

Beyond GDP: modelling labour supply as a 'free time' trade-off in a multiregional Ramsey model

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Overview

- An extension of the Ramsey model
 - Motivation and literature
 - The model's analytics
- Prospective labour supply data
 - Demographics
 - Labour-force participation rate (LFPR)
 - Average annual working hours (AWH)
- An implementation in the WITCH model
 - 2 contrasted global prospective scenarios of free-time preference convergence



An extension of the Ramsey model

Context & literature/1

- **Welfare is not only GDP**
 - Sen seminal contribution on income distribution (1966)
 - Recent echo in policy circles—stirred by the economic crisis? Stiglitz, Sen, Fitoussi report (2009)
- **Time is not only labour endowment**
 - Time off the labour market has intrinsic value
 - It is quite diversely employed
 - Unpaid work at home (Becker, 1964) or not (associations)
 - Leisure (Nordhaus and Tobin, 1973)
 - Self care
 - Eating and sleeping time

Context & literature/2

- **Empirical Work**

- Focus on divergence in working hours in European countries and the United States
- Prescott (2004) attributes it to labour tax differentials
- Alesina *et al.* (2006) point to the consequences of unionisation of European labour forces
- Blanchard (2004) underlines contrasted uses of productivity gains

- **Modelling Work**

- De Hek (1998, 1999), Ladròn-De-Guevara *et al.* (1999) develop endogenous growth models with 2-factor welfare

Motivation

- Optimal growth models assume the social planner objective is **function of consumption only**
- We challenge this assumption and extend the objective function to **time off the L market**, 'free time'
- Time endowment is traded off between consumption/capital accumulation and activities off the labour market
- We explore **paradigm shifts** in this trade-off at a global scale in the long term

The model

A Ramsey model extended to 'free-time':

$$U = \sum_{t=1}^T R_t \left(u_t(C_t) + \alpha_t v_t(\phi_t) \right)$$

subject to

$$K_{t+1} = (1 - \delta) K_t + A_t F(K_t, \phi_t L_t) - C_t$$

Analytical solution

Solves into the canonical Euler equation

$$\frac{\partial u_{t-1}}{\partial C_{t-1}} = \frac{R_t}{R_{t-1}} \left(1 - \delta + A_t \frac{\partial F}{\partial K_t} \right) \frac{\partial u_t}{\partial C_t}$$

complemented by one on labour supply ϕ_t :

$$\frac{\partial v_{t-1}}{\partial \phi_{t-1}} = \frac{R_t}{R_{t-1}} \frac{\alpha_t}{\alpha_{t-1}} \frac{A_{t-1} \frac{\partial F}{\partial \phi_{t-1}}}{A_t \frac{\partial F}{\partial \phi_t}} \left(1 - \delta + A_t \frac{\partial F}{\partial K_t} \right) \frac{\partial v_t}{\partial \phi_t}$$

Expression of α_t

- Transversal condition (closure rule) defines K_T together with C_T as a function of K_T , L_T and ϕ_T
- First order condition at T yields another constraint on C_T and ϕ_T
- Injecting the first into the second yields a constraint on ϕ_T , K_T , L_T , A_T , R_T from which an expression of α_T can be drawn
- The second Euler equation gives α_t as a function of α_{t-1} – a recursive definition of α_t

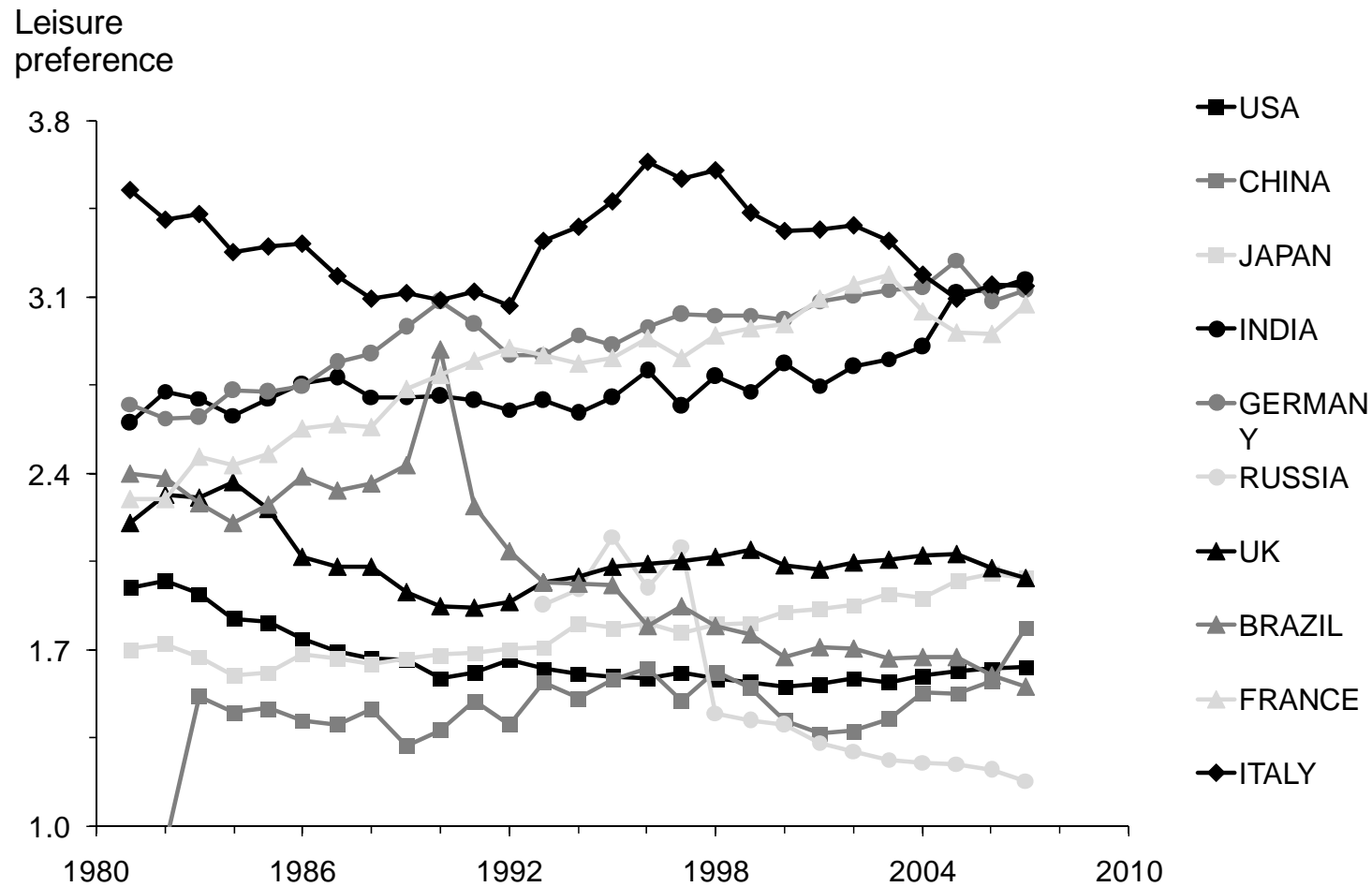
At the equilibrium

$$-\alpha_t \frac{\partial v_t}{\partial \phi_t} = A_t \frac{\partial F}{\partial \phi_t} \frac{\partial u_t}{\partial C_t}$$

i.e. the marginal utility of extended ‘free time’
equates the instantaneous marginal utility
of extended working hours

Hist. leisure preferences

(10 largest economies)





Prospective labour supply data

Demographic data

Active population disaggregated from total population

- Up to 2050
 - ILO's EAPEP database up to 2020, then extrapolated, provides activity rates
 - These are applied to the UNPD medium variant
- Beyond 2050
 - Population growth rates from former WITCH version (UN medium fertility assumptions)
 - Constant activity rates (maintained at 2050 level)

Labour supply

- **Labour supply potential** defined by superior limits to the Labour Force Participation Rate (LFPR) and Annual Working Hours (AWH) (Lucas and Rapping, 1969)
- LFPR of 95% for the 20 to 69 population
 - Massive entry of women on markets
 - Postponed retirement decisions
- AWH extended to 50 60-hour weeks = 3000 hours
 - Below Prescott's maximum of 100 hours, *cf.* Alesina
 - 2 remaining weeks include national holidays
- **Labour supply ratio** is share of potential mobilised



An implementation in WITCH

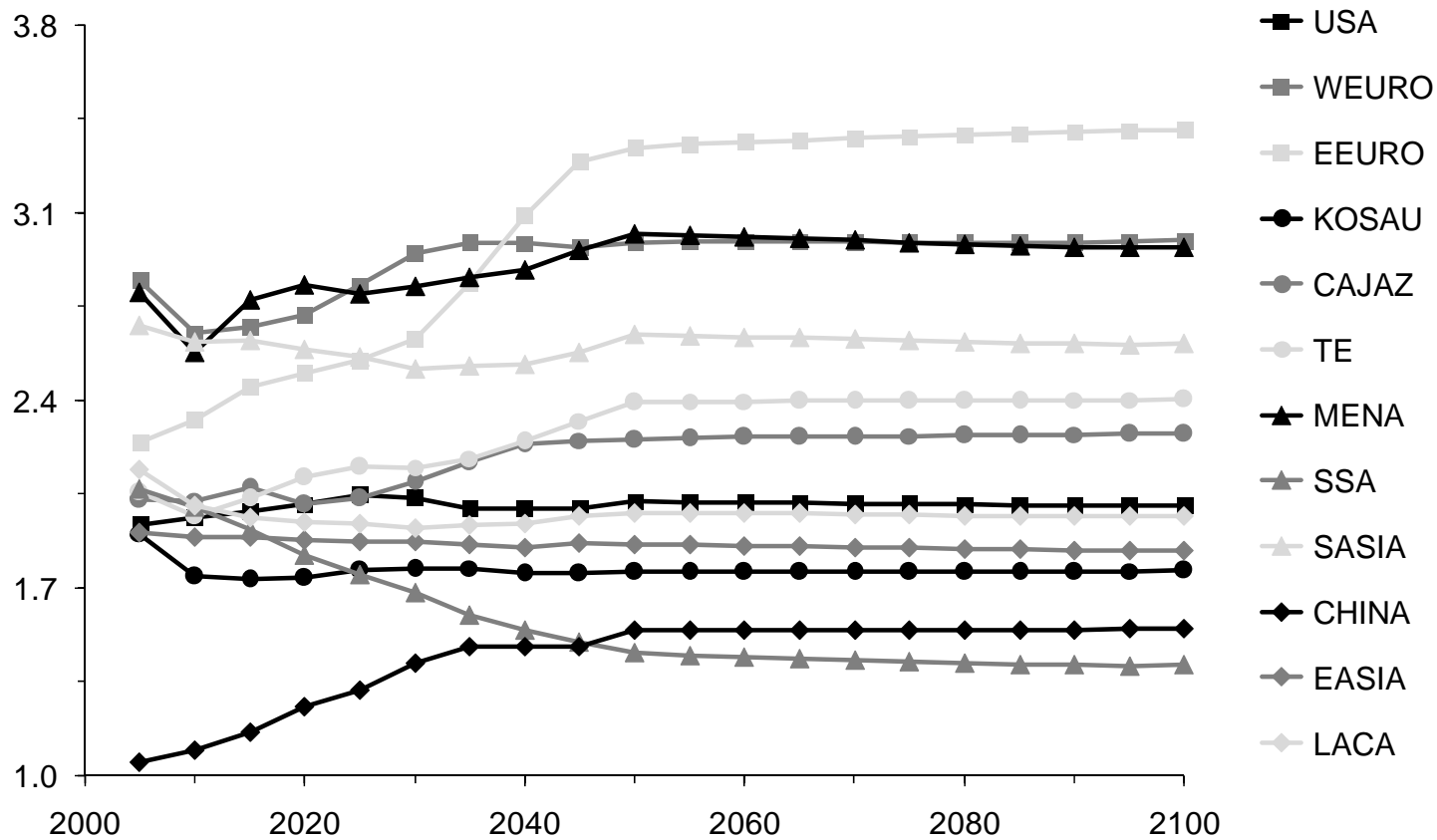
www.witchmodel.org

In 4 steps

- Preliminary demographic improvement
 - Distinction between total and active population (labour endowment)
 - TFPs recalibrated on former BAU trajectory
- Extension of utility functions to the free-time preference α_t weighing the extent of hours off the labour market
- Calibration of α_t on constructed labour supply ratio
- Normative analysis to compute the impact of converging free time preferences to contrasted development paradigms
 - American vs. Western European Way of Life

'Free-time' preference α_t

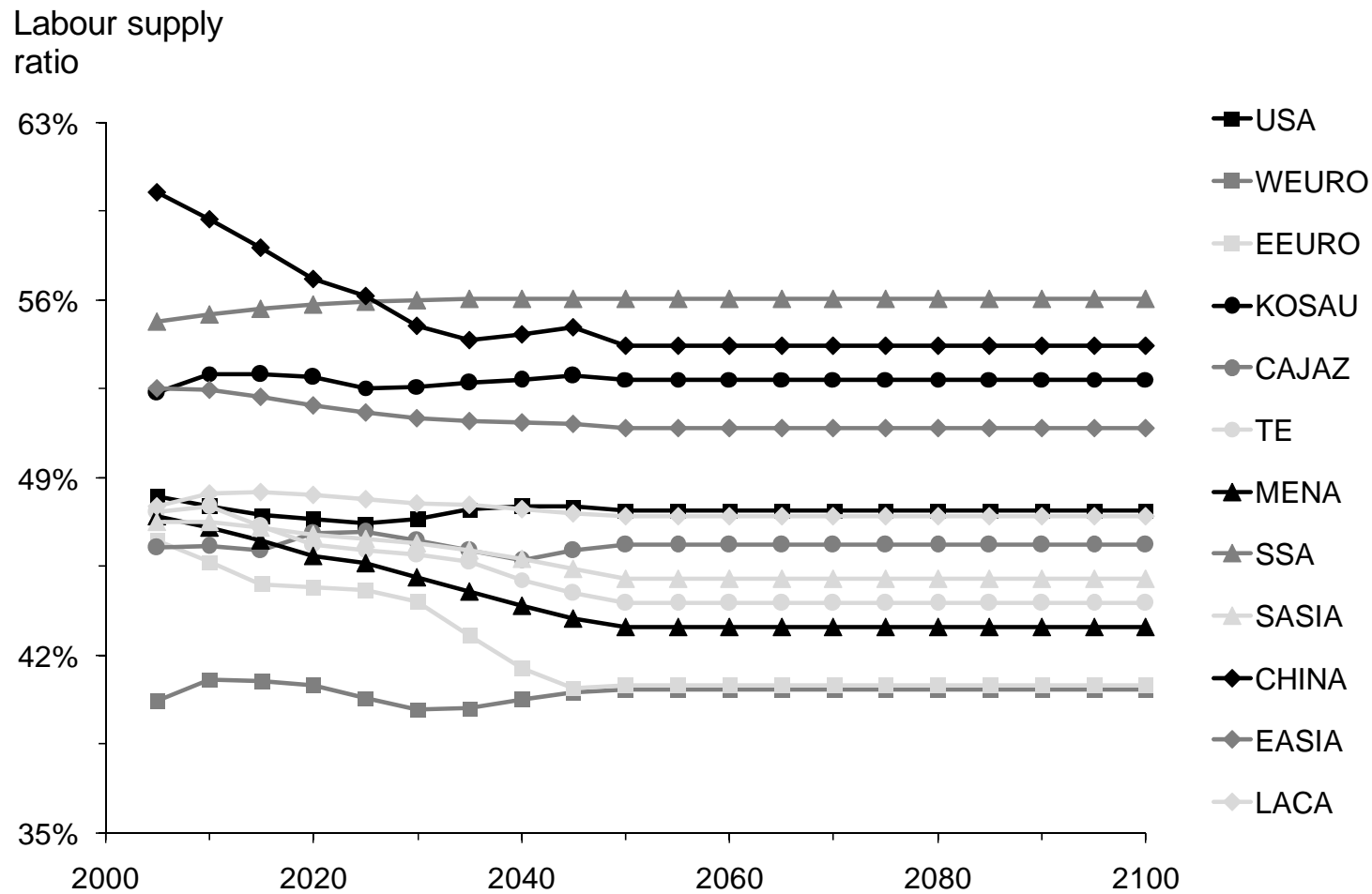
'Free time' preference



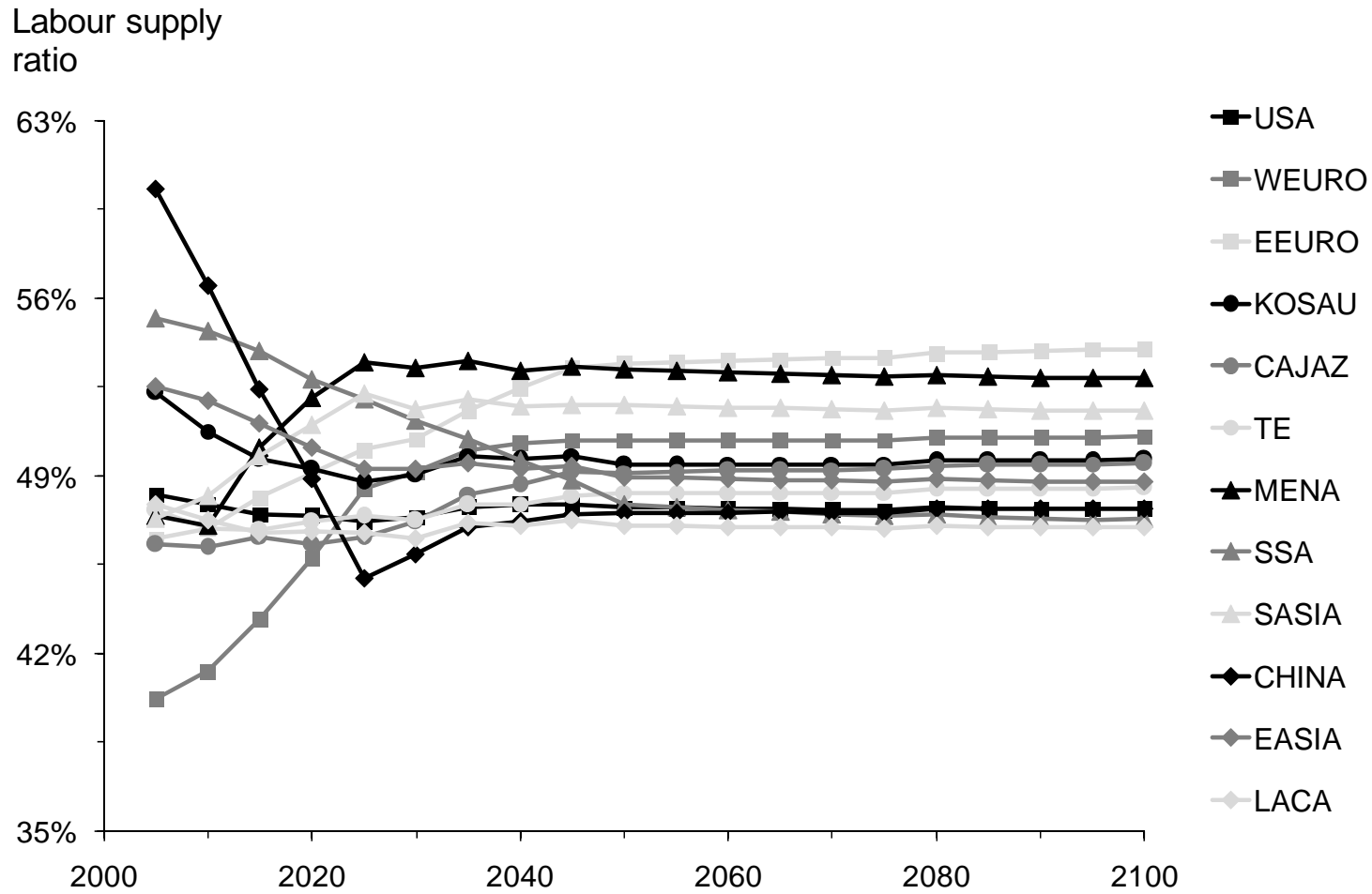
2 'global villages'

- A globalisation of values: testing a conjecture of convergence to 2 contrasted 'free time' preferences
- In all converging regions α diverges from its BAU trajectory
 - from 2005 on, at a constant rate
 - to reach some target region's trajectory in 2025
 - then sticks to it
- 2 contrasted target regions
 - The 'American (US) Way of Life' (USWL)
 - The (Western) 'European Way of Life' (WEWL)

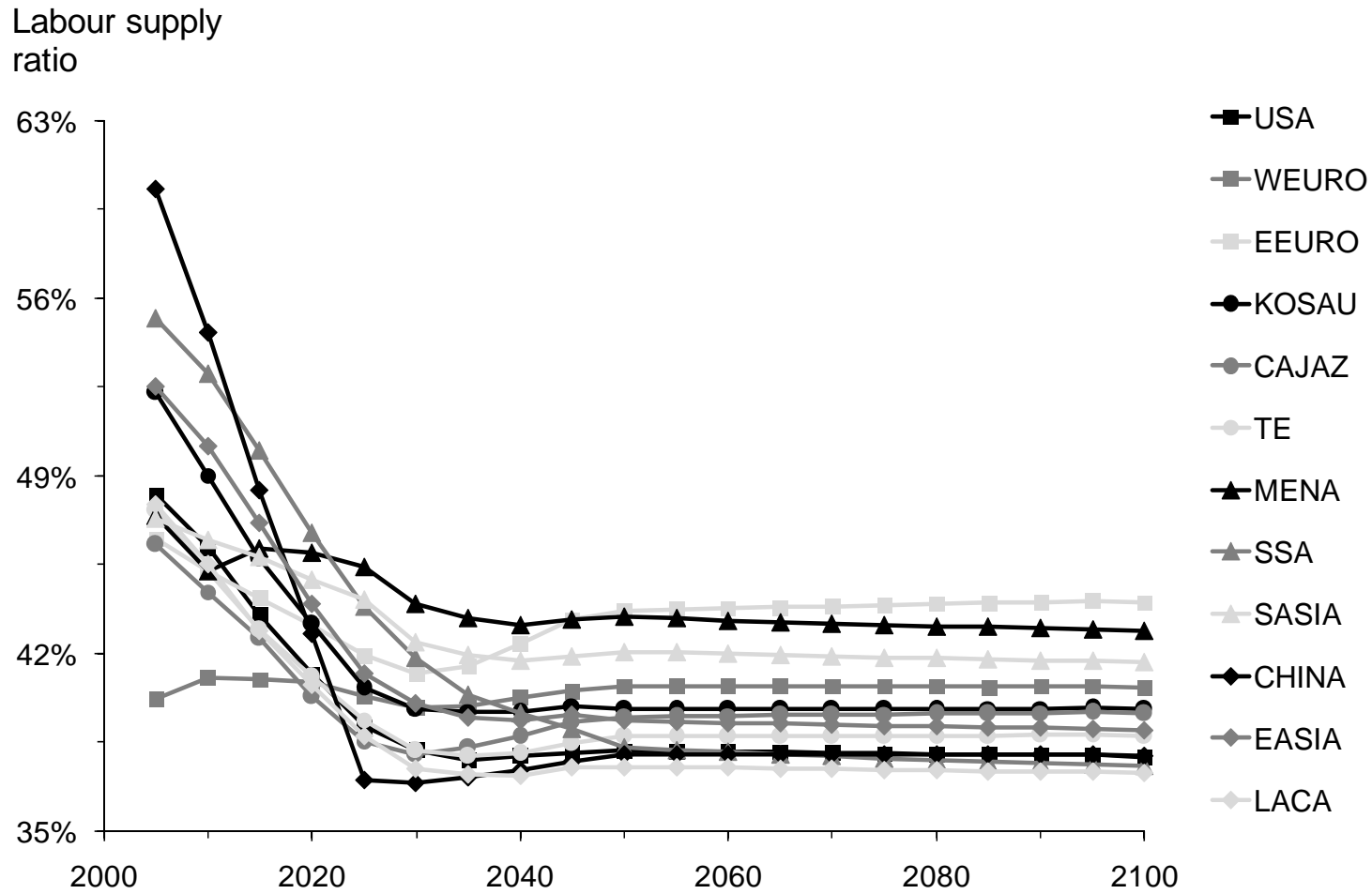
BAU Labour supply ratio



USWL labour supply ratio



WEWL labour supply ratio



Impacts on GDP and L time

Impacts on discounted 2005 to 2100 GDP and L time

- USWL
 - GDP impact from -13% (CHINA) to +20% (EEURO, MENA), WEURO +16%
 - L time impact from -11% (CHINA) to +15% (MENA), WEURO +14%
- WEWL
 - GDP impact from -28% (CHINA) to +2% (EEURO), USA -15%
 - L time impact from -24% (SSA) to -0% (EEURO), USA -14%
- Impact on GDP stronger than on L time because of cumulative nature of the former (through K dynamics)



Some conclusions and prospects

Conclusions and prospects

- Impacts of potential free time valuation shifts are massive, even more so in further years: USWL or WEWL induce increase/decrease in L time and GDP of **up to a third of BAU trajectories**
- A natural application: active population projection
 - Micro-funded projections more legitimate than econometrics of EAPEP?
- Some pending questions *i.e.* further research
 - Functional form of welfare valuation—threshold hypothesis?
 - Impact on exogenous technical progress? on Labour productivity?
 - Implementation in an endogenous growth framework