.1%	Eurostat
$\tau^{N,prog}$	Labor income tax (progressivity)	13.8%	Malmberg (2025)
τ^{N}	Labor income tax (level)	33.8%	Tax rev./GDP $= 22,7\%$, EC
τ^{K}	Capital tax Details	74.2%	Tax rev./GDP $= 10,4\%$, EC
τ^{C}	Consumption tax	18.4%	Tax rev./GDP $= 10,8\%$, EC
b	Debt-GDP ratio	110%	EC
Government : social transfers			
ϕ^{I}	guaranteed min. income	20.2%	French RSA
$\phi^{R}(\omega_1)$	lowest pension	21%	ASPA/average wage
$\phi^{R}(\omega_3)$	highest pension	47.5%	Pensions/GDP $= 14,0\%$, Eurostat

Labour supply moments

- Calibrate preference (shocks) to match **labour participation elasticity=** 1.08 among workers aged 25-61 (Erosa et al. 2017), then check relative elasticities across groups

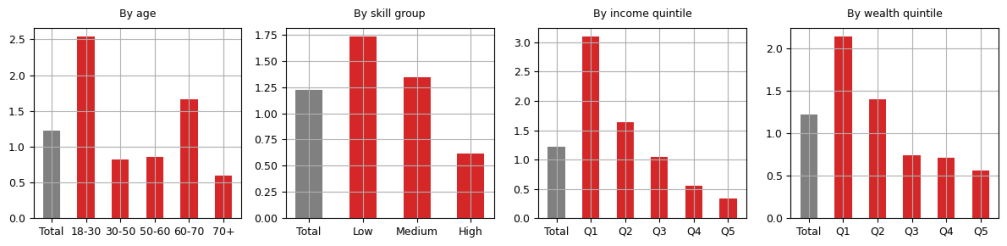


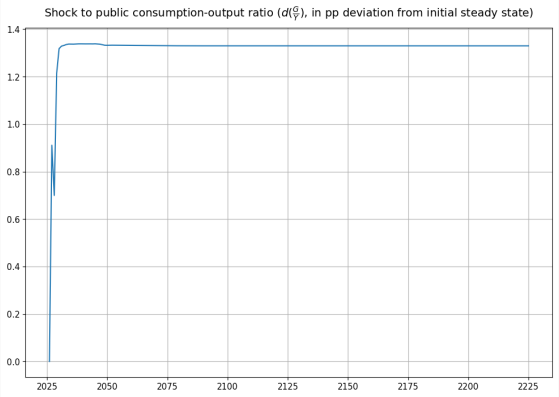
Figure: Labour participation elasticities with respect to pre-tax wages

Notes: *lpe*s are computed as the average response of active population in period 0 to an unexpected, fully transitory, increase in (pre-tax) wages of 1%, holding transfers fixed.

- Check implied **marginal propensities to earn** (MPEs) out of windfall transfer Details

1 instrument: Legal retirement age +2y

- Current legal age in France = **63**
- Will likely rise to **64**, possibly **65** (still $<$ EU average)
- Consider first a +2y scenario, holding all other instruments unchanged
- **How much more can the gov't spend?**



$\Rightarrow$ benchmark path of G_t/Y_t

1 instrument: Legal retirement age +2y

		2035	2040	2050	2100
Ret. age, 2y	Ouput	1.9	2.0	2.1	2.2
	Capital	0.3	0.7	1.2	1.6
	Active pop.	3.0	2.9	2.7	2.6
	TFP	0.3	0.3	0.3	0.4
	Private consumption	-0.4	-0.3	-0.1	0.1

% deviation from initial steady state

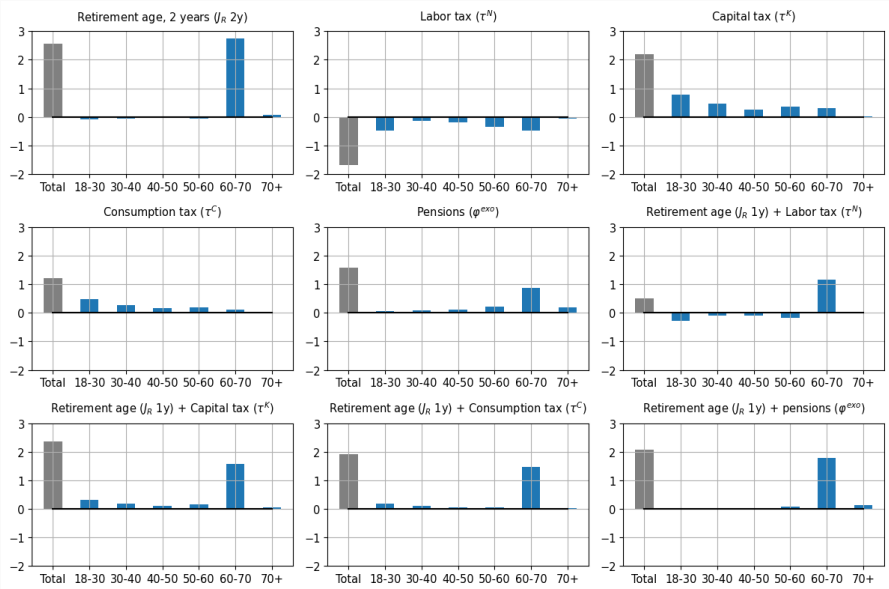


Figure: "Total" is the aggregate impact on **labour-force participation**, in % dev. from the initial steady state. The other bars are the contributions of the subgroups of the population to the aggregate

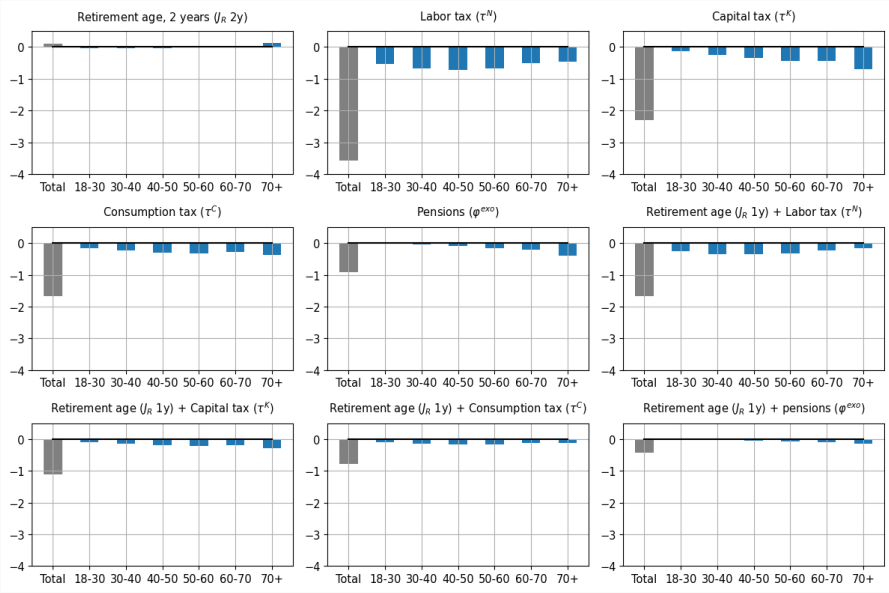


Figure: "Total" is the aggregate impact on **consumption**, in % dev. from the initial steady state. The other bars are the contributions of the subgroups of the population to the aggregate impact.

1 INSTRUMENT: LABOUR INCOME TAX LEVEL (τ_t^N)

		2035	2040	2050	2100
Ret. age, 2y	Ouput	1.9	2.0	2.1	2.2
	Capital	0.3	0.7	1.2	1.6
	Active pop.	3.0	2.9	2.7	2.6
	TFP	0.3	0.3	0.3	0.4
	Private consumption	-0.4	-0.3	-0.1	0.1
Labor tax (τ_t^N)	Ouput	-1.3	-1.5	-1.9	-2.1
	Capital	-1.6	-2.6	-3.8	-4.7
	Active pop.	-2.6	-2.3	-2.1	-1.7
	TFP	0.8	0.8	0.7	0.6
	Private consumption	-2.4	-2.7	-3.2	-3.6

% deviation from initial steady state

1 instrument: labour income tax level (τ_t^N)

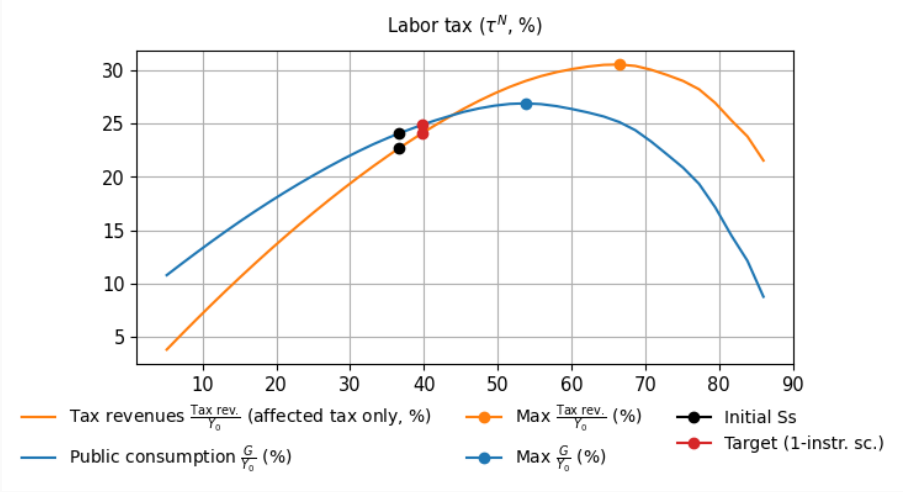


Figure: Labour tax revenues and public consumption *(% of final initial steady state output)*.

One instrument: labour income tax

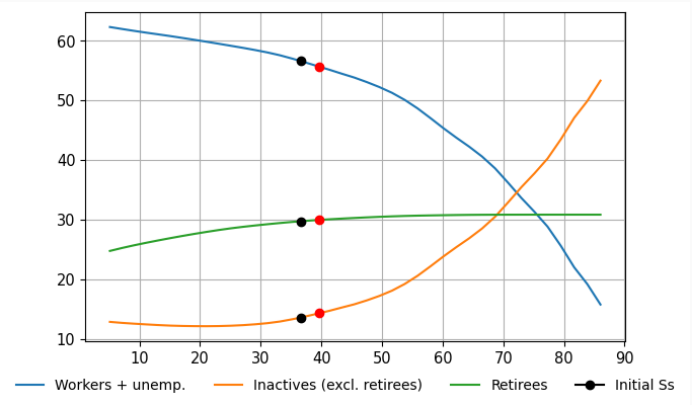


Figure: Labor market status *(% of model population (18+ y.o))*.

Labour-force participation by age group Labour-force participation by productivity group

One instrument: Corporate tax, Consumption tax

		2035	2040	2050	2100
Corporate tax (τ^K)	Ouput	-0.5	-0.7	-1.0	-1.3
	Capital	-2.2	-3.2	-4.4	-5.4
	Active pop.	0.9	1.3	1.8	2.2
	TFP	-0.2	-0.3	-0.4	-0.5
	Private consumption	-1.0	-1.4	-1.9	-2.3
Cons. tax (τ^C)	Ouput	0.4	0.4	0.4	0.4
	Capital	-0.0	-0.0	-0.1	-0.1
	Active pop.	1.1	1.1	1.2	1.2
	TFP	-0.2	-0.2	-0.2	-0.3
	Private consumption	-1.7	-1.7	-1.7	-1.7

% deviation from initial steady state

One instrument: Corporate tax, Consumption tax

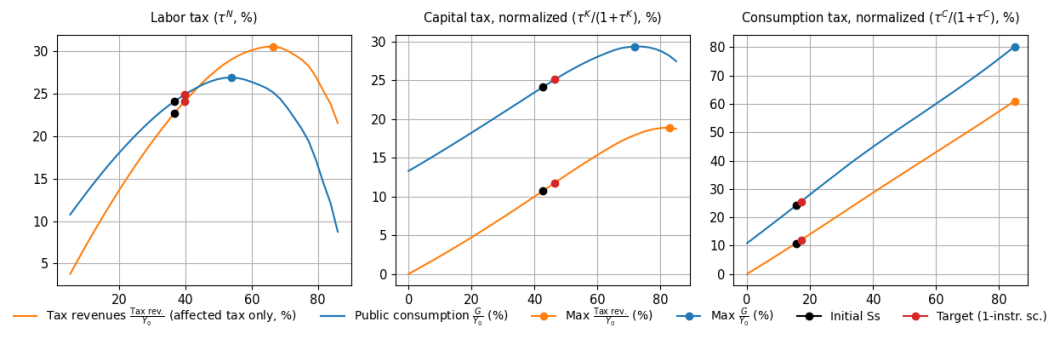


Figure: Laffer curves *(% of initial steady state output)*.

Labour-force participation by age group

Labour-force participation by productivity group

2 instruments: +1y and a tax

		2035	2040	2050	2100
Ret. age, 1y + Labor tax (τ^N)	Ouput	0.3	0.2	0.2	0.1
	Capital	-0.9	-1.1	-1.3	-1.5
	Active pop.	0.3	0.4	0.4	0.5
	TFP	0.5	0.5	0.5	0.5
	Private consumption	-1.5	-1.5	-1.6	-1.7
Ret. age, 1y + corporate tax (τ^K)	Ouput	0.7	0.6	0.5	0.5
	Capital	-1.1	-1.3	-1.7	-2.0
	Active pop.	2.0	2.1	2.2	2.4
	TFP	0.0	0.0	-0.0	-0.0
	Private consumption	-0.8	-0.9	-1.0	-1.1
Ret. age, 1y + cons. tax (τ^C)	Ouput	1.1	1.2	1.3	1.3
	Capital	0.1	0.3	0.5	0.7
	Active pop.	2.1	2.1	2.0	1.9
	TFP	0.0	0.0	0.0	0.1
	Private consumption	-1.1	-1.0	-0.9	-0.8

% deviation from initial steady state

Aggregate crowding out vs inequality

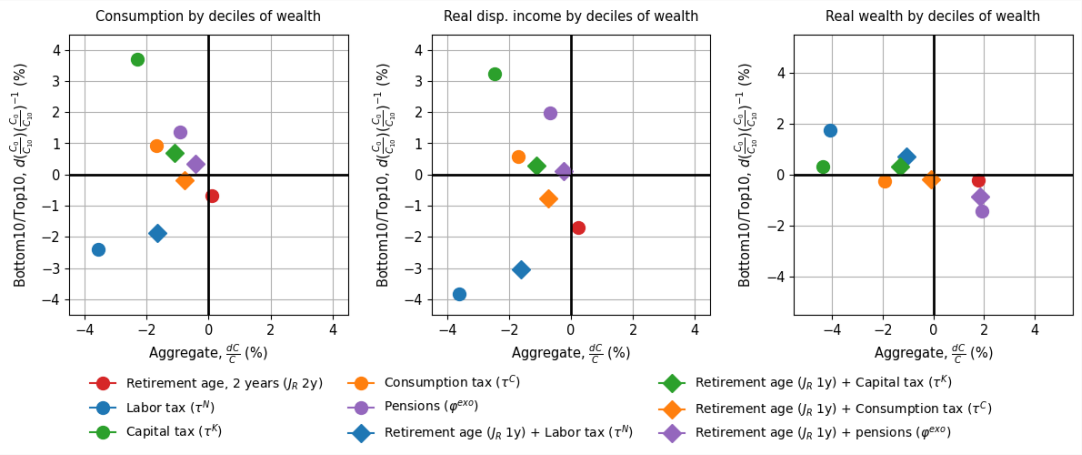


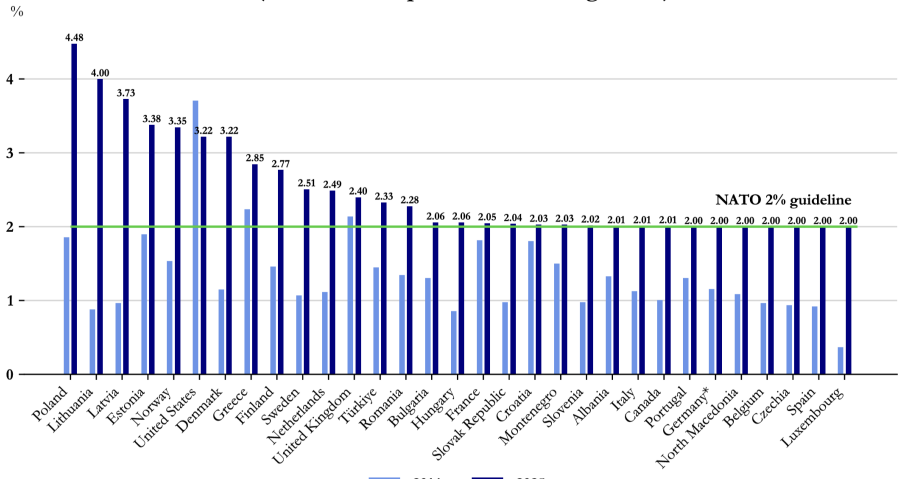
Figure: Long run impact of military buildup on different variables (aggregate and distribution) under various financing scenarios *(aggregate impact in % deviation from initial steady state)*

Summary

- Rich quantitative OLG-HA model
- Simulate military buildup $\approx$ recent NATO commitment; evaluate micro-macro impact
- Raising legal retirement age from **63 to 65** almost fully covers the financing need
  ($\uparrow$ labour-force participation $\Rightarrow$ no consumption crowding out)
- Raising it to **64** and covering the shortfall with pension cuts or capital tax brings the best aggregate/inequality balance
- Raising labour income tax (even jointly with pension reform) is highly detrimental to aggregate consumption **and** consumption inequality

Appendix

Graph 4: Defence expenditure as a share of GDP (%) (based on 2021 prices and exchange rates)



Notes: Data as at 3 June 2025, based on 2021 prices and exchange rates. Figures for 2025 are estimates.
* Germany has made a political commitment to spend at least 2% of GDP on defence, but will only be able to provide figures when the national budget for 2025 has been approved by the German parliament.

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Capital taxation wedge

- Corporate + capital income taxes create wedge btw $MPK - \delta$ and post-tax return to HHs
- Both are proportional, hence equivalent; we assign the full wedge to the corporate tax and calibrate it using EC data on total revenue from capital taxation ($= 10,4\%$ of GDP):

$$MPK - \delta = \left(1 + \tau^K\right) r_k \quad \Rightarrow \tau^K = 74.2\%$$

- If we assigned the wedge to a capital income tax η instead, we'd have

$$r_k^{net} = (1-\eta) r_k = (1-\eta)\left(MPK - \delta\right)$$

- The corresponding fractions of $PMK - \delta$ accruing to the gov't are

$$\frac{r_{k,t}}{MPK - \delta} = \frac{1}{1+\tau^K} \qquad \text{versus} \qquad \frac{r_{k,t}^{net}}{MPK - \delta} = 1 - \eta$$

- Rev. from corporate tax $\tau^K = 74.2\% \Leftrightarrow$ rev. from K income tax $\eta = \frac{\tau^K}{1+\tau^K} = 42.6\%$

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Marginal propensities to earn (MPEs)

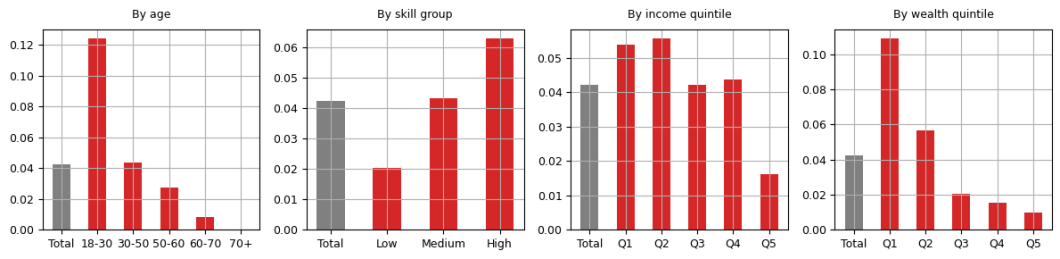

Figure: Marginal propensity to earn out of a one-time transfer.

Notes: The marginal propensity to earn is computed as the period 0 average earnings response to an unexpected, fully transitory, lump-sum transfer of about 165 000€.

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Productivity by age

- Calibrate trend age-productivity to match pre-shock average hourly wages by age group
- Fitted quadratic trend $e_j = 0.8 + 0.004 \times j - 0.0004 \times j^2$

Table: Average hourly wages by age.

	Hourly wages (less than 30 y.o = 100)	
Age Group	Data	Model
18-29	100.0	100.0
30-49	140.7	133.1
50+	160.3	166.0

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Hours worked by age

- Calibrate trend hours by age to match pre-shock average hourly hours by age group
- Fitted quadratic trend $v_j^n = 1.2 - 0.03 \times j + 0.0006 \times j^2$, where $v_j^n = h_j^{-1}$

Table: Hours worked in model and data.

	Hours worked (percentage of average)	
Age Group	Data	Model
18-24	88.1	88.1
25-64	101.9	102.0
65-69	73.8	73.8

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Labour-force participation by age

- Calibrate participation cost to match pre-shock participation rates by age and education groups
- Fitted quadratic trends, low-skills: $\kappa_{low,j} = 0.3 + 0.05 \times j - 0.0008 \times j^2$; medium-skills: $\kappa_{mid,j} = 2.0 - 0.07 \times j + 0.0009 \times j^2$; high-skills: $\kappa_{high,j} = 1.7 - 0.07 \times j + 0.0009 \times j^2$

	LFP (%)	
Age Group	Data	Model
18-24	67.2	65.0
25-59	87.2	84.2
60-64	41.6	50.4
65-74	7.3	3.6
75+	0.8	0.3

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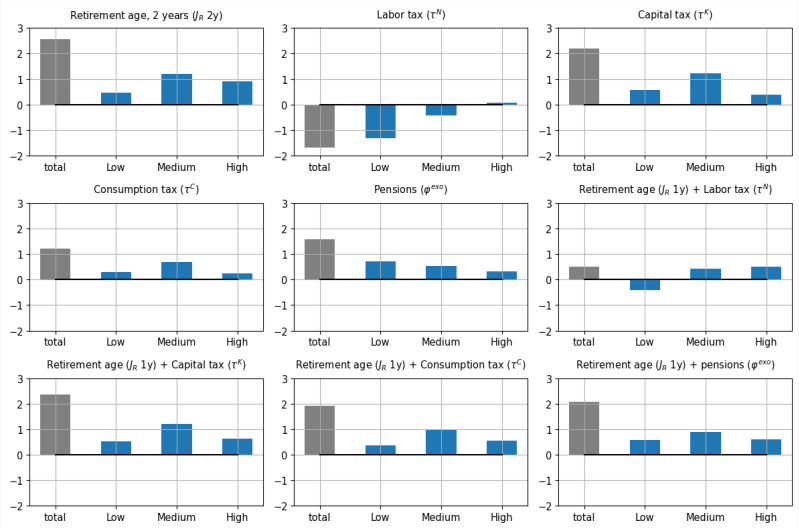
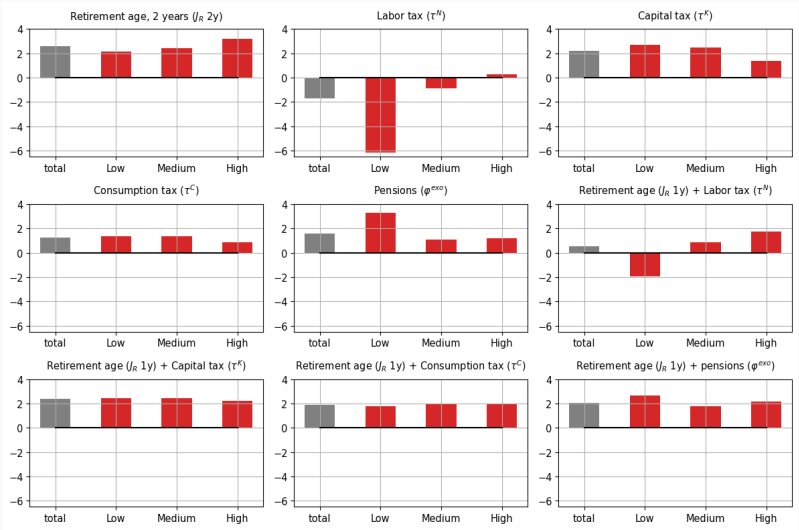
Labour-force adjustments by productivity group



Back to full labour income tax
Back to full corporate or cons. tax
Back to partial labour income tax
Back to partial corporate or cons. tax

Labour-force adjustments by productivity group



Back to full labour income tax
Back to full corporate or cons. tax
Back to partial labour income tax
Back to partial corporate or cons. tax

Level vs. progressive taxation