EU-FEM: A FEM-like Microsimulation Model for Europe

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SHARE conference 2015
12/11/2015

Outline

1. Background
2. Data sources
3. Model structure and Estimation
   - Transition models
   - New Cohorts
4. Results
   - Status Quo
   - Scenario: Leaner new cohorts

Aim of the Project

- The aim of this project is to build a dynamic micro-simulation FEM-like model in Europe (EU-13), in order to implement what if scenarios, mainly dealing with the role of (primary and secondary) prevention policies on health outcomes and health care expenditure.

- Following OECD guidelines, potential questions that the model should be able to answer are the following (see Astolfi et Al., 2011):
  1. What may be future health expenditures if no action is taken?
  2. What are the drivers of rising costs?
  3. In which sector of the health care system are costs rising the most?
  4. What will be the potential impact on health care expenditures if different medical technologies or innovations experts view are actually introduced?
  5. What will be in the short, medium and long-run term the effects on expenditure and health outcomes of health care policies aimed at improving primary and secondary prevention.

What are microsimulation models?

Microsimulation is a way of modeling real life events by simulating the actions of the individual units that make up the system where the events occur

- Large scale complex quantitative models
- Focus on individuals or households
- Starts with large micro-data sets
- Mirror the heterogeneity in the population

Partners

The project is in collaboration with several well know international research institutions. CEIS Tor Vergata leads the project and receives support from the following organizations:

- Health Division, Dir. for Employment, Labour and Social Affairs OECD
- Department of planning Ministry of Health
- Center for Health Policy (CHP) at Stanford University
- Schaeffer Center at University of South California

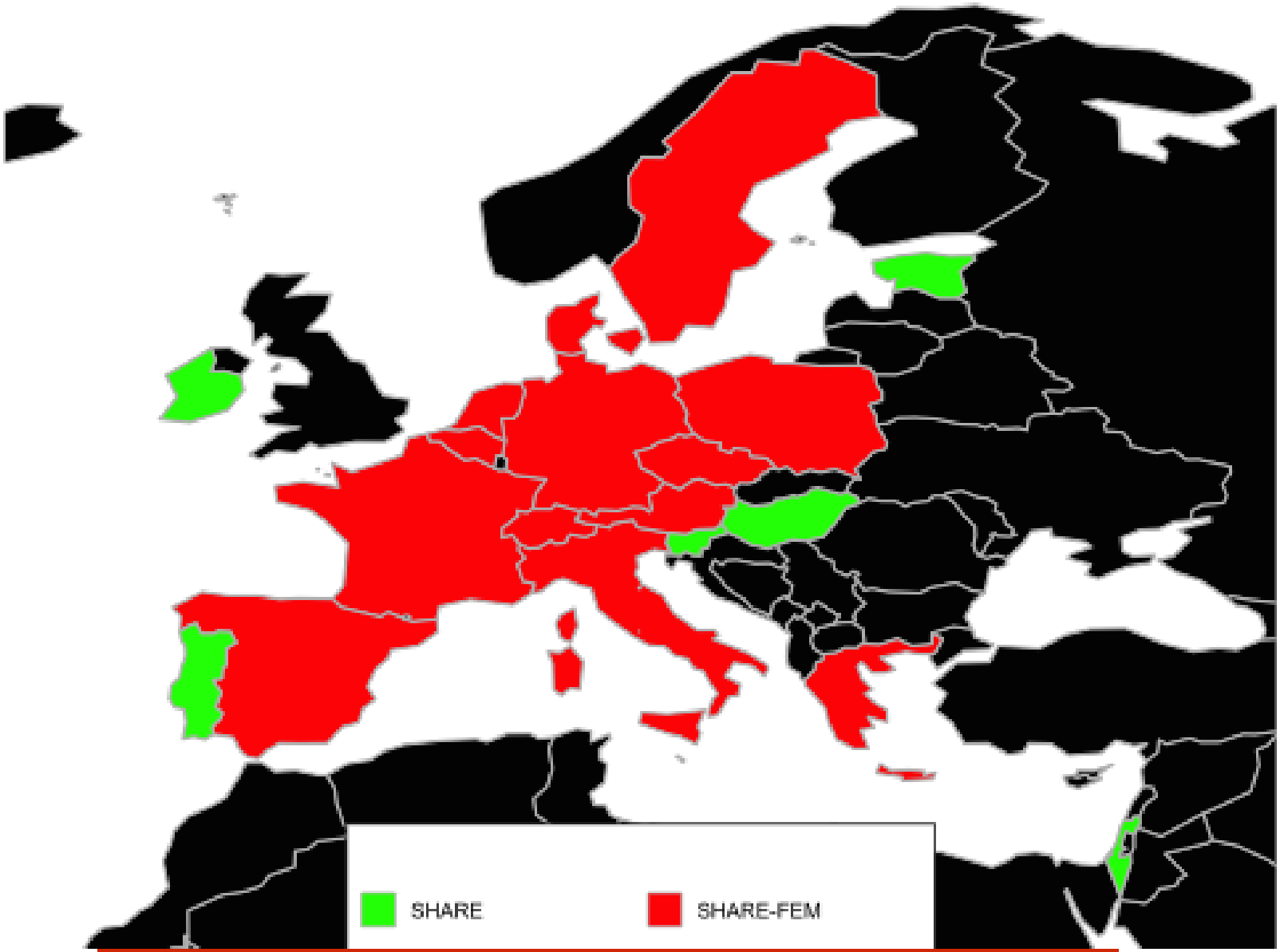
Primary Data Sources

1. Harmonized SHARE dataset, Version B (February 2014) developed by the Gateway to Global Aging Data of the Schaeffer Center. → base data ;
2. ECHP → historical trends;
3. Eurostat → Population projections (Moving to UN projections);
4. Human Mortality Database (HMD) → mortality data;
5. HS-SiSSI Database → Direct primary care costs and trends;
6. Hospital discharge data → Direct inpatients costs (TBA based on the future implementation of a "hospitalization module" exploiting informations on health care utilization included in SHARE).

Survey of Health, Ageing and Retirement in Europe (SHARE):

- A cross-national panel dataset on health, socio-economic status, and the social and family networks.
- Europeans aged 50 and over.
- Current version of EU-FEM considers:
  1. Waves 1 (2004/2005), 2 (2006/2007), 3 (2008/2009) and 4 (2010/2011);
  2. Countries included in this version of EFEM: Austria, Belgium, Czech Republic, Denmark, France, Germany, Greece, Italy, the Netherlands, Spain, Sweden, Poland and Switzerland.
- Harmonized SHARE: Ensures comparability across Europe, Us, Canada, Mexico, Singapore and Japan

SHARE countries used in EFEM



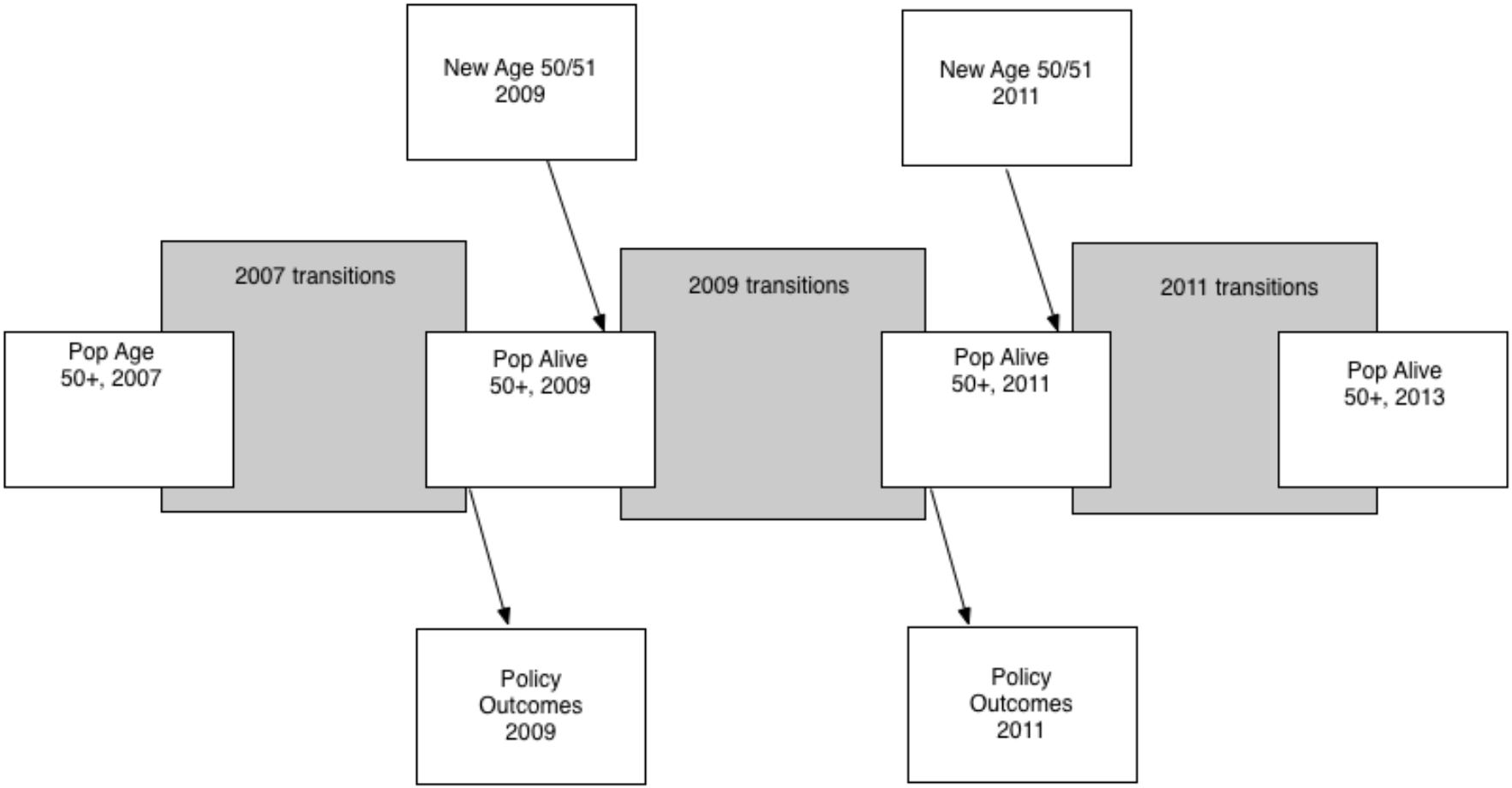
- The Health Search - SiSSI (Simulation of Italian Health Care expenditure) is the collection of patient level clinical records from italian GP's:
  1. Begins in 2001;
  2. More than 1.000 GPs are active;
  3. Records for about 1.3 million patients nationwide;
  4. HS belongs to the network of European databases managed by the Erasmus University and by the CRS network of Cegedim with includes also France, Germany, Spain, Belgium, Italy and UK.

- We used this dataset in order to:
  1. compute chronic conditions trends (cancer, heart diseases, diabetes, hypertension, lung diseases, stroke) and project them up to 2080;
  2. computes average direct primary care costs for the above conditions by gender and age.

- European Community Household Panel is a panel survey of 15 European countries from 1994 to 2001:
  1. Longitudinal panel survey with annual waves;
  2. Representative samples for 16+ years of age;
  3. Income, health, education, housing, demographics and employment characteristics
  4. data for: Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden.

- We used this dataset in order to:
  1. compute obesity and smoking status trends and project them up to 2080.

Model structure



Transition models

Estimated outcomes

Economic Outcomes	Health Outcomes	Other Outcomes
Employment	Death	Income Tax Revenue **(TBA)**
Earnings	Heart	Social Security Revenue **(TBA)**
Wealth	Stroke	
Demographics	Cancer	Medical Expenses
Health Insurance **(TBA)**	Hyper-tension	
	Diabetes	
Defined Benefit Claim **(TBA)**	Lung Disease	
	BMI	
	QALY	
Social Security Claim **(TBA)**	Smoking Status	
	ADL Status	
	IADL Status	
	Pain	
	Parkinson **(TBA)**	
	Osteoporosis **(TBA)**)	
	Cancer by ICD9 macro-categories **(TBA)**	

Transition and other models

- Unbalanced panel for the age 50+ population.
- We have four types of outcomes: binary, ordered, censored and continuous.
- Binary and ordered outcomes are modeled using probit and multinomial logit transition models allowing for state-dependence by including the lagged outcome on the right-hand side.
- Censored outcomes, earnings and financial wealth are modeled through two part models (e.g. Earnings are only observed when individuals work)

Transition models: estimation results

SHARE waves 2,4 and HRS waves 2-9

CEIS TOR VERGATA Centre for Economic and International Studies

EU vs US: Mortality and main chronic diseases

	Death EU	Death US	Diabetes EU	Diabetes US	Hearth EU	Hearth US	Hypert EU	Hypert US
Austria	0.120*		-0.051		0.161*		-0.060	
Germany	0.074		-0.003		0.240***		0.036	
Sweden	0.142**		-0.121		0.259***		-0.100*	
Netherlands	0.108*		0.066		0.040		-0.247***	
Spain	0.156**		0.188**		0.000		-0.057	
France	-0.016		-0.116		0.034		-0.374***	
Denmark	0.132**		-0.278***		0.096		-0.206***	
Greece	-0.080		-0.282***		-0.396***		-0.488***	
Switzerland	-0.138		-0.121		-0.199**		-0.391***	
Belgium	-0.106*		-0.027		0.120*		-0.065	
Czech republic	0.246***		0.284***		0.198**		0.236***	
Poland	0.297***		0.047		0.327***		0.014	
Less than high school	0.125***	0.049**	0.078	0.091***	0.098**	0.099***	0.102**	0.043*
Some college and above	-0.035	-0.049***	-0.054	-0.026	-0.073*	-0.015	-0.072**	-0.017
Male	0.311***	0.193***	0.082**	0.131***	0.114***	0.200***	0.001	-0.071***
Male AND Less than high school	-0.039	-0.044	-0.090	-0.024	-0.105	-0.046	-0.074	-0.012
Min(63, two-year lag of age)	0.049***	0.022***	0.024***	0.025***	0.034***	0.021***	0.028***	0.015***
Min(Max(0, two-year lag age - 63), 73 - 63)	0.041***	0.030***	0.009	0.009***	0.033***	0.025***	0.020***	0.014***
Max(0, two-year lag age - 73)	0.069***	0.047***	0.005	-0.012***	0.014**	0.018***	-0.001	-0.001
N	26644	119278	22259	95977	21188	89061	16575	61027
pseudo R^2	0.266	0.245	0.071	0.071	0.070	0.051	0.066	0.022

Significance levels: "": $p < 10\%$; "**": $p < 5\%$, "***": $p < 1\%$. Italy is the base country for EU models.

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Transition models: estimation results - 2

	Death EU	Death US	Diabetes EU	Diabetes US	Hearth EU	Hearth US	Hypert EU	Hypert US
lag of Heart disease (previous survey)	-0.004	0.228***						
lag of Stroke (previous survey)	-0.001	0.119***						
lag of Cancer (previous survey)	0.532***	0.412***						
lag of Hypertension (previous survey)	-0.050*	0.102***			0.133***	0.187***		
lag of Diabetes (previous survey)	0.160***	0.226***			0.064	0.172***	0.159***	0.157***
lag of Lung disease (previous survey)	0.162***	0.379***						
lag of Has exactly 1 IADL (previous survey)	0.380***	0.199***						
lag of Has 2 or more IADLs (previous survey)	0.565***	0.528***						
lag of Has exactly 1 ADL (previous survey)	0.272***	0.229***						
lag of Has exactly 2 ADLs (previous survey)	0.255***	0.370***						
lag of Has 3 or more ADLs (previous survey)	0.716***	0.611***						
lag of Current smoking (previous survey)	0.190***	0.182***	0.119**	-0.015	0.115**	0.134***	0.020	0.052**
lag of Widowed (previous survey)	0.270***	0.055***	0.043	0.030	-0.094	0.033	-0.058	0.055**
Heart problem status at age 50 (1/0)-imputed	0.339***	0.042	0.208*	0.155**			0.382***	0.121*
Stroke status at age 50 (1/0)-imputed	0.381*	-0.044	0.444	0.026	0.460	0.302*	0.436	0.139
Cancer status at age 50 (1/0)-imputed	0.939***	-0.167***	0.022	-0.025	0.182	0.124**	0.042	0.004
High blood preasure status at age 50 (1/0)-imputed	0.989***	0.036	-0.032	0.267***	-0.071	0.141***		
Diabetes status at age 50 (imputed)	0.184**	0.104***			0.146	0.195***	0.018	0.123***
Lung disease status at age 50 (1/0)-imputed	0.912***	-0.153	0.257	0.158	-0.331	0.430***	-0.267	0.150
Init. of Ever smoked	-0.026	0.091***	0.072	0.010	-0.005	0.051***	0.019	-0.023
Smoking status at age 50 (imputed)	0.230***	0.113***	-0.029	0.088***	-0.040	0.014	-0.083**	0.018
Flag indicating widow at age 50	-0.343***	0.035	-0.022	0.077	0.090	-0.063	0.113**	-0.041
Flag indicating single at age 50	0.047	0.110***	0.028	0.057**	-0.062	0.032	-0.010	0.030
Splined two-year lag of BMI $\leq$ log(30)			1.483***	1.033***	0.405***	-0.231**	1.271***	0.778***
Splined two-year lag of BMI $>$ log(30)			1.998***	1.197***	0.379	0.408***	1.052***	0.574***
Log of years between current interview and previous			0.137**	0.392***	0.077	0.278***	0.132***	0.269***
N	26644	119278	22259	95977	21188	89061	16575	61027
pseudo R^2	0.266	0.245	0.071	0.071	0.070	0.051	0.066	0.022

Significance levels: "": $p < 10\%$; "**": $p < 5\%$, "***": $p < 1\%$.

New cohorts

- Trends are extrapolated from historical data.
- Estimation of covariance (correlation) matrix between outcomes of interest using a multi-equation mixed-process model based on a sample of 50-55 aged individuals from SHARE data.
- New cohorts 50-51 aged individuals are generated up to 2150 by applying trends and imposing estimated correlations between outcomes.

Estimated covariance matrix (estimated on the 50-55 years sample, SHARE wave 2)

	fhibpe	fhearte	fdiabe	fcancre	fstroke	flunge	fshlt	fwtstate	fsmkstat	fanyadl	fanyiadl	fwork	g(iearnx)
fhibpe	1.000												
fhearte	0.280	1.000											
fdiabe	0.329	0.301	1.000										
fcancre	0.039	0.183	0.119	1.000									
fstroke	0.235	0.343	0.171	0.203	1.000								
flunge	0.100	0.163	0.151	0.235	0.153	1.000							
fshlt	0.268	0.472	0.410	0.444	0.511	0.452	1.000						
fwtstate	0.316	0.125	0.361	0.038	0.028	0.037	0.158	1.000					
fsmkstat	-0.031	0.053	-0.011	-0.016	0.106	0.195	0.090	-0.074	1.000				
fanyadl	0.224	0.291	0.192	0.240	0.516	0.271	0.565	0.088	0.073	1.000			
fanyiadl	0.160	0.218	0.213	0.280	0.490	0.301	0.541	0.047	0.160	0.662	1.000		
fwork	-0.117	-0.317	-0.250	-0.292	-0.406	-0.289	-0.452	-0.053	-0.006	-0.392	-0.580	1.000	
g(iearnx)	-0.055	-0.276	0.041	-0.287	0.271	-0.101	-0.497	-0.103	-0.087	-0.337	0.210	0.323	12.423

$g(.)$ is the generalized inverse hyperbolic sin transform.

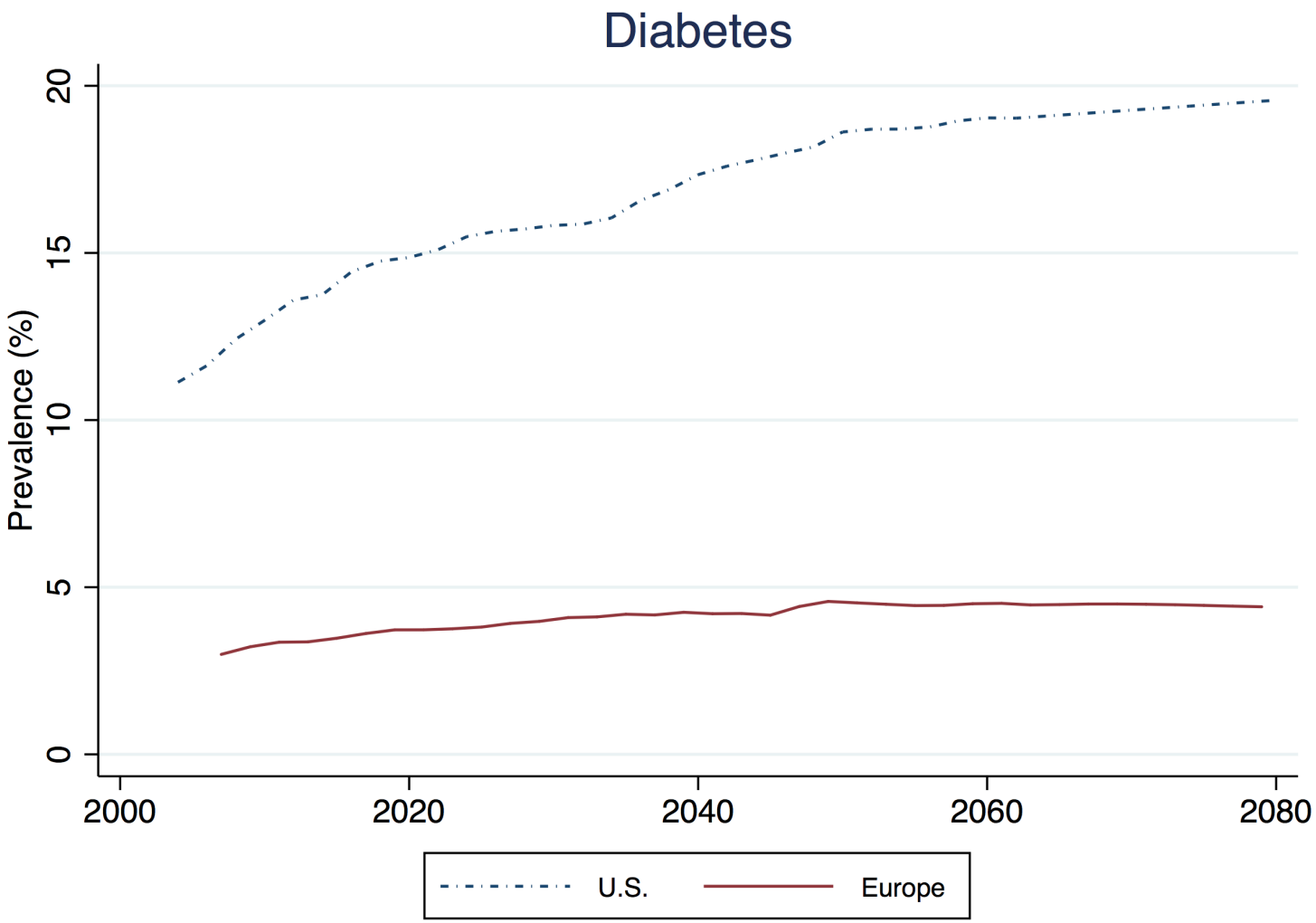
Estimated covariance matrix (estimated on the 50-55 years sample, HRS wave 1)

	fhibpe	fhearte	fdiabe	fshlt	fwtstate	fsmkstat	Function Status	fwork	g(iearnx)
fhibpe	1								
fhearte	0.277	1							
fdiabe	0.300	0.232	1						
fshlt	0.290	0.430	0.325	1					
fwtstate	0.282	0.083	0.157	0.134	1				
fsmkstat	-0.017	0.014	-0.001	0.076	-0.116	1			
Function Status	0.120	0.198	0.104	0.416	0.086	-0.020	1		
fwork	-0.072	-0.220	-0.095	-0.396	0.013	-0.047	-0.361	1	
g(iearnx)	0.005	-0.024	-0.087	-0.087	-0.003	-0.041	-0.104	0.000	-9.660

$g(.)$ is the generalized inverse hyperbolic sin transform.

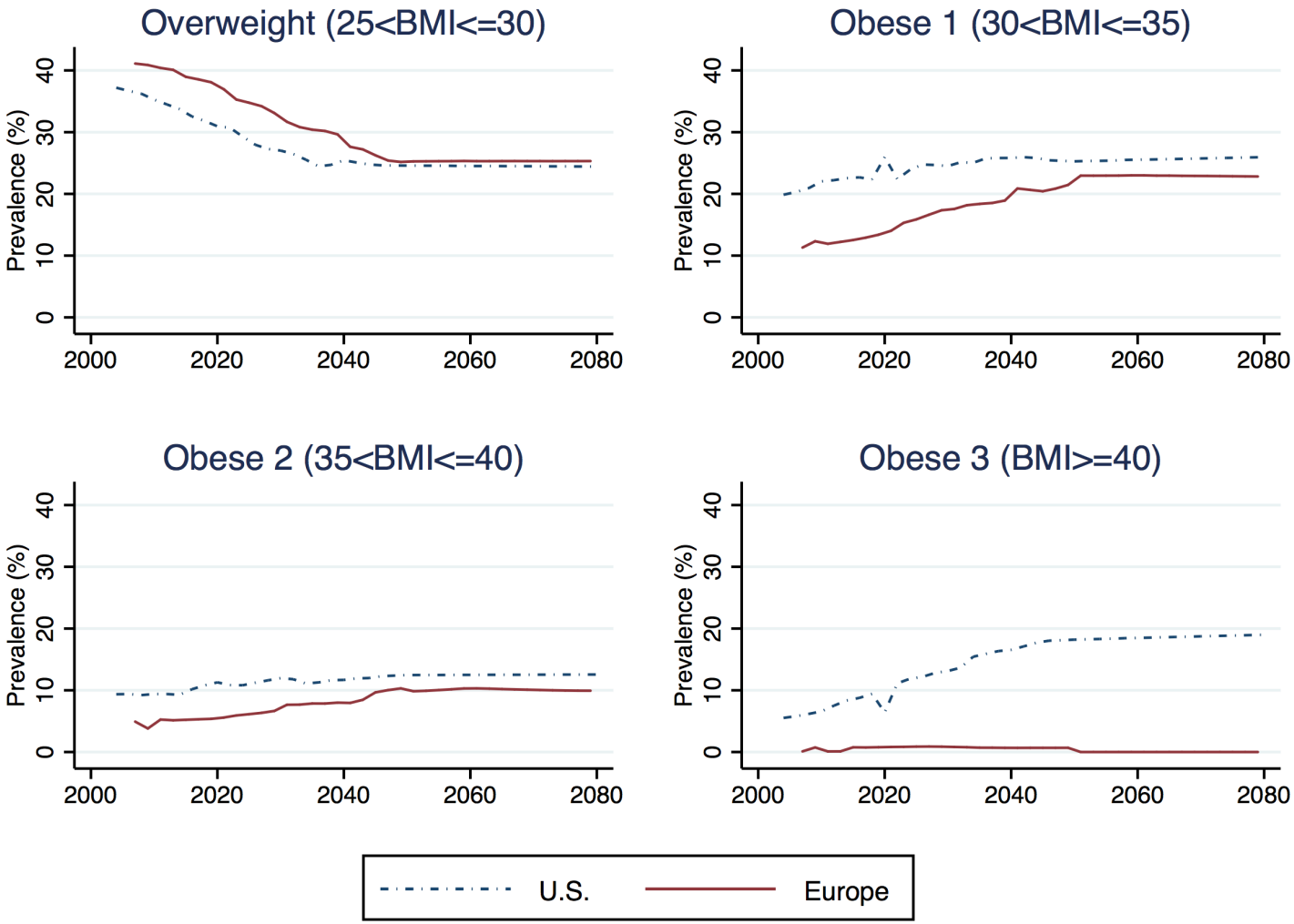
New cohorts

EU vs US: comparison of predicted outcomes for new cohorts



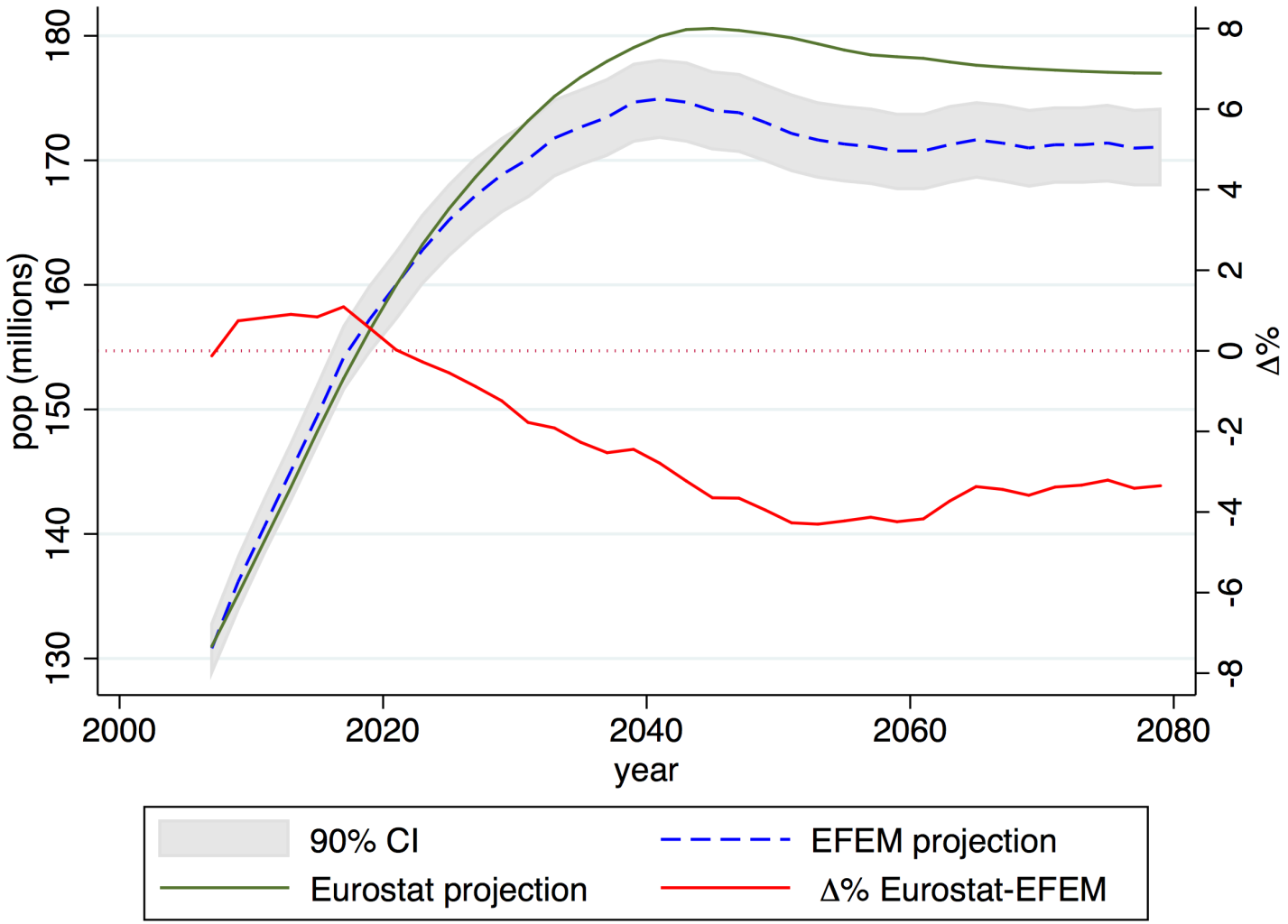
New cohorts

EU vs US: comparison of predicted outcomes for new cohorts - 2



Status Quo

Population - 1



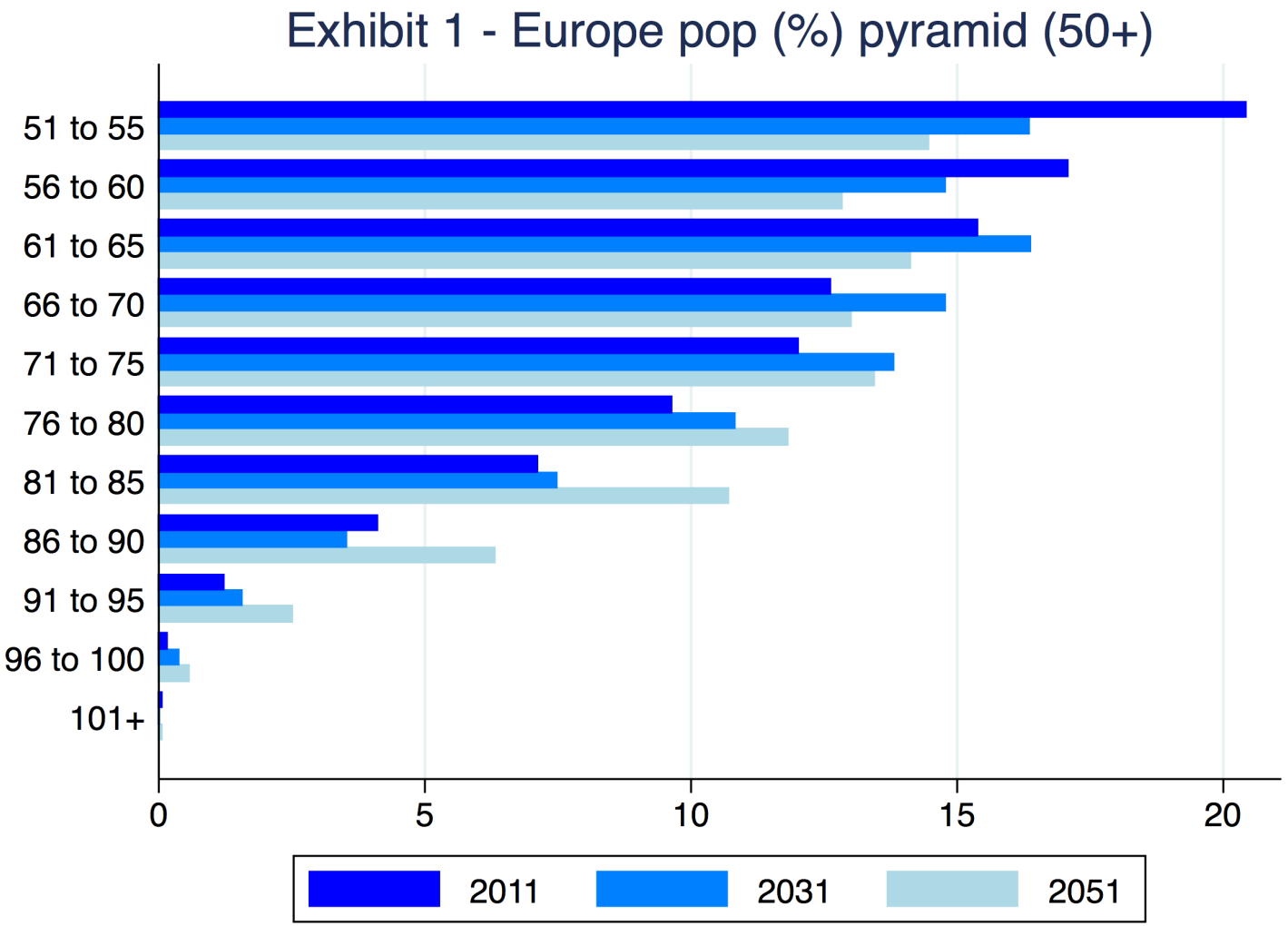


Exhibit 1 - Europe pop (%) pyramid (50+)
51 to 55
56 to 60
61 to 65
66 to 70
71 to 75
76 to 80
81 to 85
86 to 90
91 to 95
96 to 100
101+
0
5
10
15
20
2011
2031
2051

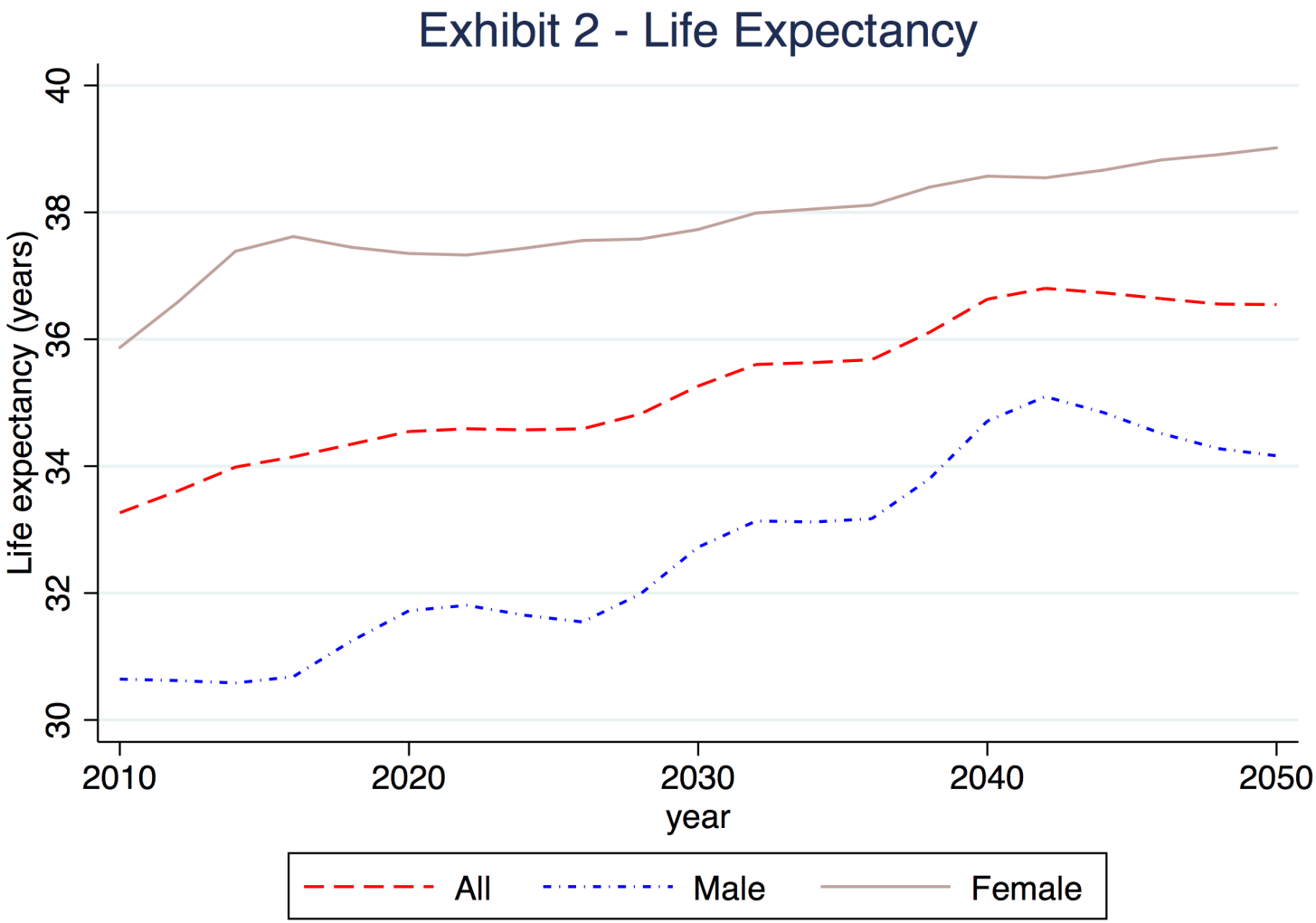


Exhibit 2 - Life Expectancy
Life expectancy (years)
30
32
34
36
38
40
2010
2020
2030
2040
2050
year
All
Male
Female

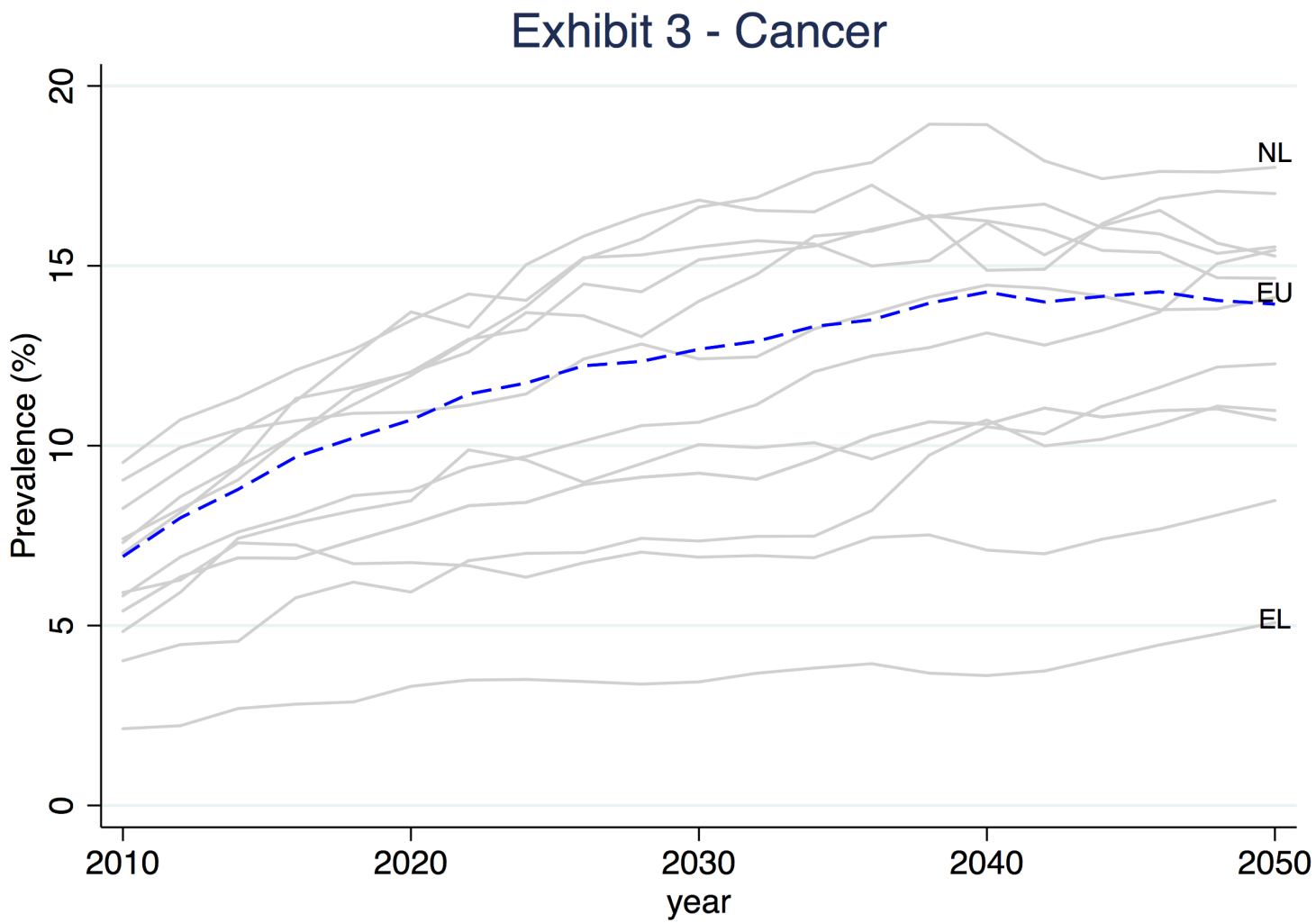


Exhibit 3 - Cancer
Prevalence (%)
0
5
10
15
20
2010
2020
2030
2040
2050
year
NL
EU
EL

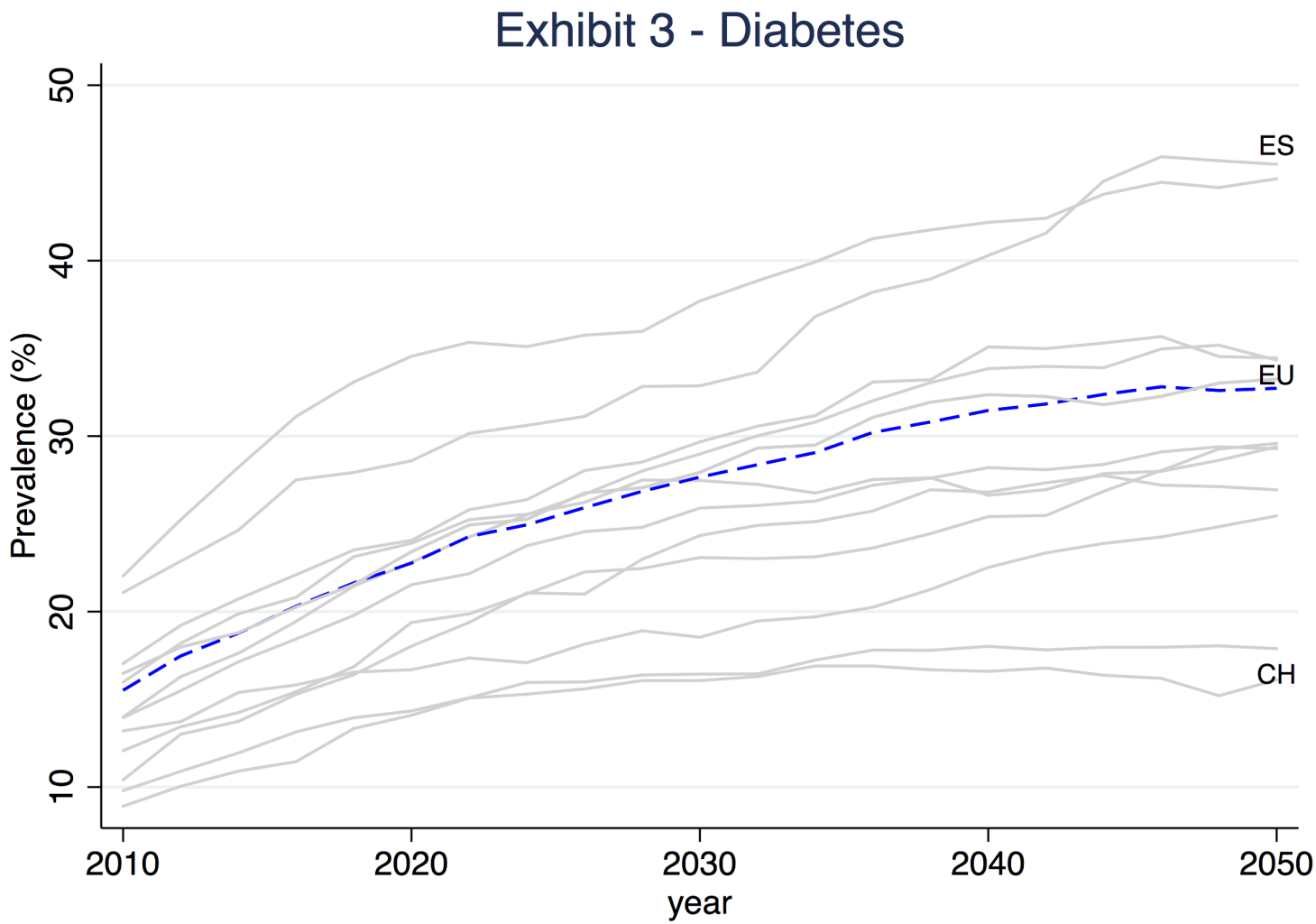


Exhibit 3 - Diabetes
Prevalence (%)
10
20
30
40
50
2010
2020
2030
2040
2050
year
ES
EU
CH

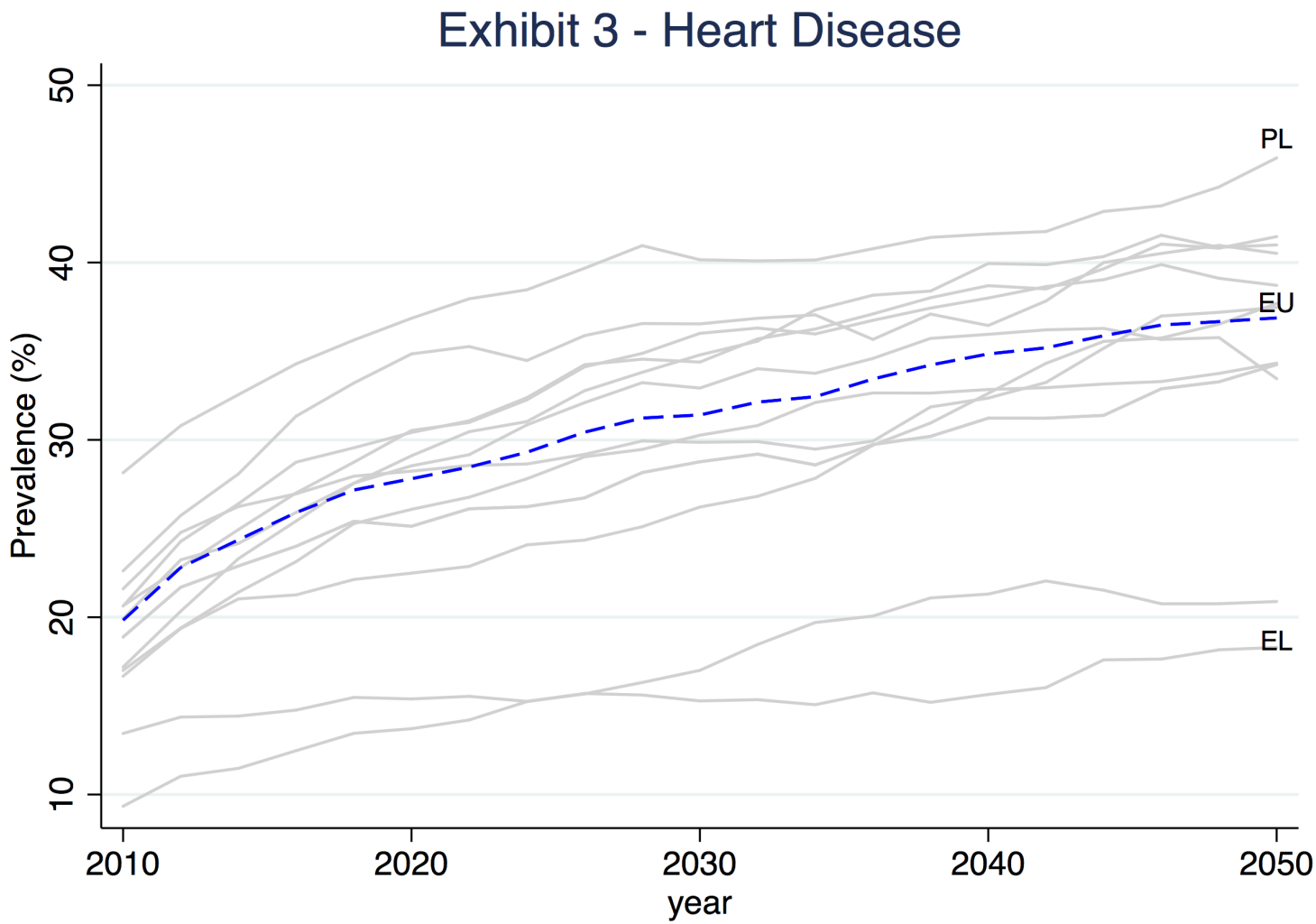


Exhibit 3 - Heart Disease
Prevalence (%)
10
20
30
40
50
2010
2020
2030
2040
2050
year
PL
EU
EL

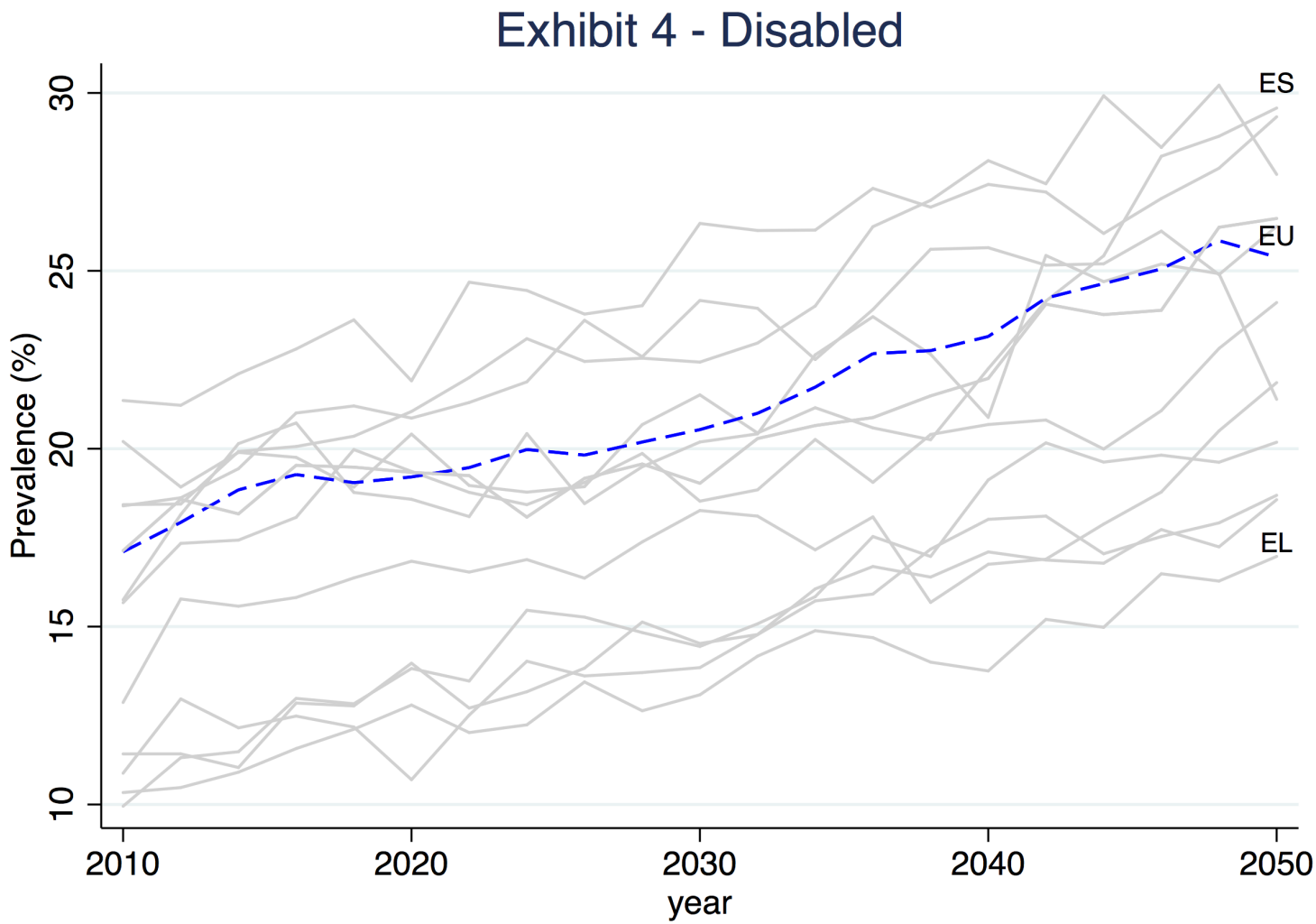
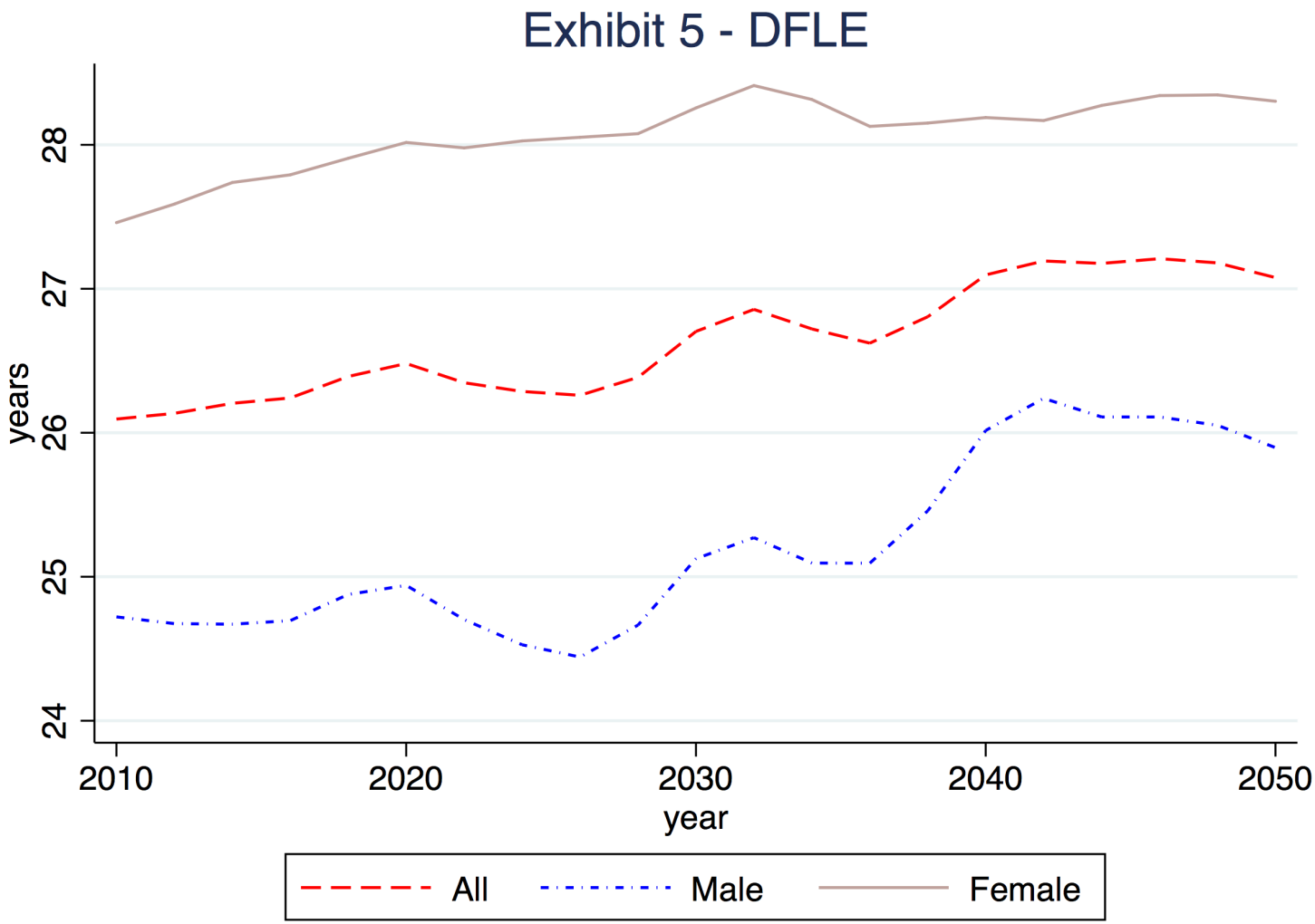


Exhibit 4 - Disabled
Prevalence (%)
10
15
20
25
30
2010
2020
2030
2040
2050
year
ES
EU
EL

Status Quo

DFLE



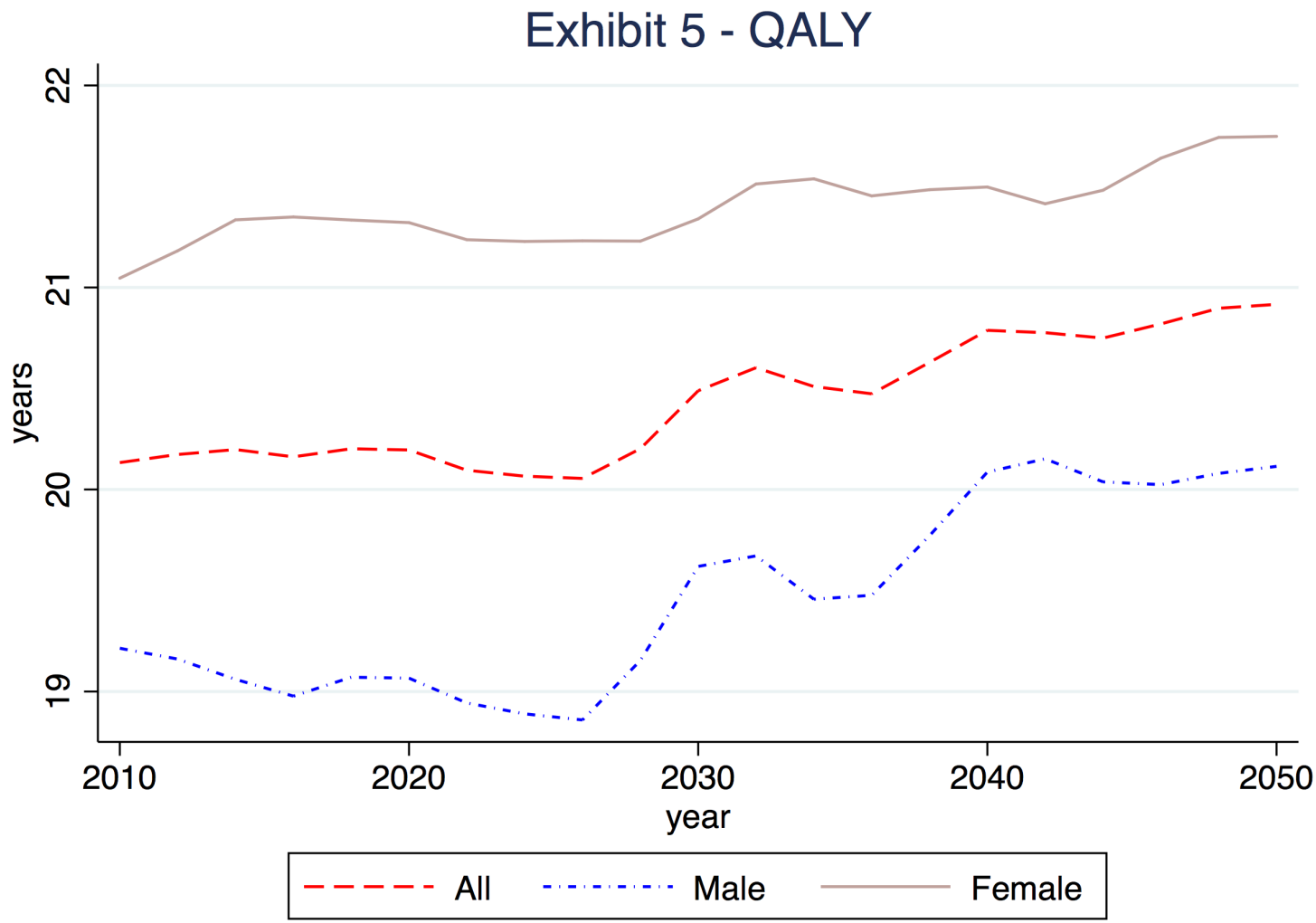


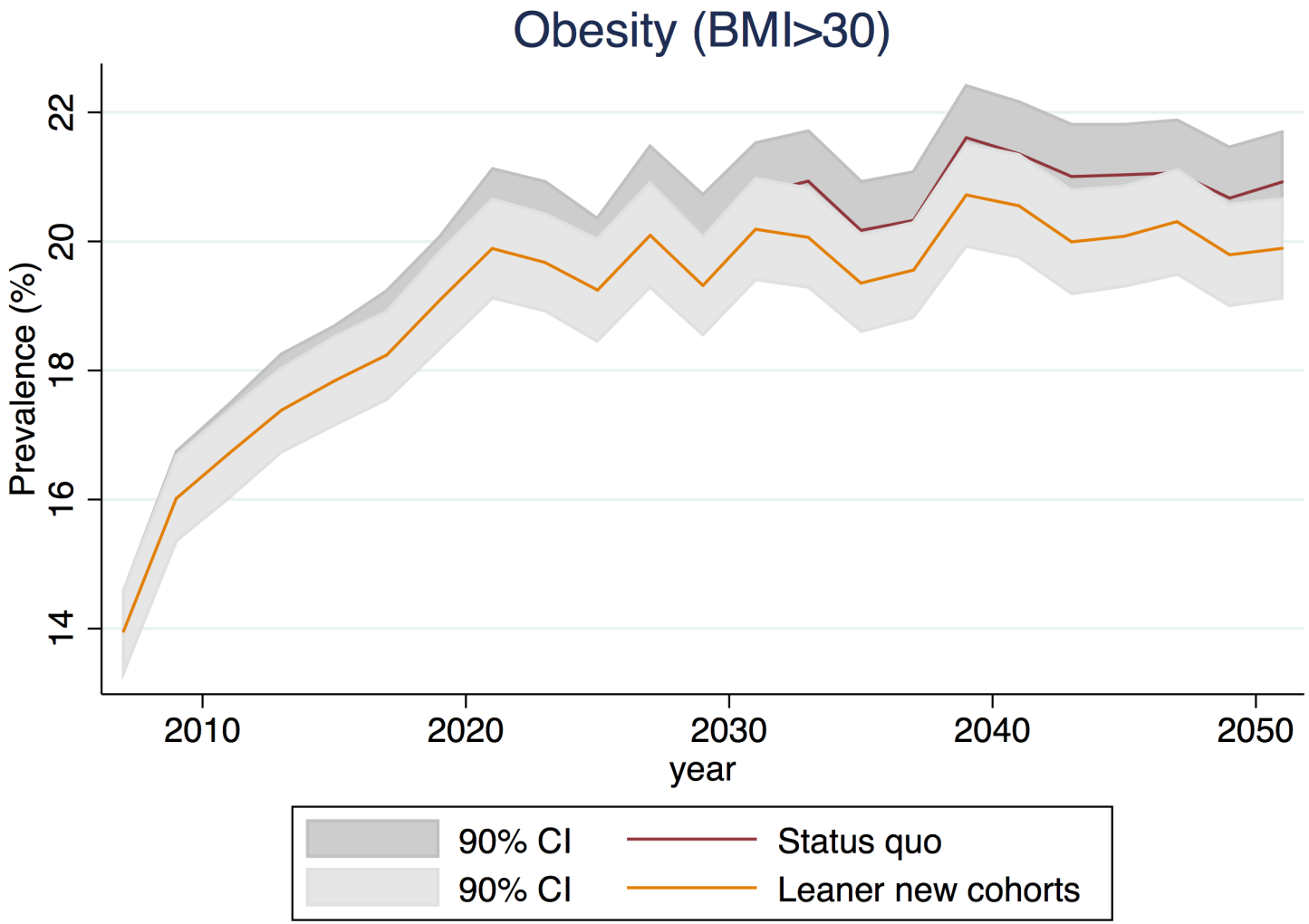
Exhibit 5 - QALY
years
22
21
20
19
2010
2020
2030
2040
2050
year
All
Male
Female

Example: Leaner new cohorts

- Evaluation of changes in trends of risk factors (BMI classes) for chronic conditions.
- This is implemented by altering the trend of incoming cohorts (50-51 year-olds) BMI classes.
- Target: 44% reduction in obese 1 ($30 < \text{BMI} \leq 35$), 54% reduction in $35 < \text{BMI} \leq 40$, and 58% reduction in obese 3 ($\text{BMI} > 40$).

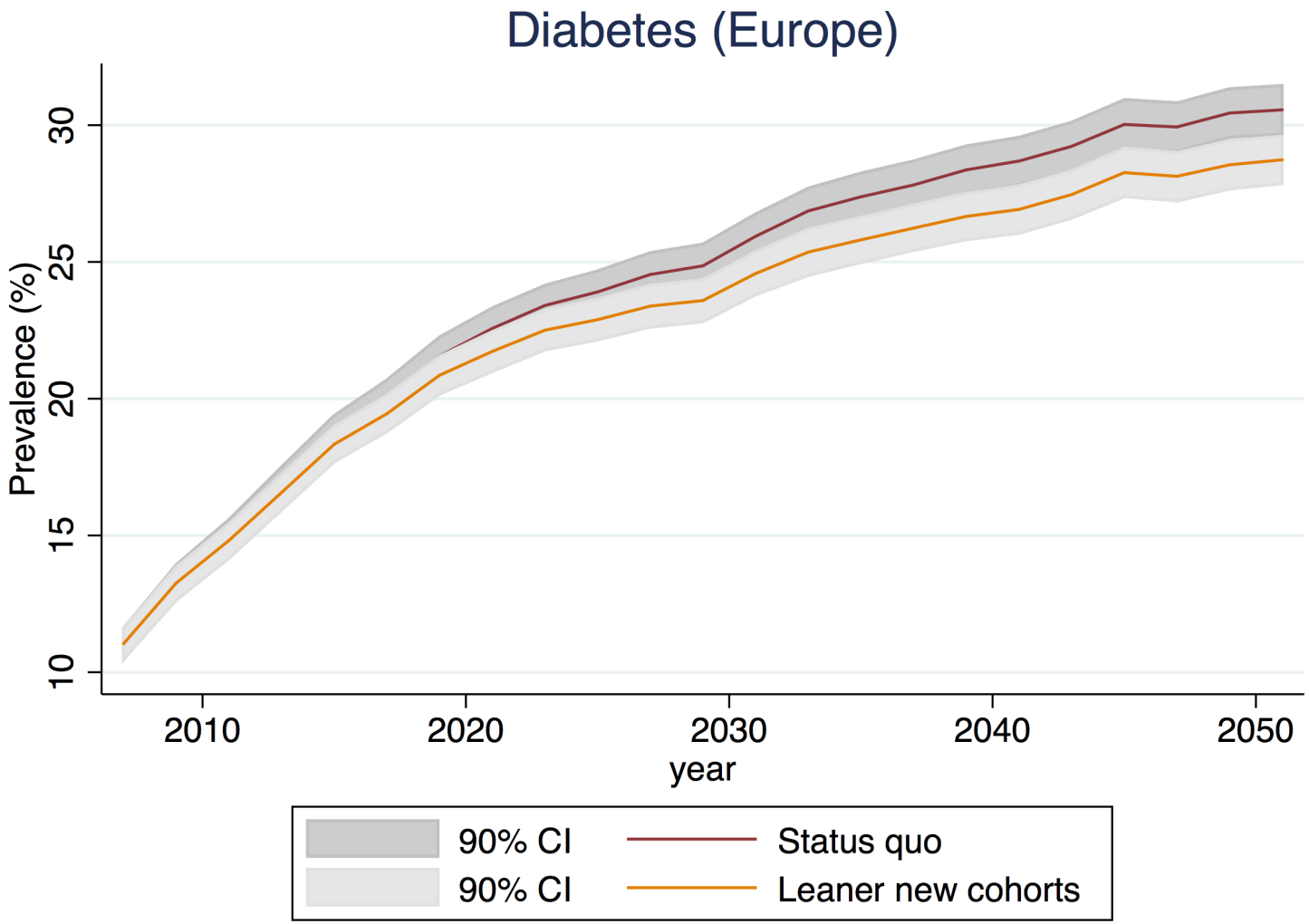
Example: Leaner new cohorts

Europe (all 13 countries)



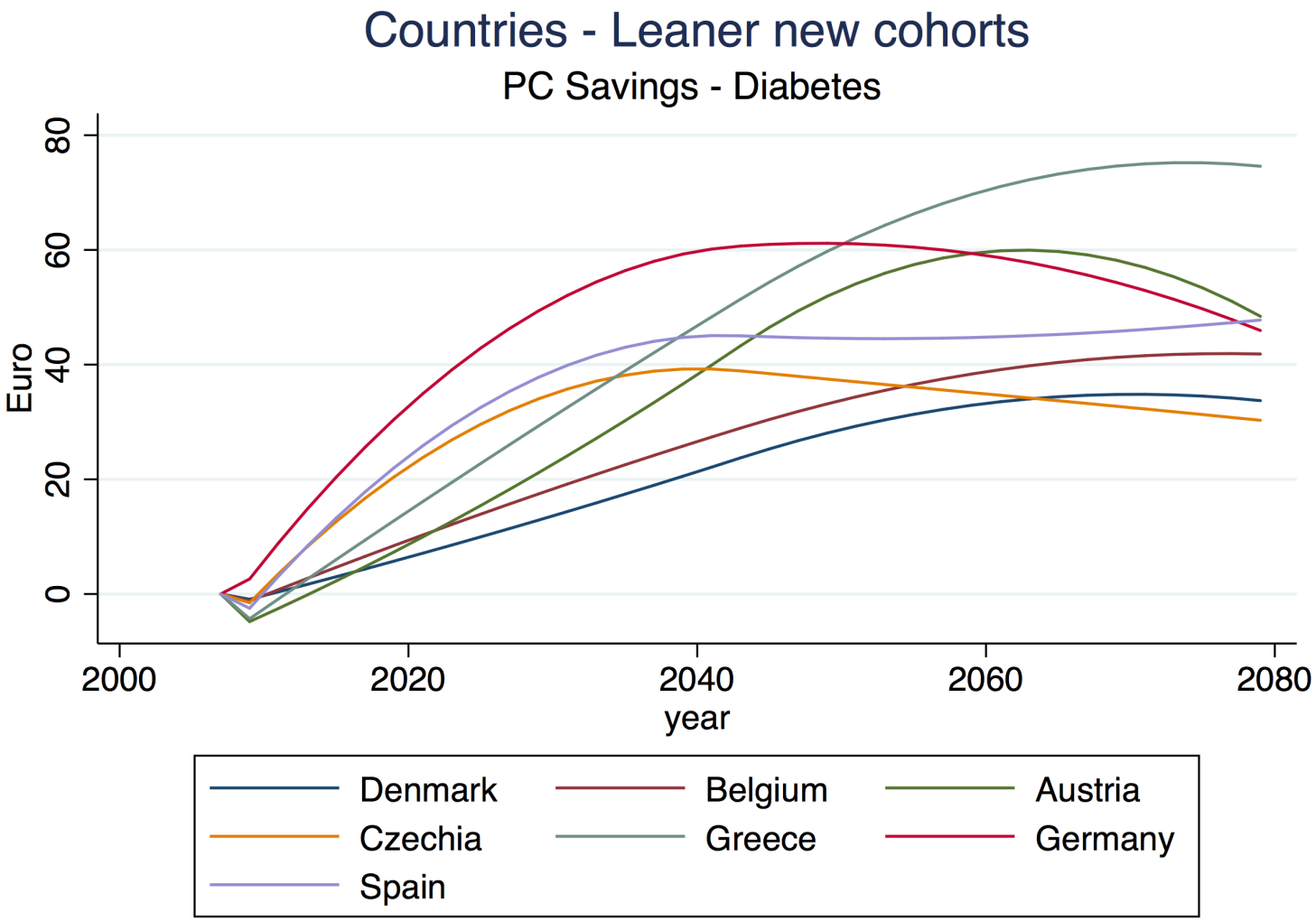
Example: Leaner new cohorts

Europe (all 13 countries)



Example: Leaner new cohorts

PC savings heterogeneity



Example: Leaner new cohorts

PC savings heterogeneity