IRPET Istituto Regionale Programmazione Economica della Toscana

IrpetDin: A dynamic microsimulation model for Italy and the Region of Tuscany

2019 - IMA 7th World Congress, Galway June 19-21

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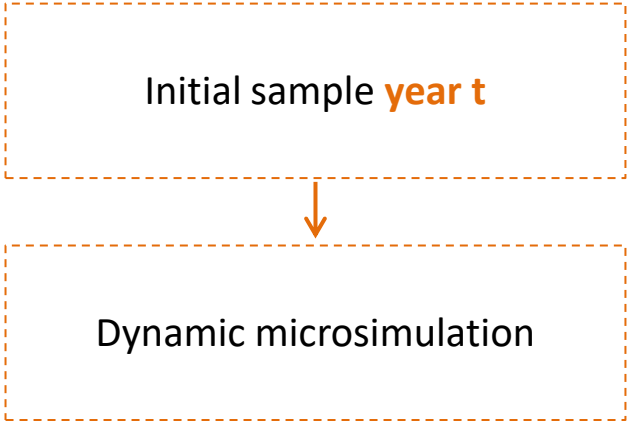
IrpetDin: general features

- **Main objectives:** to provide the regional policy maker a tool to evaluate the socio-demographic evolution of the population and the effects of social policies in then medium-long run
- **Population based:** ageing and adjustment of a cross sectional sample of the entire population
- **Database:** EUSILC (European Union Statistics on Income and Living Conditions) 2008 - EUROSTAT
- **Closed model:** except newly born children and migrants, the model only uses a fixed set of individuals
- **Dynamic ageing:** produces a longitudinal database of histories of each individual in each period of the simulation
- **Probabilistic:** transitions among states through probabilistic methodologies → Monte Carlo technique
- **Discrete time:** transition and updating for each year
- **Simulation period:** 2009-2050
- **Territorial coverage:** Italy and Region of Tuscany

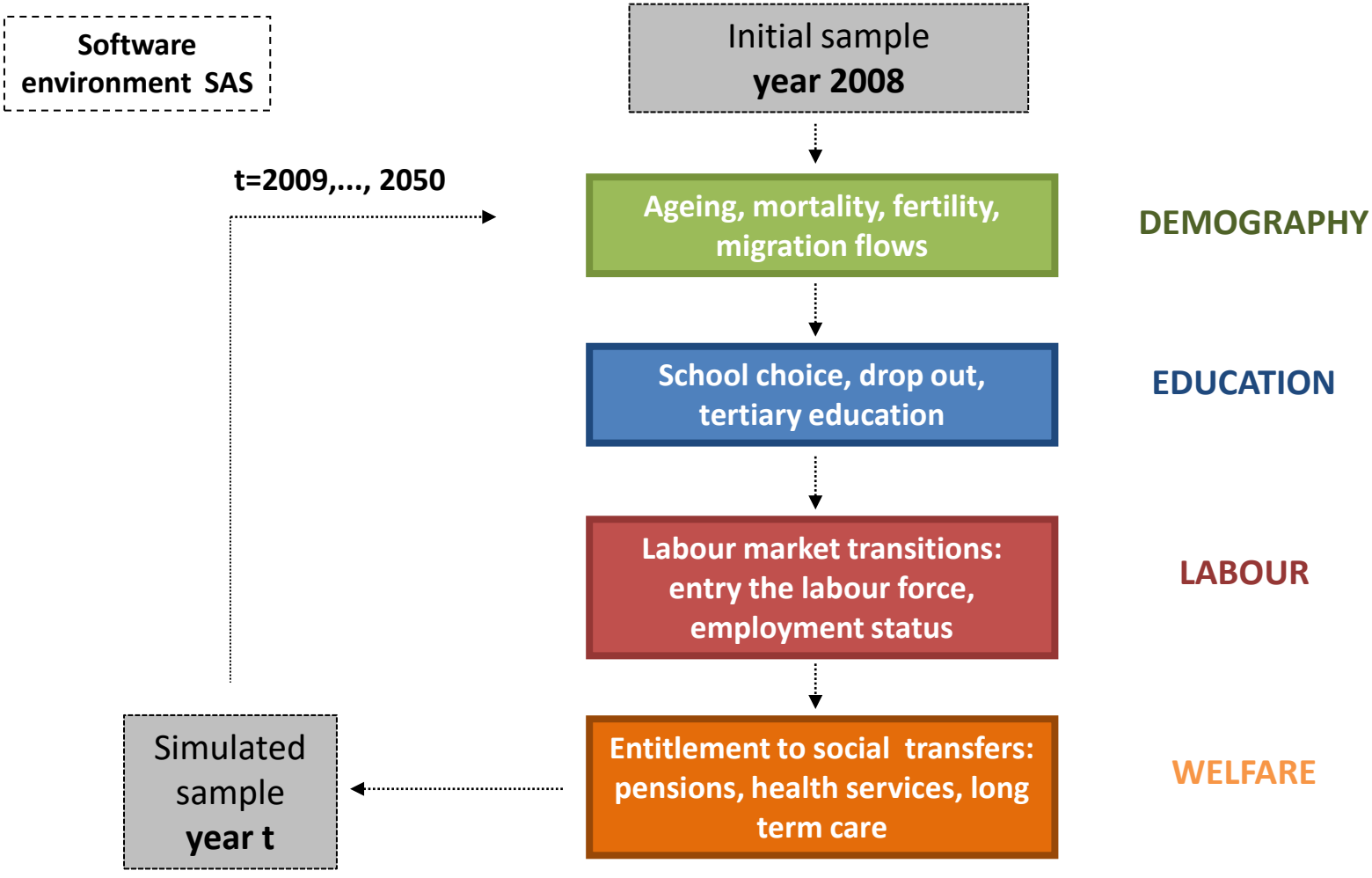
IrpetDin: general features



"Explosion" of the inital sample and its alignment to external more correct data on demography and labour force

Modules

Sequence of IrpetDin modules



Demographic module

Event	Potential candidates	Estimation	Variables used to determine events	Source
Ageing	All individuals			
Mortality	All individuals	Transition matrix	Area, age, gender	Mortality tables ISTAT
Marriage	Single, divorced, widowed aged 18-59	Transition matrix	Area, age, gender, education	Official data on marriage ISTAT Stato Civile
Fertility	Married/cohabitant women aged 18-45	Transition matrix	Area, age, n° children, education, nationality	Birth attendance certificates RT + Istat survey on births ISTAT
Dissolution	Married/cohabitant aged 20-64, at least 3 years of marriage	Transition matrix	Area, age, gender, nationality	Official data on civil status ISTAT
Leaving home	Individuals aged 18-59, unmarried, employed, not the head of the family	Transition matrix	Area, age, gender	Survey “Famiglia soggetti sociali “ISTAT
Migration flows	All individuals	Transition matrix	Age, gender, education, occupational status, type and size of the family	Individual data on registrations and cancellations ISTAT + Demographic balances of foreign citizens ISTAT

Education module

Event	Potential candidates	Estimation	Variables used to determine events	Source
Choice of secondary school	Individuals aged below 16	Multinomial logit	Area, gender, parents' education	Survey on secondary school graduates ISTAT
Educational attainments at secondary school (drop-out, repeating, high school certificate)	Enrolled to 1° year of secondary school	Transition matrix + multinomial logit	Area, gender, parents' education, type of secondary school	School register RT + Survey on secondary school graduates ISTAT
Entry to tertiary school	Individuals with secondary school diploma	Logit	Area, gender, type of secondary school and mark	University register + Survey on secondary school graduates ISTAT
University career (drop outs, three- and five-year degree)	Enrolled to university	Transition matrix	Area, age, gender, type of course, mark, year of study	Survey on university graduates ISTAT

Labour module

Event	Potential candidates	Estimation	Variables used to determine events	Source
Entry in the labour force	Individuals leaving the school (aged 15-39) and inactive people	Logit	Area, gender, age, education, CF	Labour Force Survey ISTAT
Employment status	Individuals belong to the labour force	Matching between labour demand and labour supply	Area, education, sector	Alignment to Irpet's macro model

Matching between labour demand and supply

Labour demand

- Aligned to IRPET multi-regional multi-sectoral structural macro econometric model
- Standard Labour Units (SLU) for each simulation year and sector of activity, coherent to GDP and productivity growth → distinguished in level of education (Excelsior survey) and translated in workers, through an estimated working time

Labour supply: endogenously determined by the microsimulation model

Matching between demand and supply: by level of education

$$If \quad L_{t,s} < O^*_{t-1,s} \Rightarrow \quad \text{Over-supply}$$

$$O^*_{t-1,s} = O_{t-1,s} - P_{t-1,s}$$

$$If \quad L_{t,s} > O^*_{t-1,s} \Rightarrow \quad \text{Over-demand}$$

$$l^*_t = L_{t,s} - O^*_{t-1,s}$$

$$If \quad l^*_g \geq \phi_g \Rightarrow \pi_g = 1 \quad else \quad \pi_g = \frac{l^*_g}{\phi_g}$$

$$If \quad l^*_b \geq \phi_b + (\phi_g - l^*_g) \Rightarrow \pi_g = \pi_b = 1 \quad else \quad \pi_g = \pi_b = \frac{l^*_b}{\phi_b + (\phi_g - l^*_g)}$$

$$\pi_{c\_str} = \frac{l^*_c}{\phi_c} \quad then \quad \pi_g = \pi_b = \pi_c = \frac{l^*_c - k_{c\_str}}{\phi_c + (\phi_g + \phi_b - l^*_b - l^*_g)}$$

L=labour demand
O=labour suppply
Φ=unemployed
Π=prob. to find a job
k=employed

g=tertiary education
b=secondary education
c=primary education
s=sector
t=time

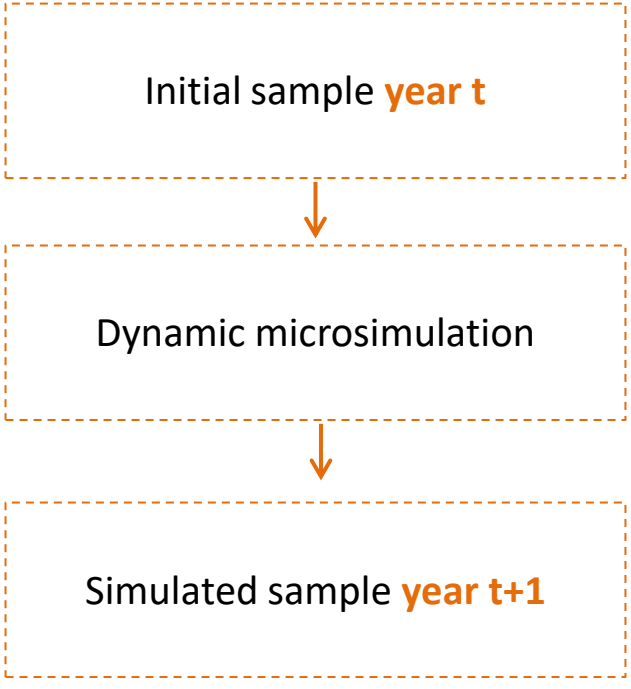
Labour module

Event	Potential candidates	Estimation	Variables used to determine events	Source
Entry in the labour force	Individuals leaving the school (aged 15-39) and inactive people	Logit	Area, gender, age, education, CF	Labour Force Survey ISTAT
Employment status	Individuals belong to the labour force	Matching between labour demand (macro model) and labour supply (Irpetdin)	Area, education e sector	Alignement to Irpet's macro model
Career employment	All individuals employed	Transition matrix	Area, education e sector	Labour Force Survey ISTAT
Wages and earnings	All individuals employed	OLS	Area, age, gender, contributory seniority, educational level, work status, number of hours worked, citizenship	EUSILC

Social security module

Event	Potential candidates	Simulation/ Estimation	Source
Pensions			
Retirement	All non-pensioners accruing retirement requirements	Pensions and contribution rules	
Pension benefits	All pensioners in the three regimes (defined benefit, notional defined contribution and mixed)	Pensions and contribution rules	
Social pensions entitlement	Individual aged above 65 entitled to assistance benefits	Pensions and contribution rules	
Supplements to minimum and social assistance supplements	Pensioners fulfilling age and economic condition requirements	Pensions and contribution rules	
Health			
Health expenditure	All individuals (insurance approach)	Age, gender, education and nationality	Regional administrative data on specialist, pharmaceutical and hospital services (only Region of Toscany)
LTC			
Long Term Care	All individuals	Probability of being disable by age, gender and educaiton	Survey “Multiscopo”, ISTAT

IrpetDin: general features



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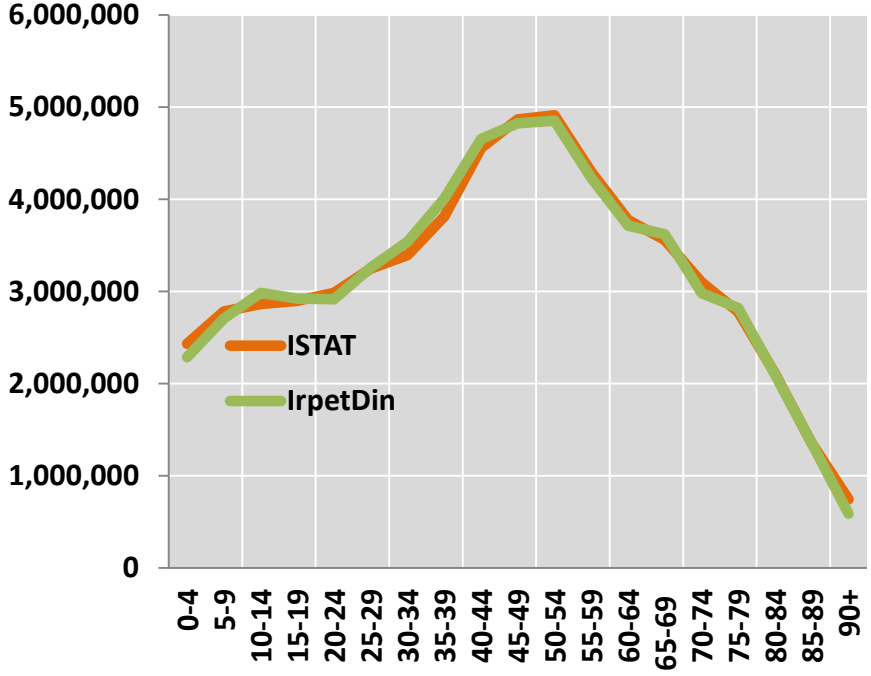
Modules

Validation: comparison between simulation and true data

Validation

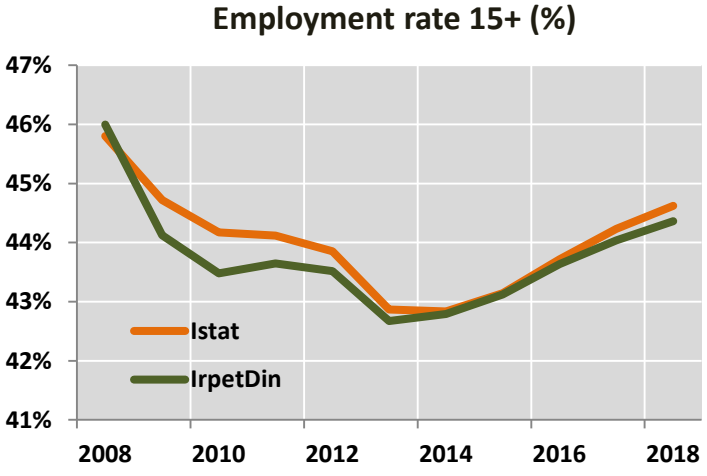
Distribution of the population at 31/12/2017 by age classes

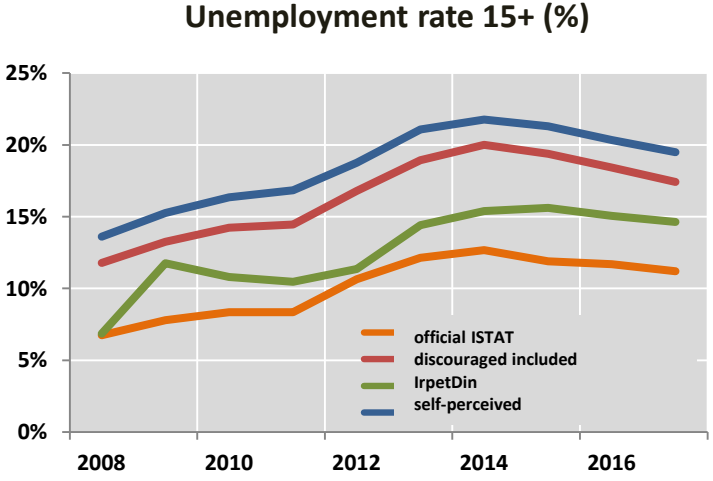


Demographic flows during 2017 and population stocks at 31/12/2017

	IrpetDin	ISTAT	Ratio IreptDin ISTAT
Births	455,400	463,074	0.98
Deaths	645,975	646,097	1.00
Migration flows	161,325	184,024	0.88
Foreign resident population	5,188,163	5,144,440	1.01
Resident population	60,403,050	60,483,973	1

Validation

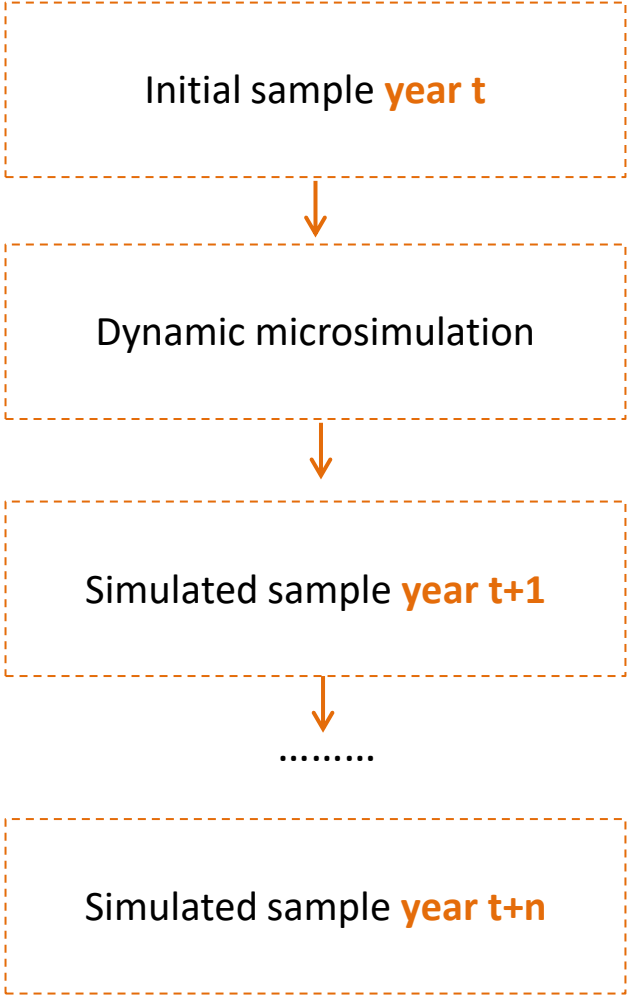




Retirees and pension expenditure

	IrpetDin	ISTAT	Ratio IrpetDin ISTAT
Stock of retirees Anno 2017	10,800,000	11,039,137	0.98
Pension flows 2016-2017-2018	284,138	291,115	0.98
Pension expenditure (billion euro) Anno 2017	236	232	1.01

IrpetDin: general features



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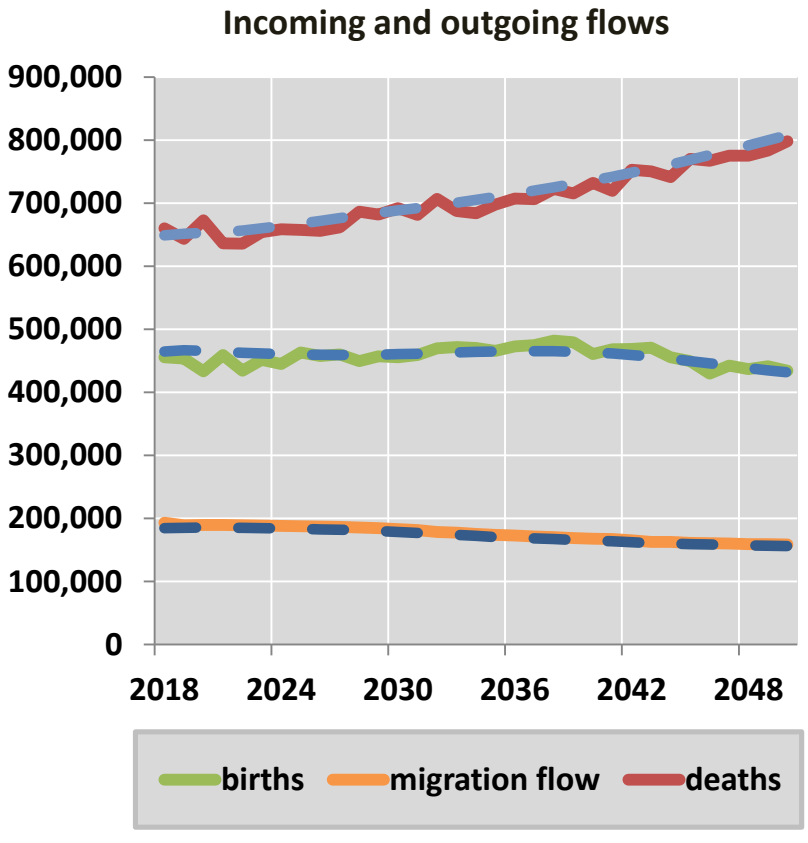
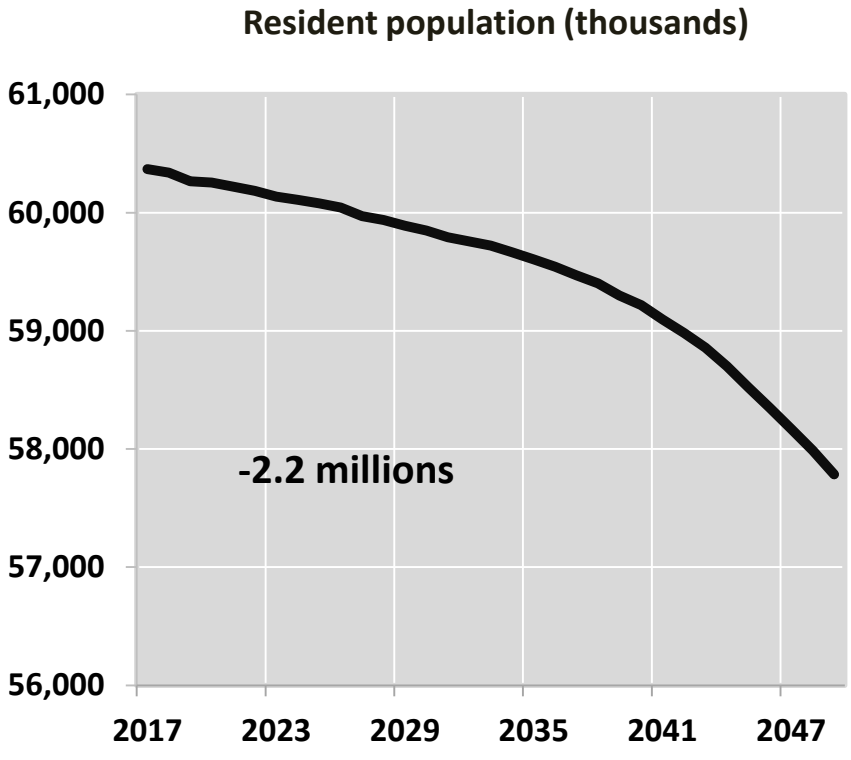
Projections into the future

Exogenous variables

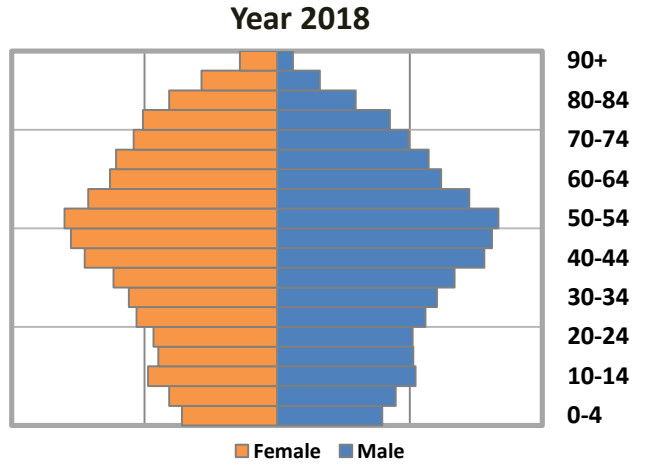
DEMO	Life expectancy	ISTAT 2017-2065 forecast, central scenario	ISTAT
	Fertility	ISTAT 2017-2065 forecast, central scenario	ISTAT
	Migrations flows	ISTAT 2017-2065 forecast, central scenario	ISTAT
MACRO	Real GDP growth rate	+1% until 2050	IRPET macro model
	Nominal GDP growth rate	+2.8% until 2050	IRPET macro model
	SLU growth rate	+0.3% until 2050	IRPET macro model
	Productivity	+0.7% until 2050	IRPET macro model
	SLU/Employed	-0.2% until 2020, then unchanged	Our assumption
	Earnings growth rate	Nominal GDP	Our assumption
WELFARE	Thresholds, social allowances and supplements to minimum	Inflation	IRPET macro model
	Pension amounts growth	Inflation	IRPET macro model
	Health costs growth	Nominal GDP per capita	Our assumption

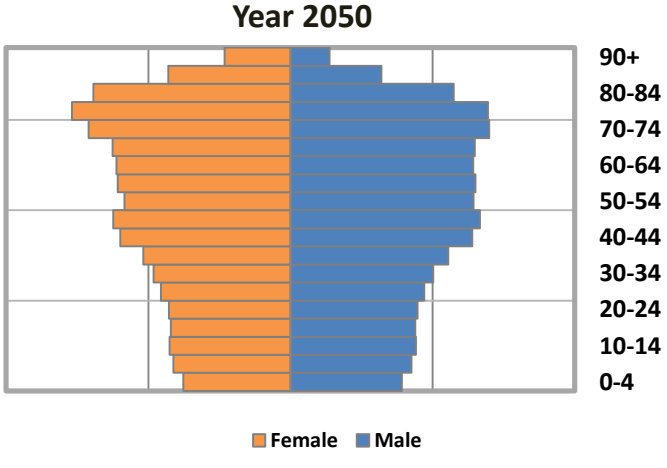
The diminishing population

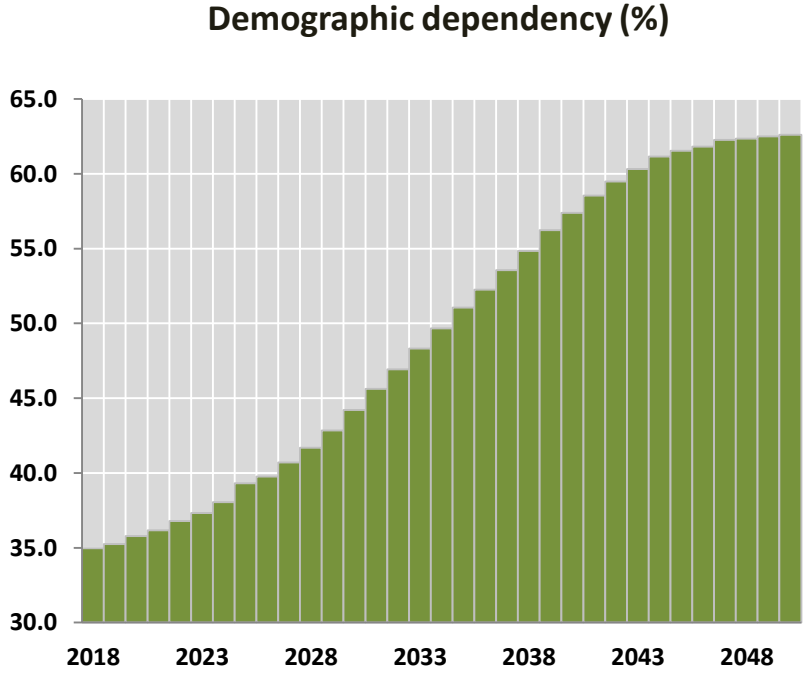




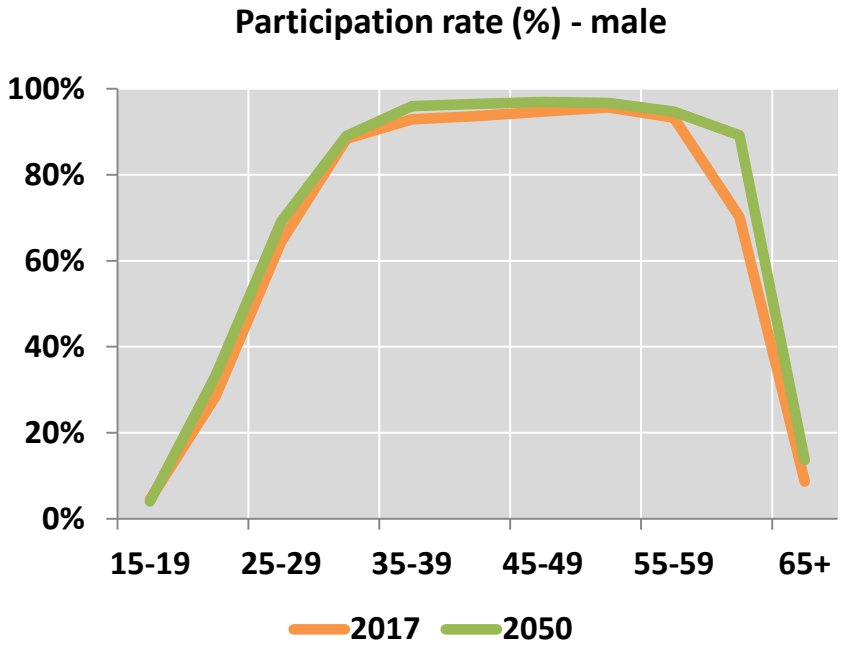
The ageing of the population

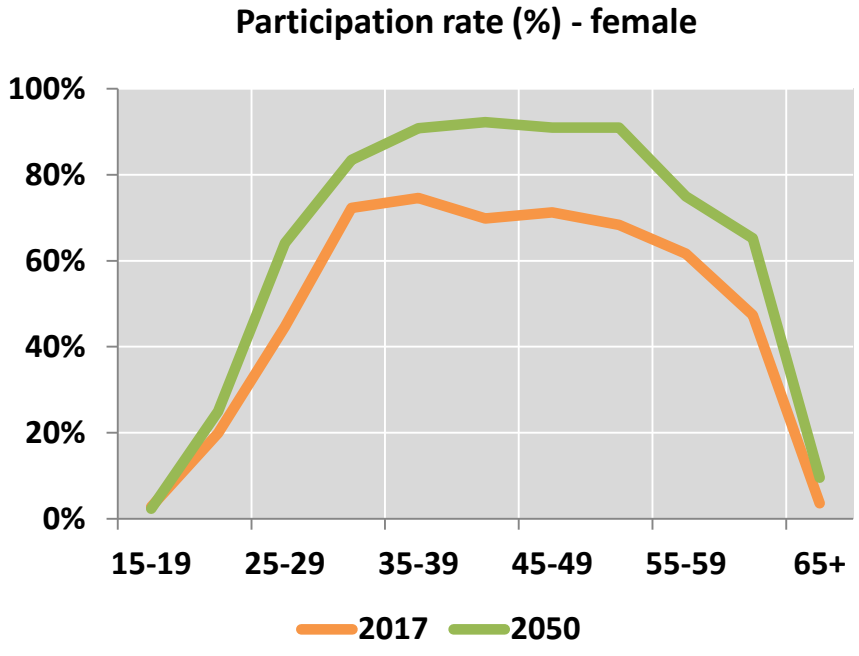




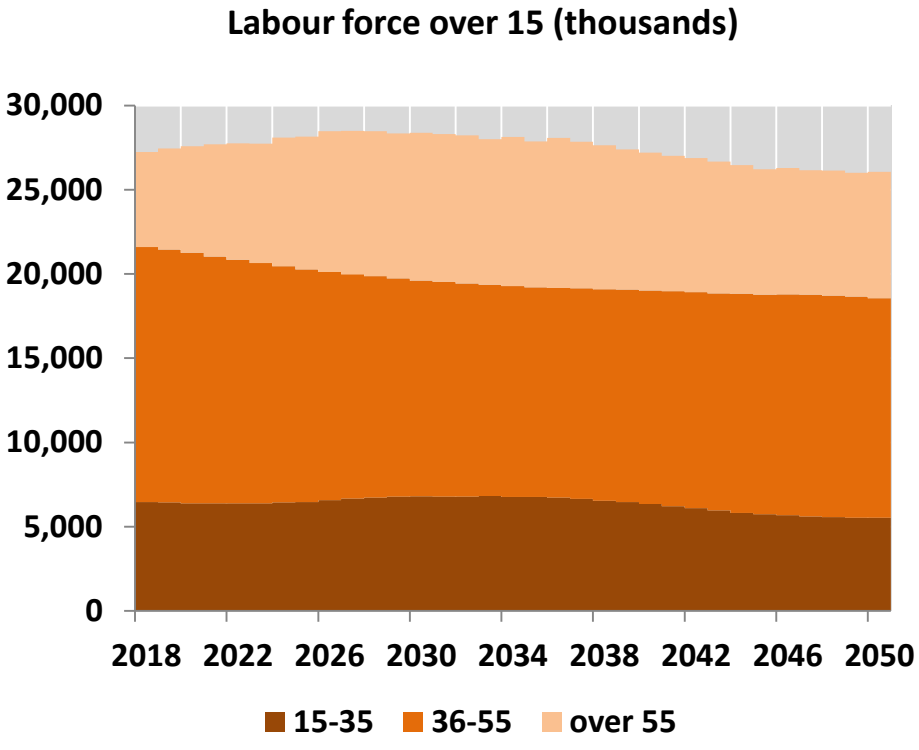


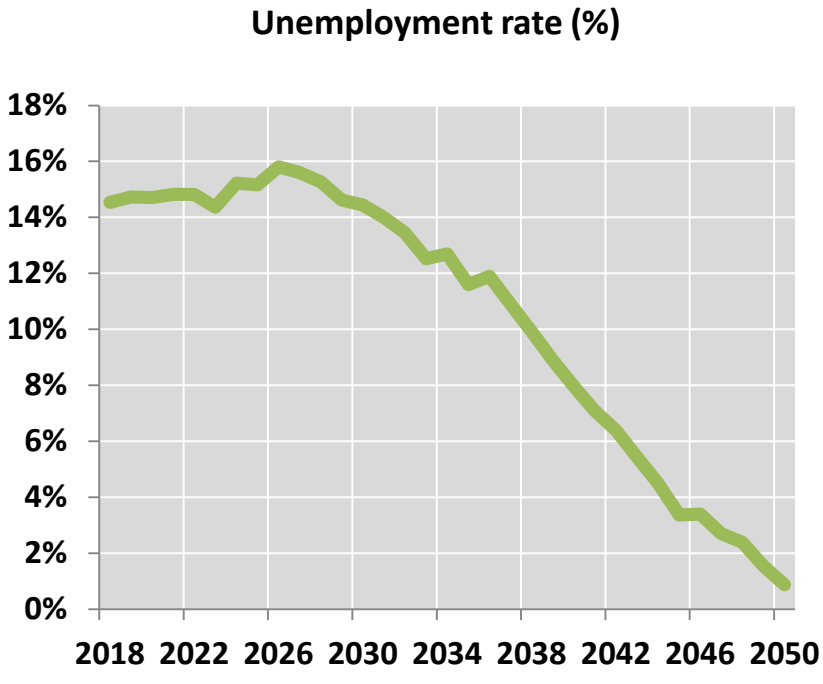
The increasing participation rate



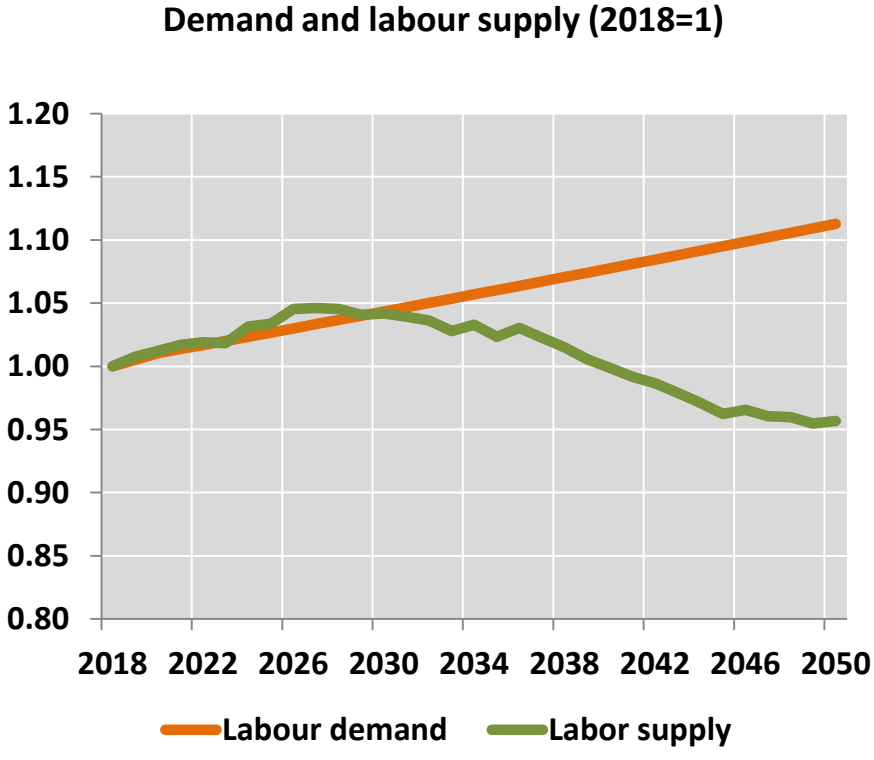


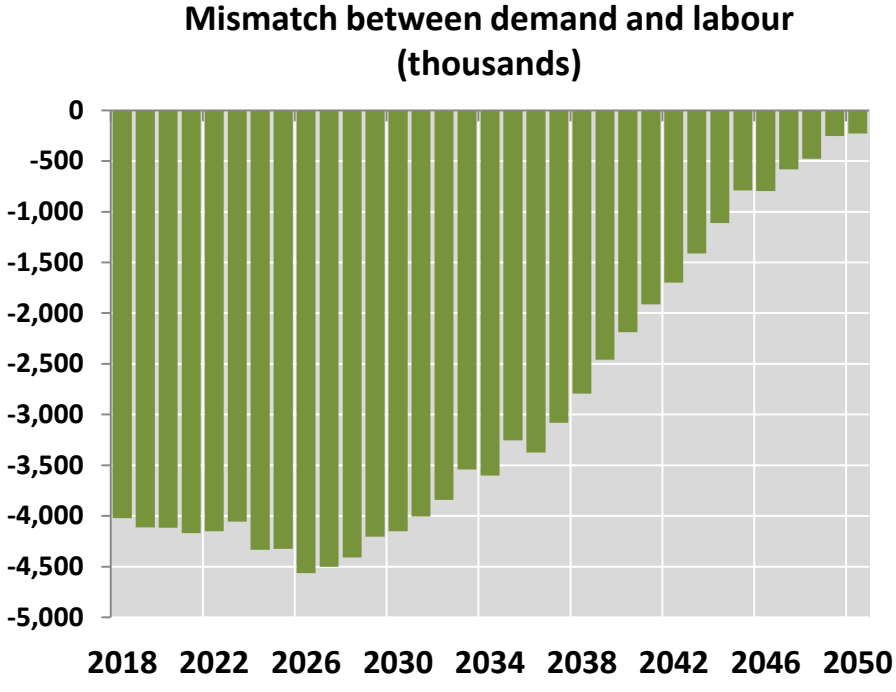
The diminishing labour force



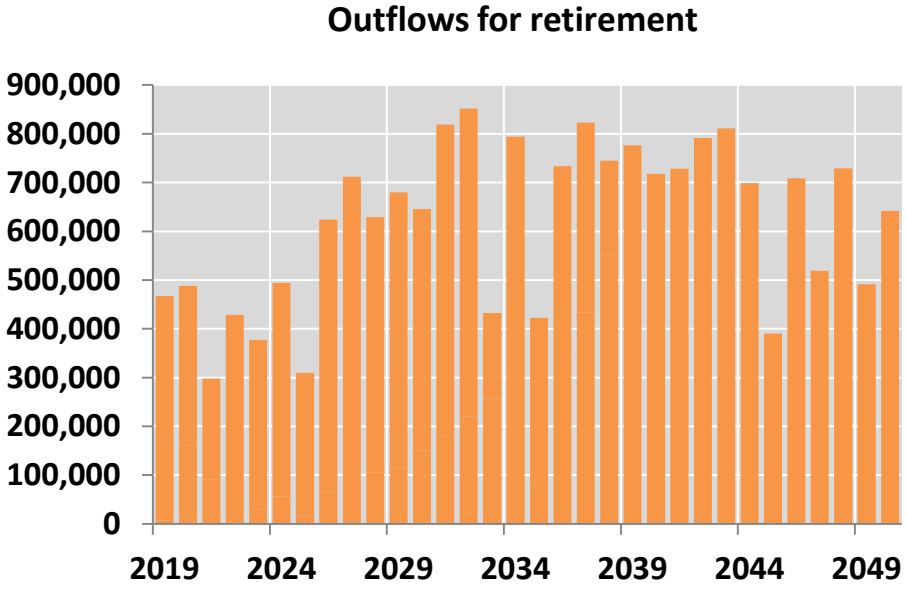


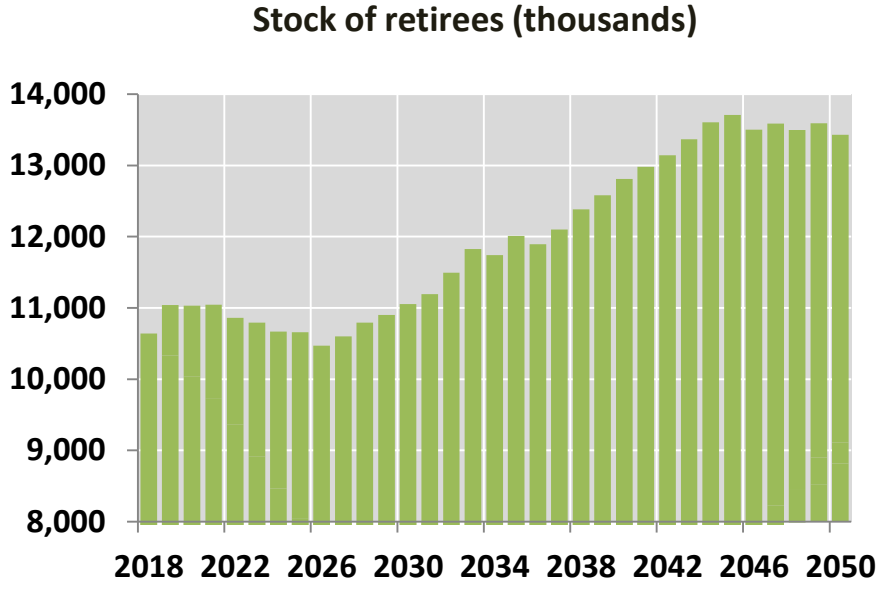
The matching between labour demand and supply



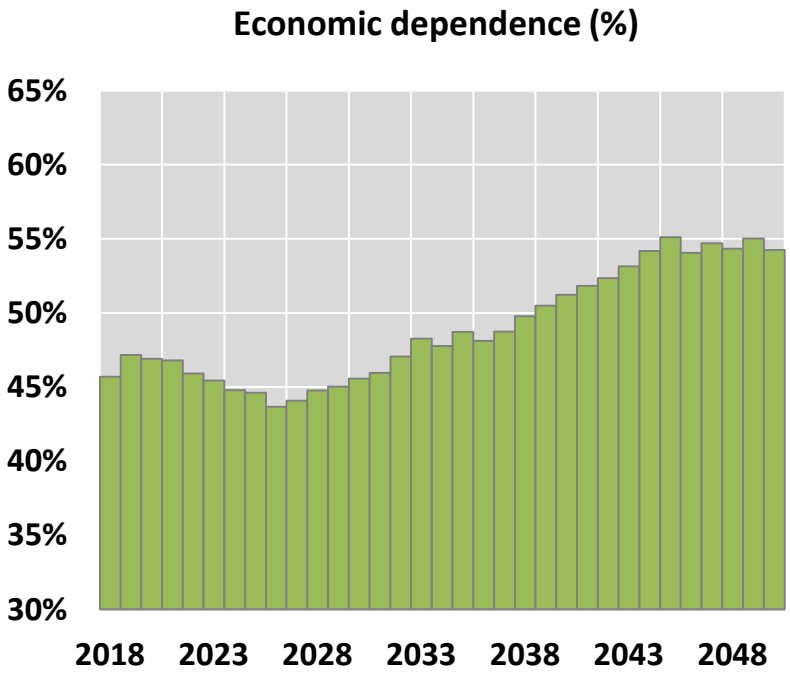


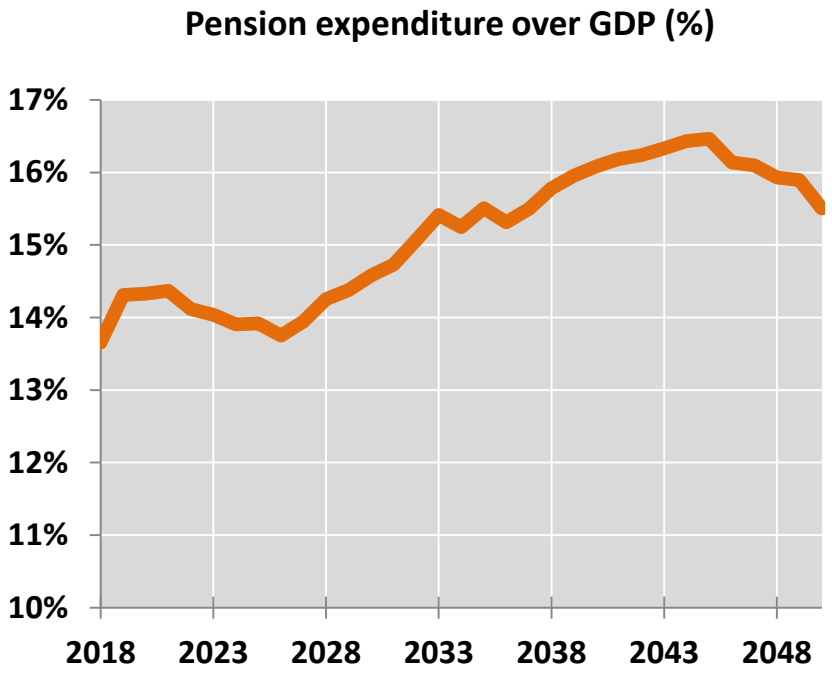
Pensions: flows and stocks



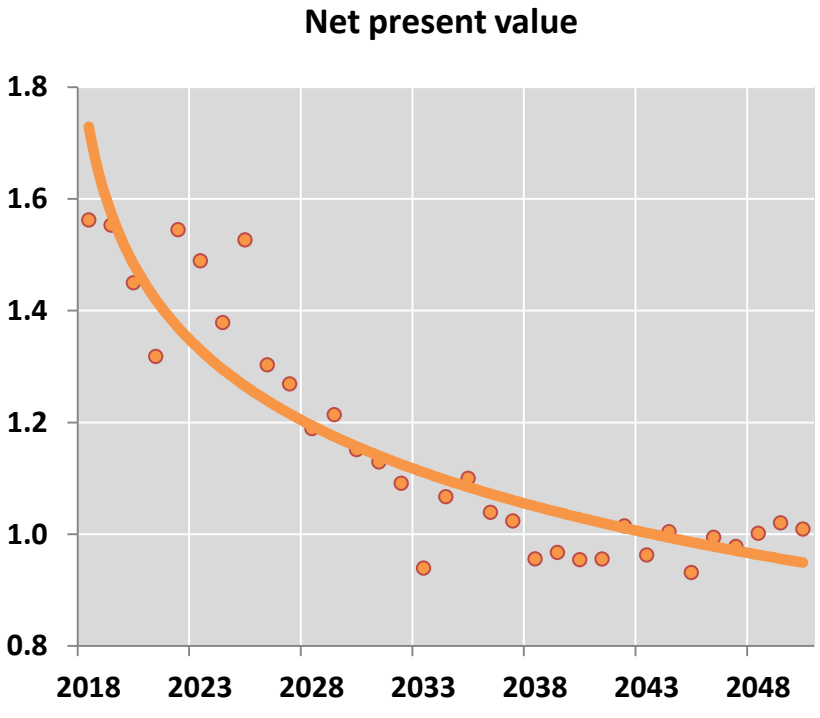


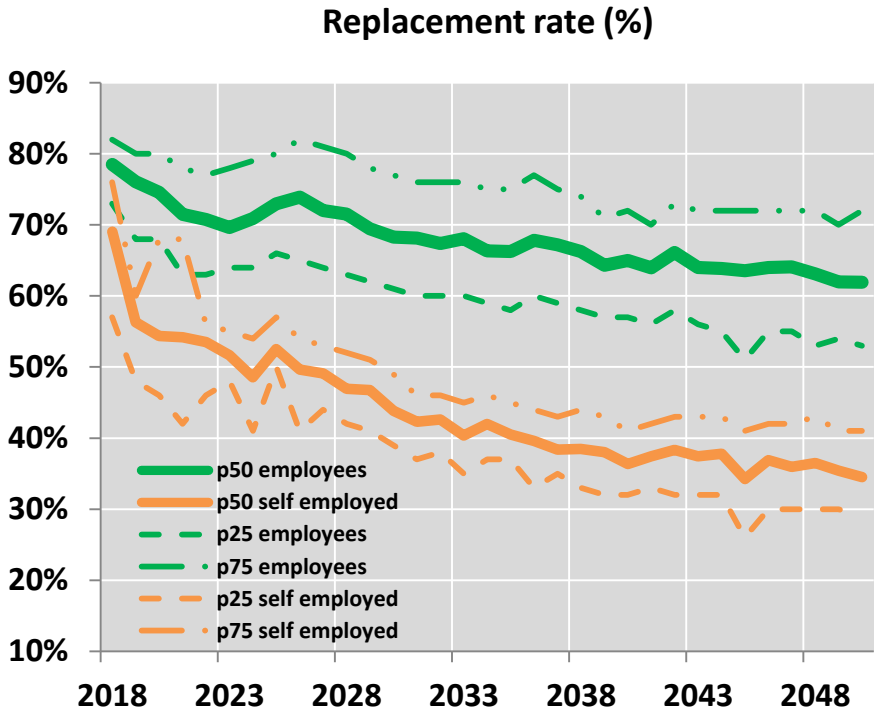
Pensions: financial sustainability





Pensions: inter-generational and intra-generational equity





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Thank you for your attention