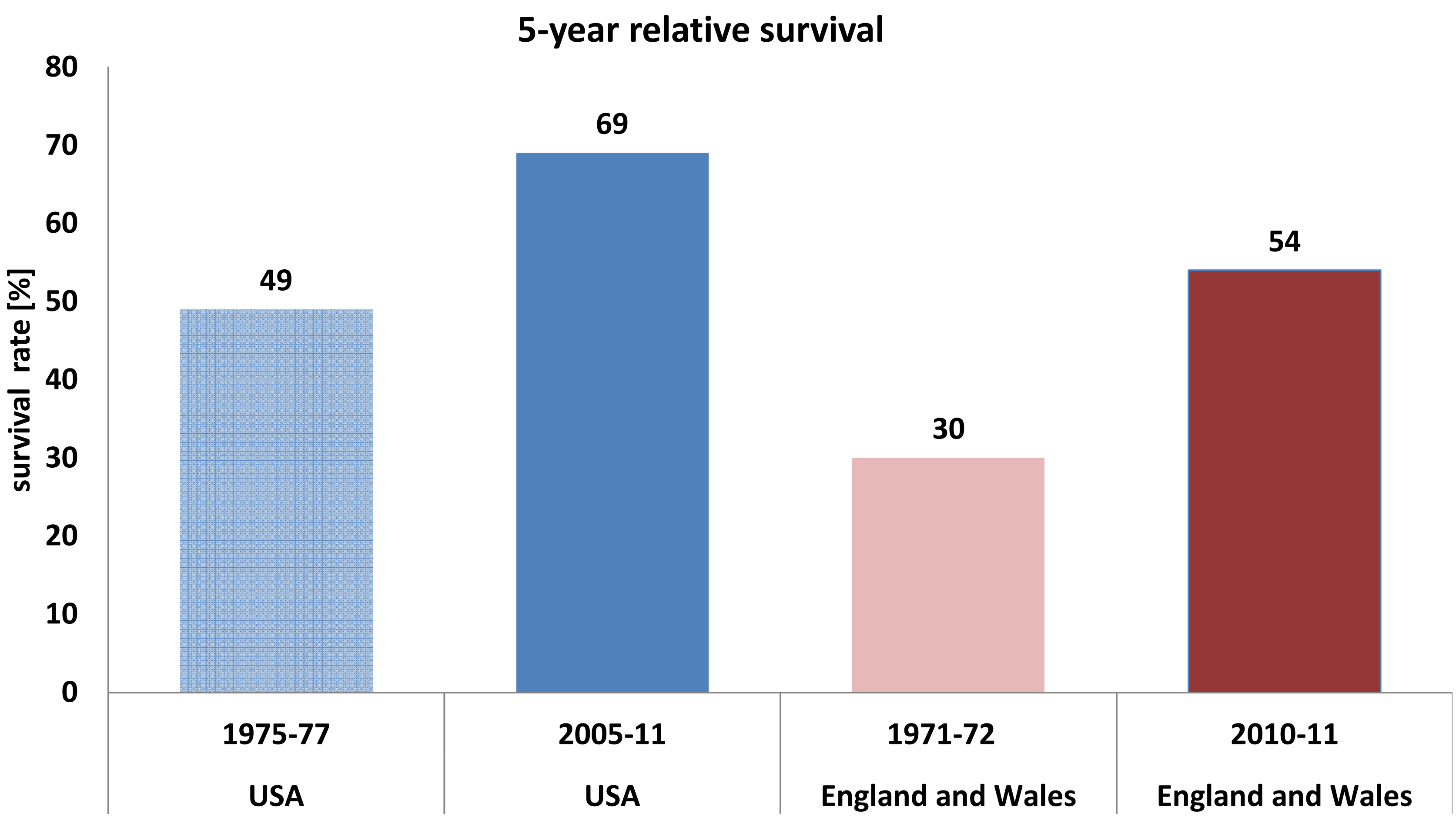
ROBERT KOCH INSTITUT

Trends of cancer survival rates estimated from data of German epidemiologic cancer registries

Stefan Dahm
Zentrum für Krebsregisterdaten
Abteilung für Epidemiologie und Gesundheitsberichtserstattung
Robert Koch Institut

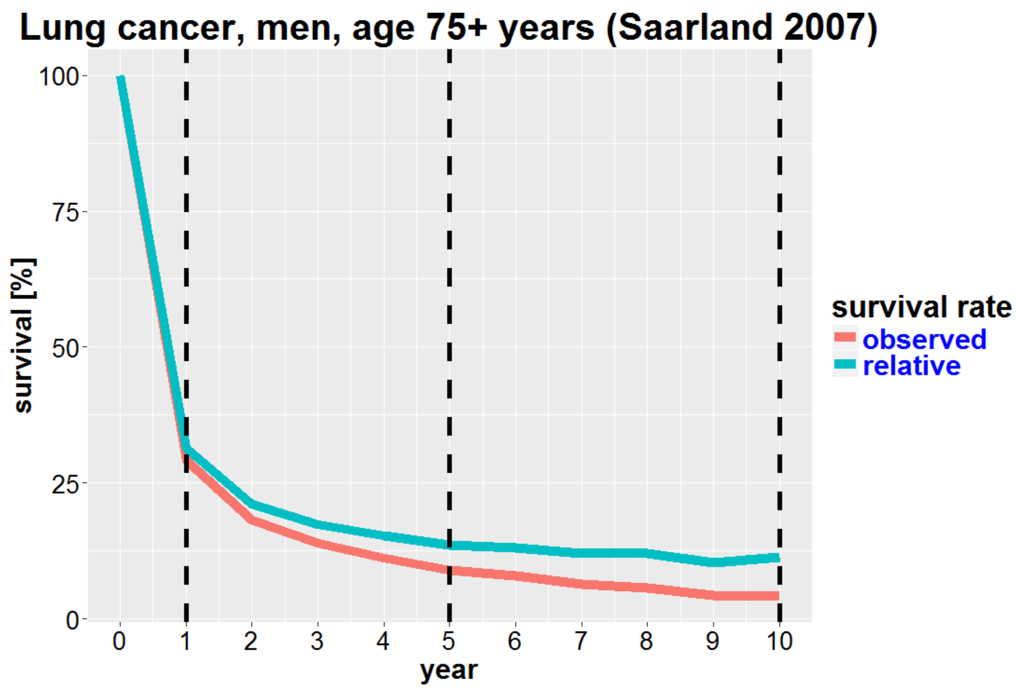
Improvement of 5-year survival for all cancer combined



ROBERT KOCH INSTITUT

Relative survival rate

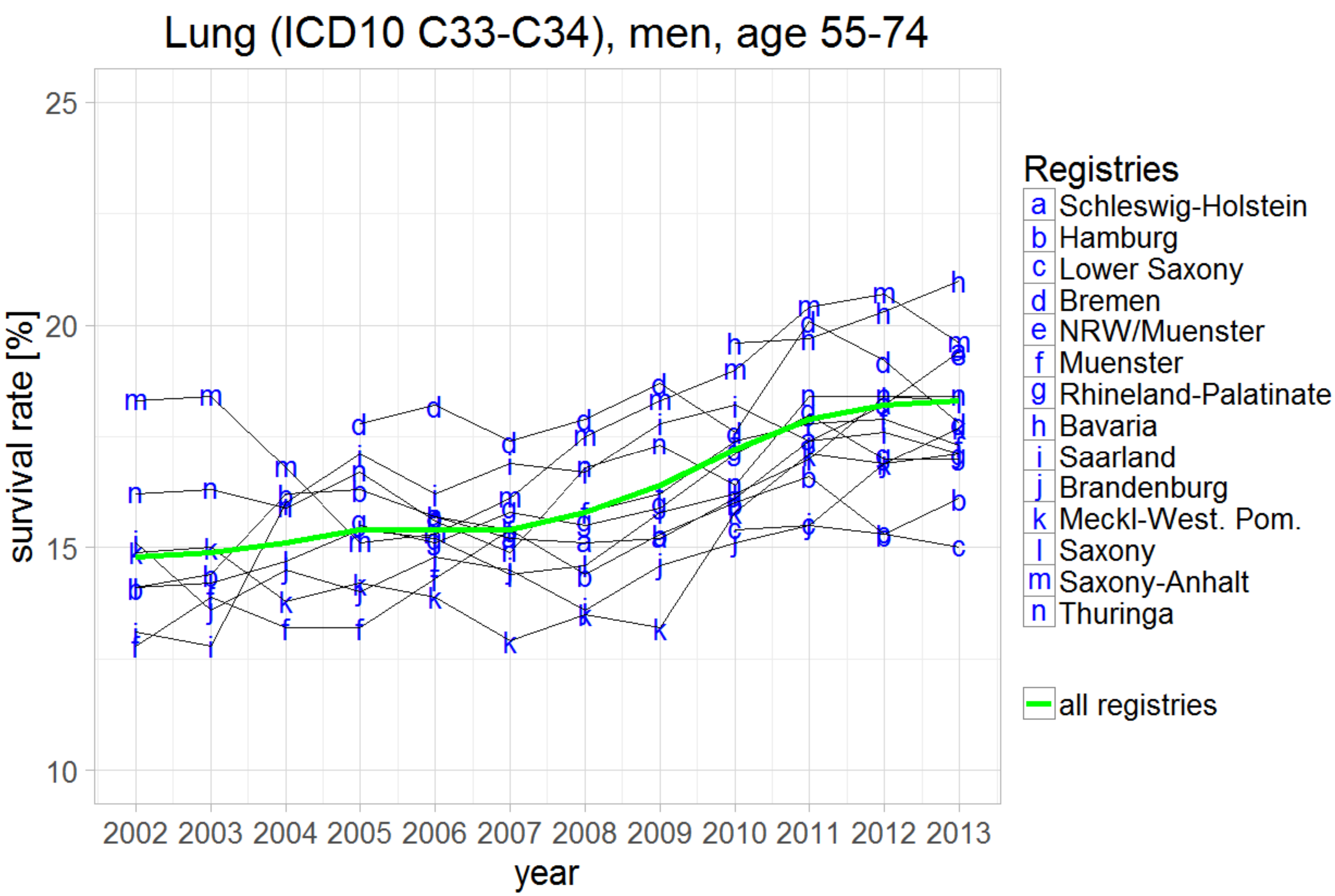
$$relative\ survival\ rate = \frac{\text{observed survival rate of cancer cases}}{\text{expected survival rate of the general population}}$$



Relative survival is observed survival controlled for backgound motrallity

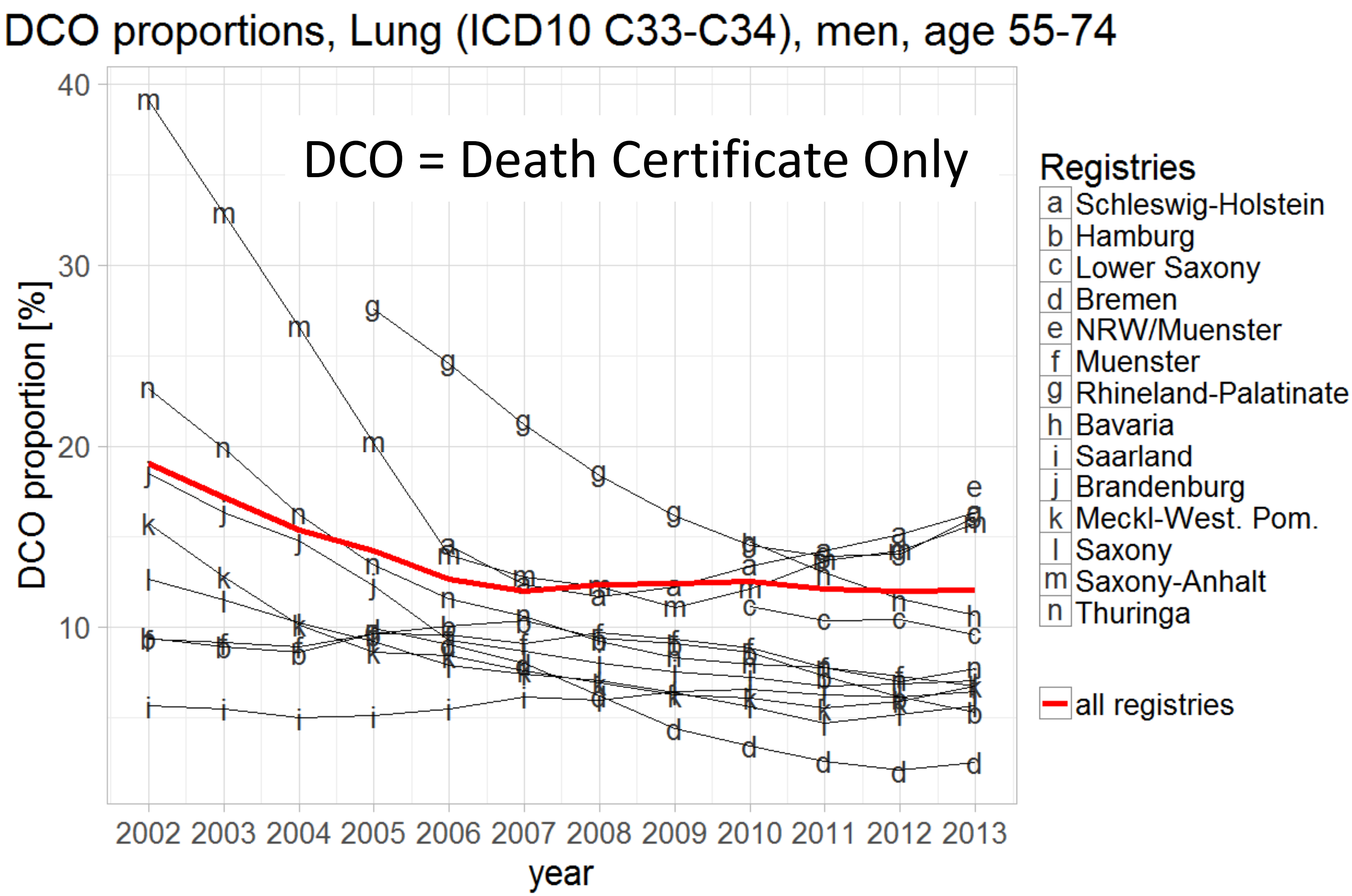
ROBERT KOCH INSTITUT

5-year relative survival rates by registries and years



ROBERT KOCH INSTITUT

DCO proportions by registries and observation years

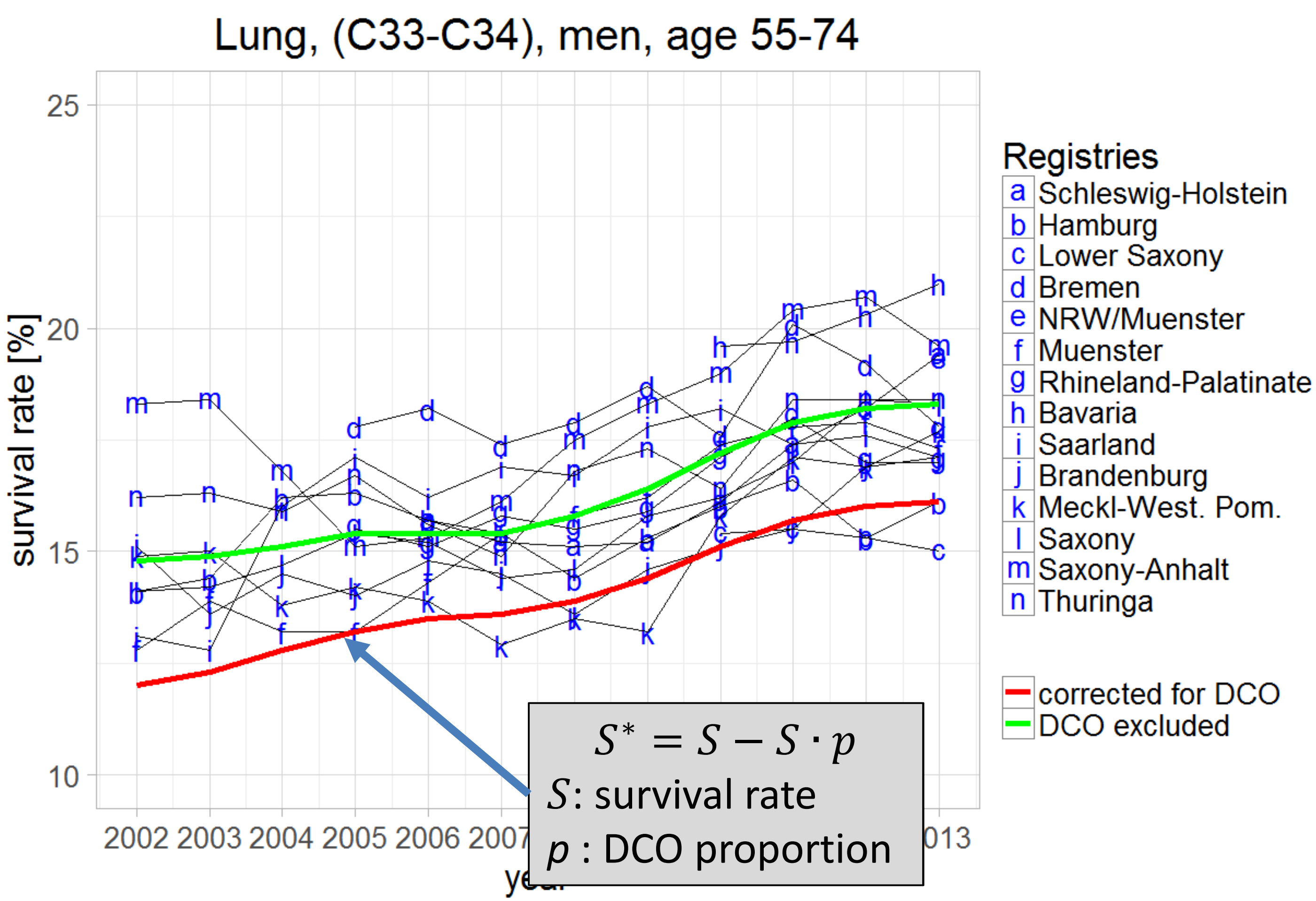


Bias on survival rate estimation related to incomplete incidence notification

Missed incidence notification	**Bias direction**
DCO cases	overestimation
Still living at follow–up end	underestimation

ROBERT KOCH INSTITUT

5-year relative survival corrected for DCO



$$S^* = S - S \cdot p$$

S: survival rate

p : DCO proportion

Silcocks, P. and C. S. Thomson (2009). Correcting population-based survival for DCOs - why a simple method works and when to avoid it. Eur J Cancer **45**(18): 3298-3302

Aim of the study

Estimating trends in cancer survival in presence of non negligible proportions of missed incidence notifications.

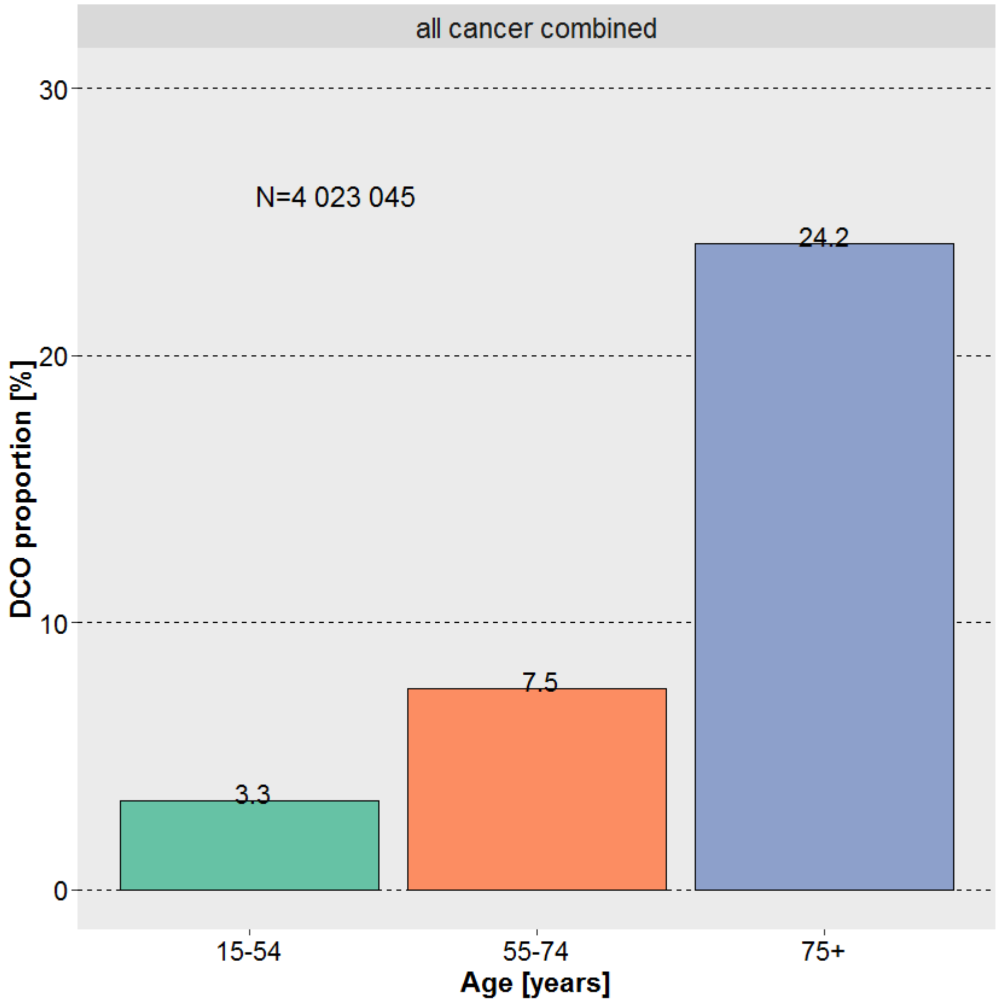
Data

4.0 million cancer cases notified by 14 German epidemiologic cancer registries in the years 1997 to 2013
(Data were provided to Robert Koch Institute)

DCO	Freq.	Proportion
yes	488 378	12.1 %
no	3 534 667	87.9 %
total	4 023 045	100.0 %

Data

DCO proportions by age groups



Method

5-year relative survival rates were estimated by excluding DCO cases stratified by cancer site, registry, calendar year (2002 to 2013), age group and sex.

$$N = 131 \text{ per cancer site, age group and sex}$$

DCO proportions recorded for the same strata.

Method

Dataset: Lung (ICD10 C33-C34), men, age: 55-74 years, N=131

Registry	year	5-year relative survival	DCO proportion
Meckl-West. Pom.	2002	14.9	15.7
Brandenburg	2002	15.1	18.5
Saarland	2002	13.1	5.6
...	...	...	...
Brandenburg	2013	17.1	15.9
Saxony	2013	18.3	17.3
Hamburg	2013	16.1	15.2

ROBERT KOCH INSTITUT

Hierarchical linear regression

$$S_{ij} = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

S_{ij}: Survival rate in calendar year *j* in registry *i, i=1,…, 14* correspond to registry

α: global intercept (fixed effect)

Random intercept(Reg$_i$): Register specific derivation from the global intercept

$trend$: Change of survival rates per calendar year (fixed effect)

$year_j$: calendar year *j=0,…, 11* (0 correspond to 2002, 11 correspond to 2013)

β: Bias per percent DCO (fixed effect)

p_{ij}: DCO proportion in registry *i* in observation period *j*

ε_{ij}: Residual in registry *i* and year *j*

ROBERT KOCH INSTITUT

Fixed effects of mixed linear regression

$$S_{ij} = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

Lung (ICD10 C33-C34), Men, Age: 55-74

Intercept α	trend (year)	β (p DCO proportion)
12.2* [11.1, 13.2]	0.42* [0.36, 0.48]	0.14* [0.10, 0.19]

5-year relative survival in 2002 controled for DCO bias

*: P < 0.0001

ROBERT KOCH INSTITUT

Fixed effects of mixed linear regression

$$S_{ij} = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

Lung (ICD10 C33-C34), Men, Age: 55-74 years

Intercept α	trend (year)	β (p DCO proportion)
12.2* [11.1, 13.2]	0.42* [0.36, 0.48]	0.14* [0.10, 0.19]

Increase of survival by 0.42 percent units per year

*: P < 0.0001

ROBERT KOCH INSTITUT

Fixed effects of mixed linear regression

$$S_{ij} = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

Lung (ICD10 C33-C34), Men, Age: 55-74 years

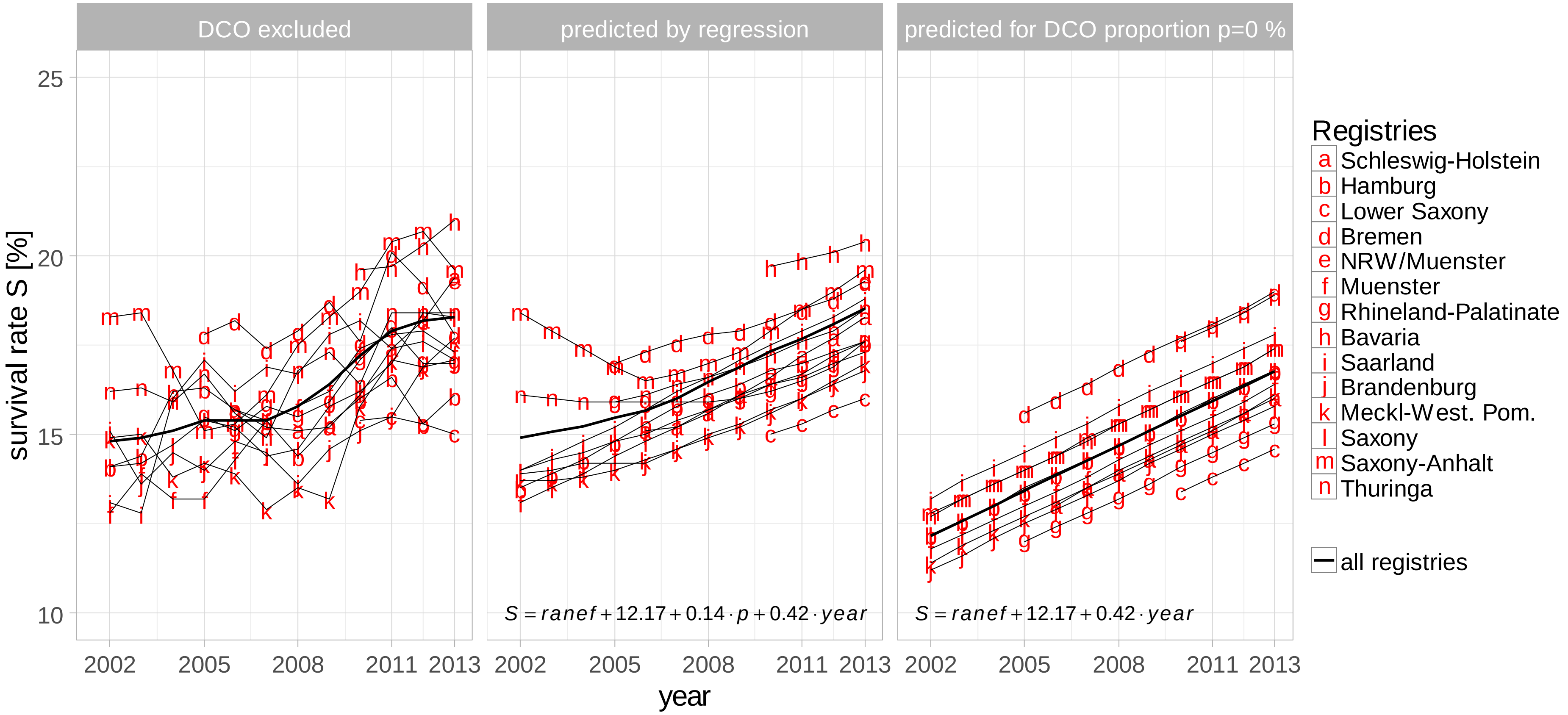
Intercept α	trend (year)	β (p DCO proportion)
12.2* [11.1, 13.2]	0.42* [0.36, 0.48]	0.14* [0.10, 0.19]

Bias per percent DCO (10 % DCO => 1.4 percent units overestimation)

*: P < 0.0001

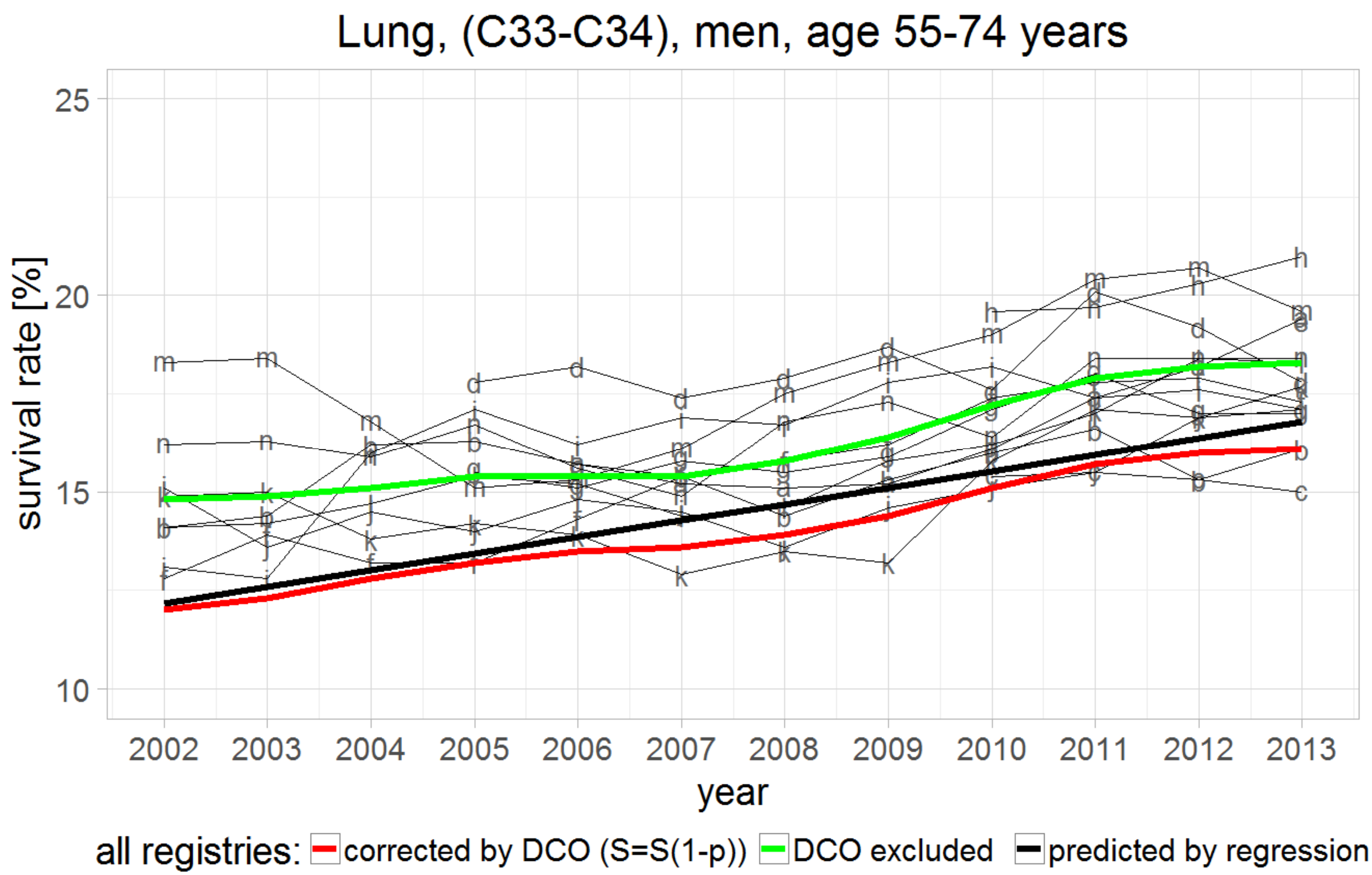
ROBERT KOCH INSTITUT

Lung (ICD10 C33-C34), men, age: 55-74 years



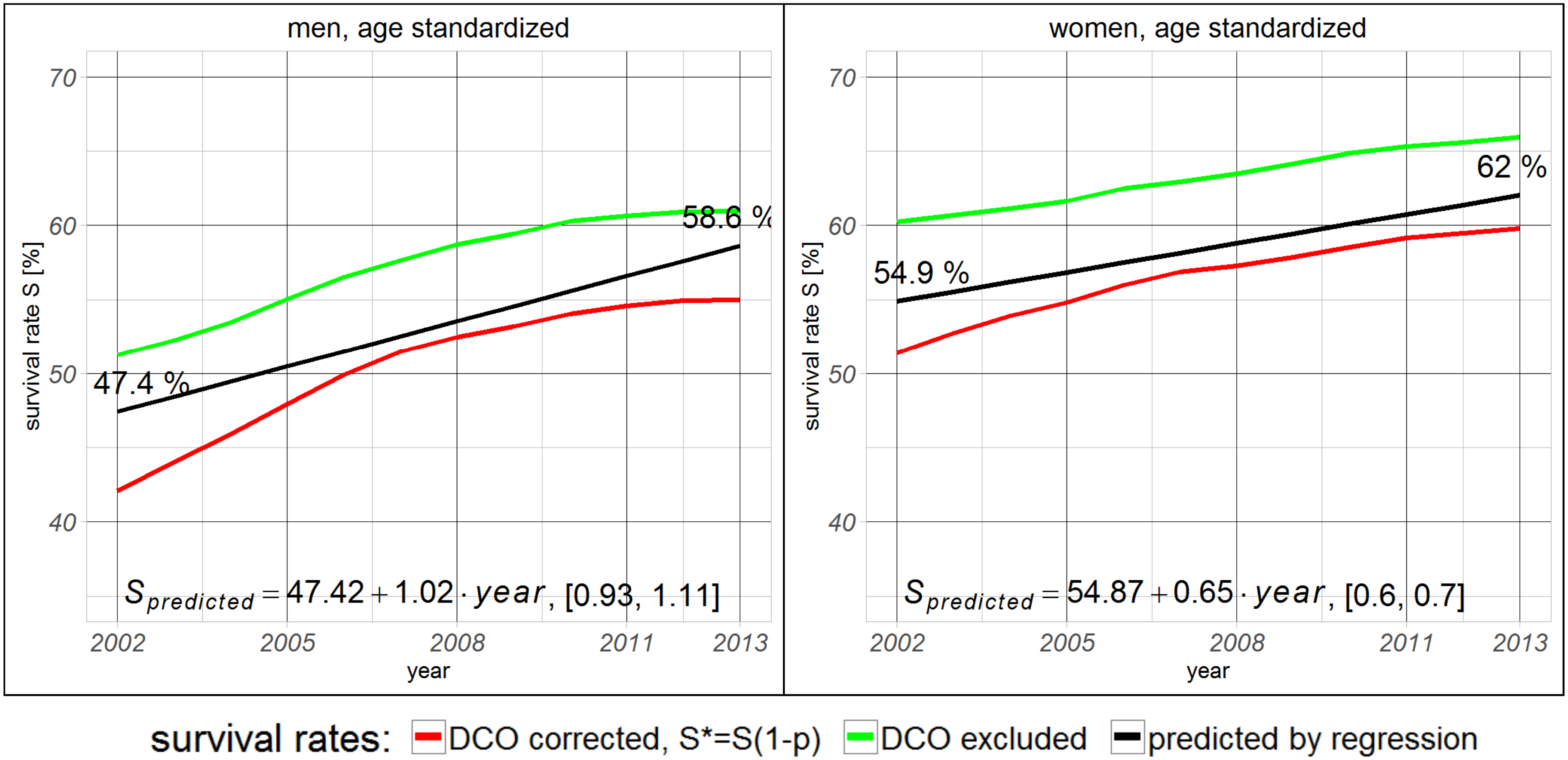
ROBERT KOCH INSTITUT

Plausibility range for modeled trend



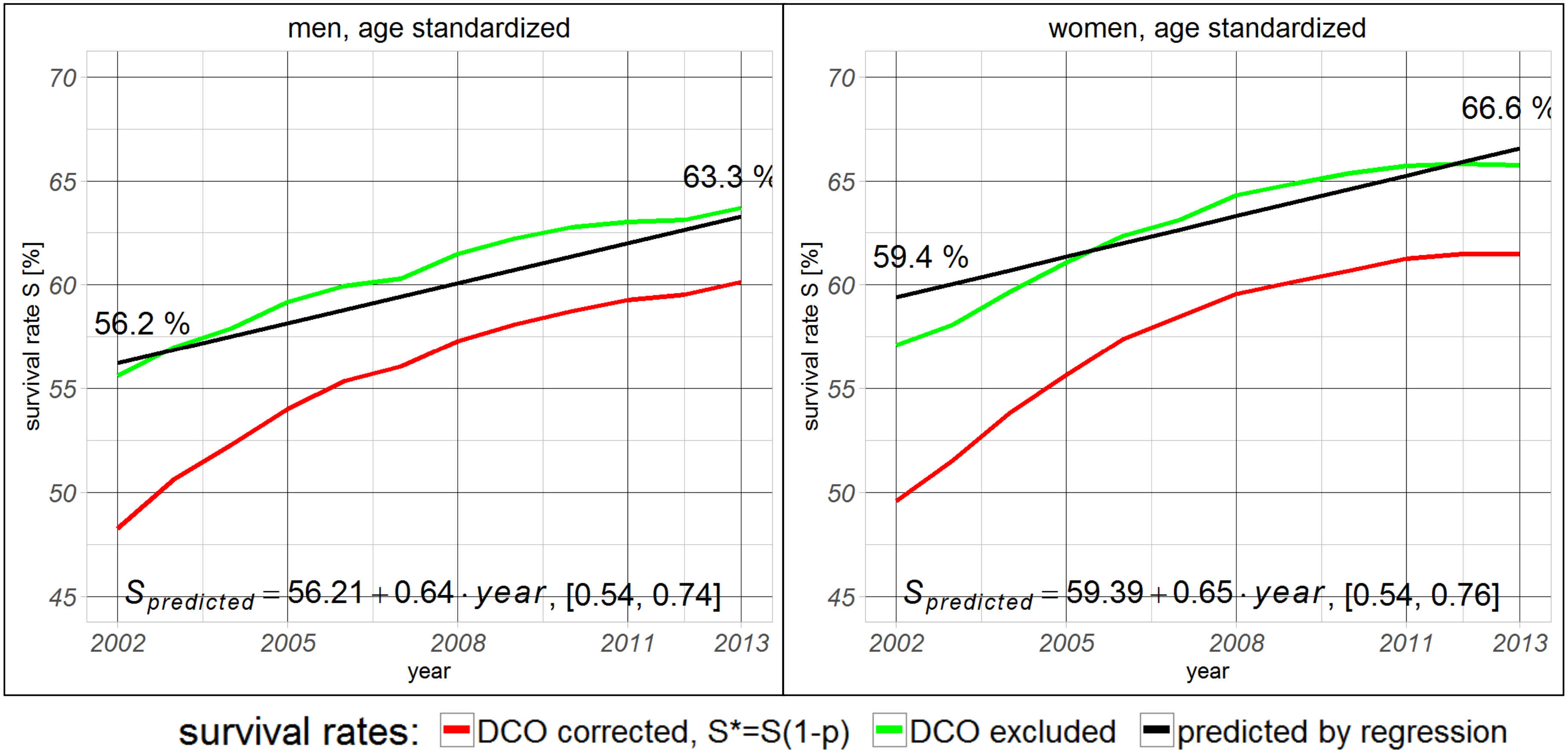
Results

All cancers combined (C00-C97 except C44), 5-year relative survival



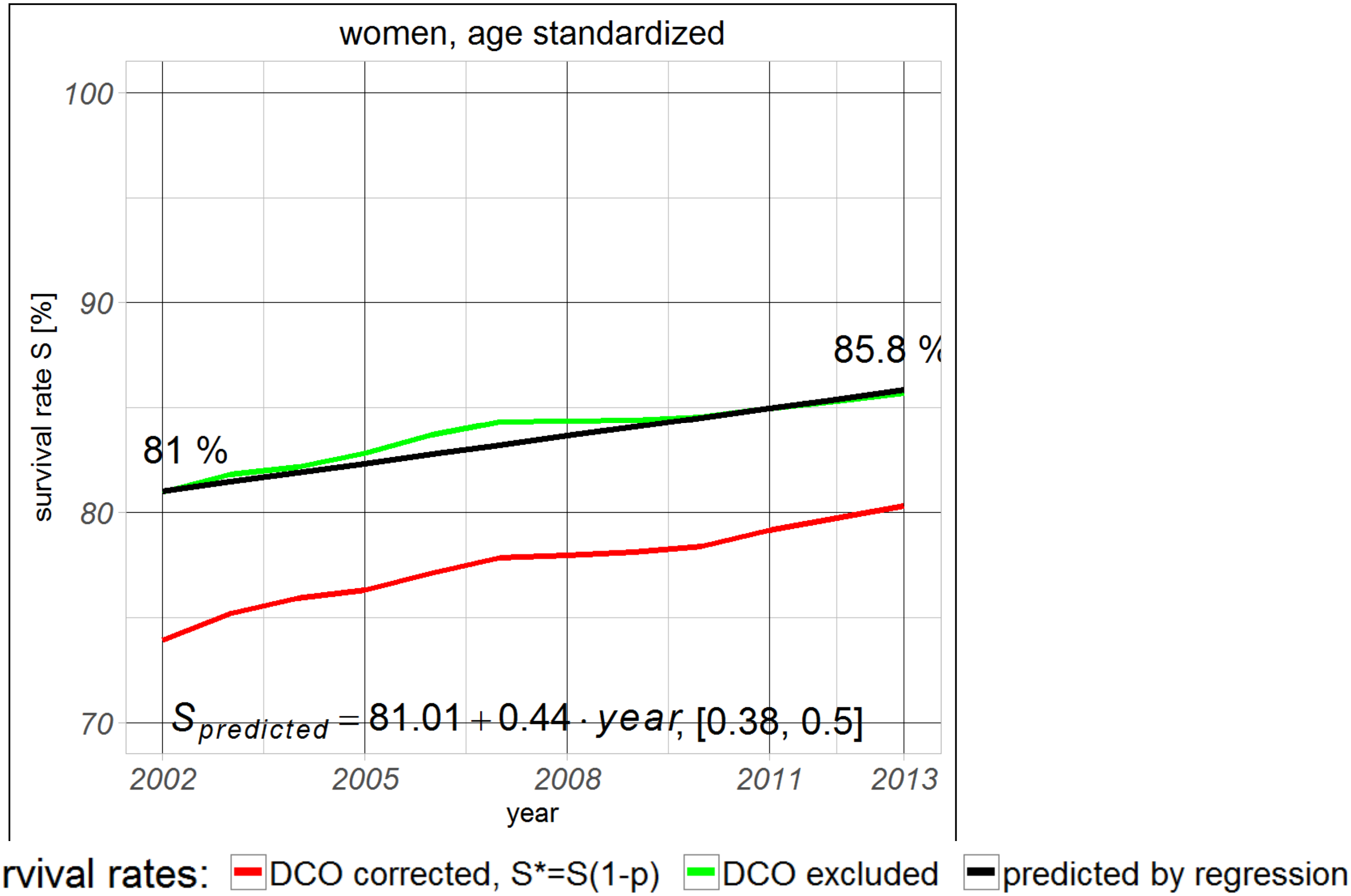
ROBERT KOCH INSTITUT

Colorectal (C18 – C21), 5-year relative survival



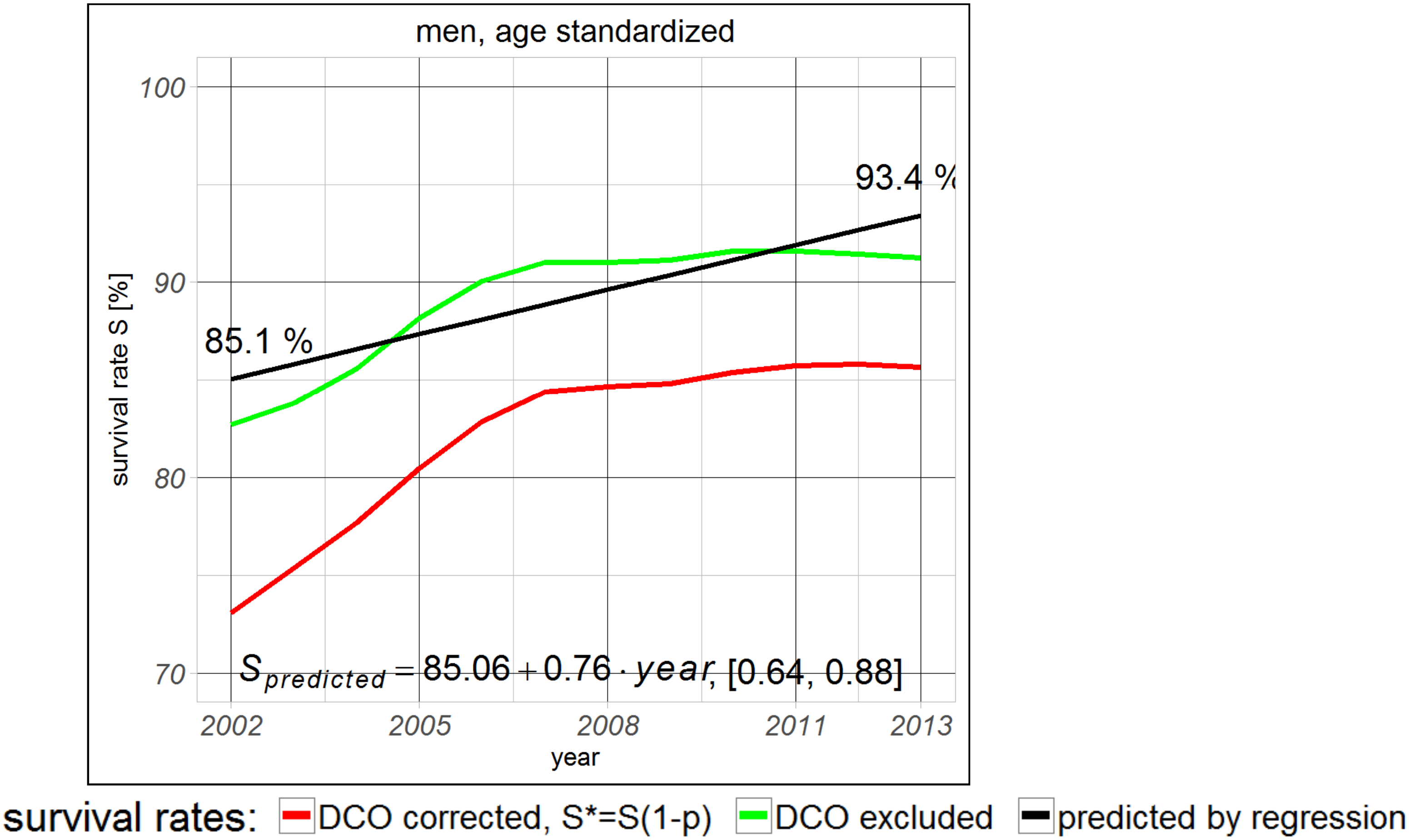
ROBERT KOCH INSTITUT

Breast cancer (ICD10 C50), 5-year relative survival



ROBERT KOCH INSTITUT

Prostate (ICD10 C61), 5-year relative survival



ROBERT KOCH INSTITUT

Summary

We introduced a method to estimate trends in cancer survival controlled for incomplete registration of cancer incidence.

ROBERT KOCH INSTITUT

Vielen Dank

ROBERT KOCH INSTITUT

Death Certificate Only (DCO)

- DCO cases **can not** be used for survival time estimation since dates of diagnosis are missing
- DCO cases have in average shorter survival times than cases notified **at life time**
- Survival rates estimated by excluding DCO cases are often biased (overestimated)
- Bias is correlated with DCO proportions

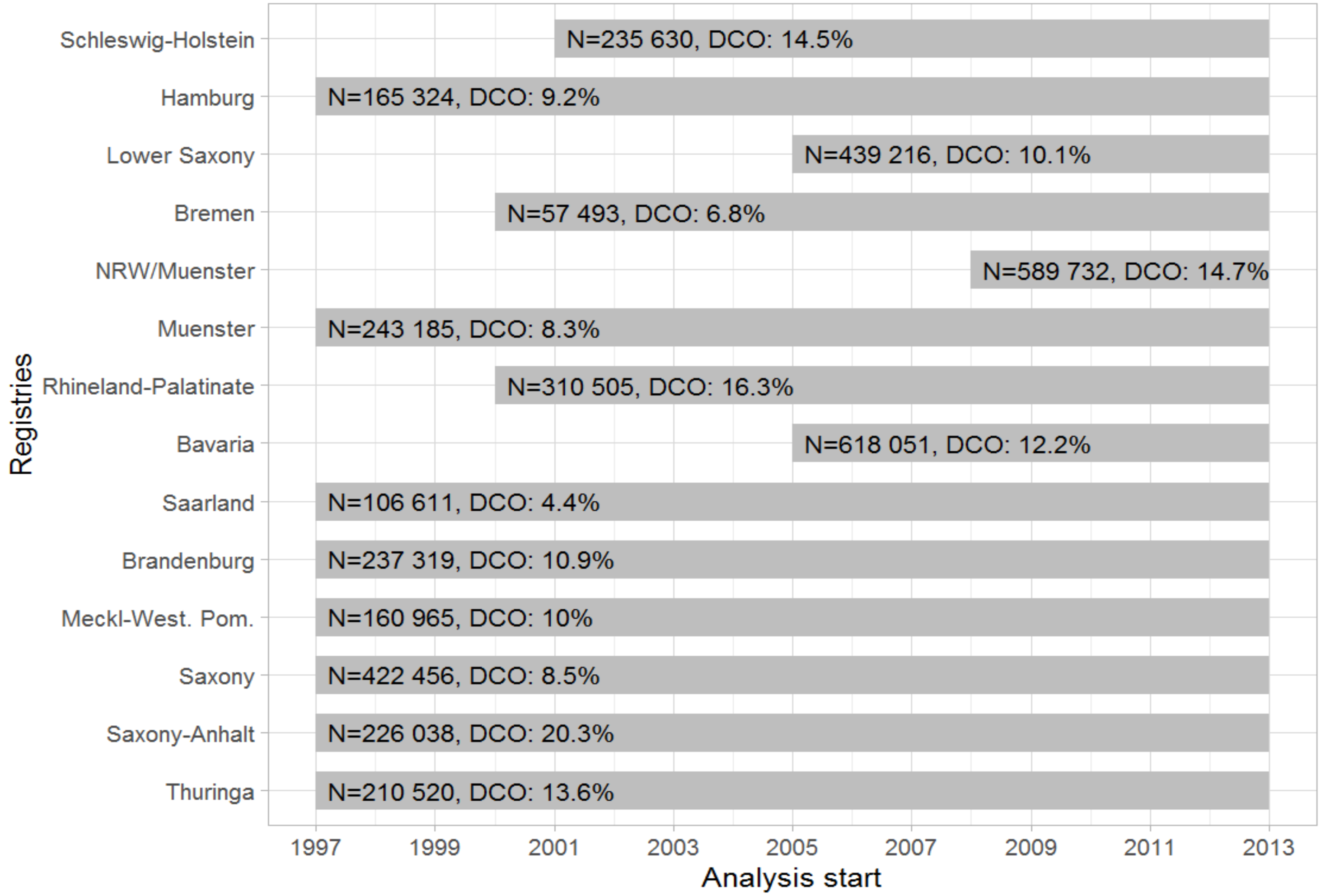
Death Certificate Only (DCO)

- DCO proportions are correlated with proportions of missed cases still living at follow-up end
- DCO proportions are a measure for completeness of cancer registration

Data

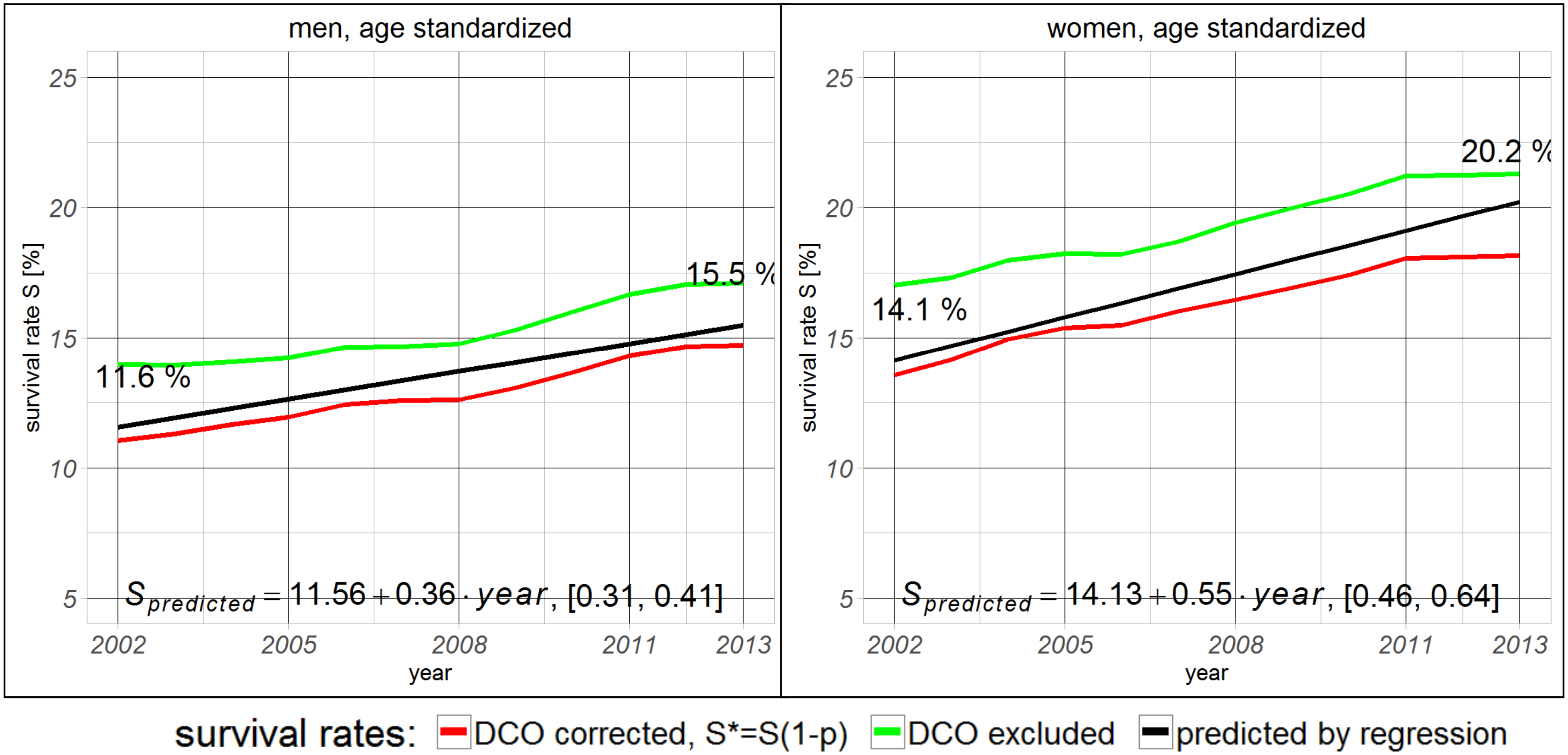
Number of cases and DCO proportions by registries

ROBERT KOCH INSTITUT



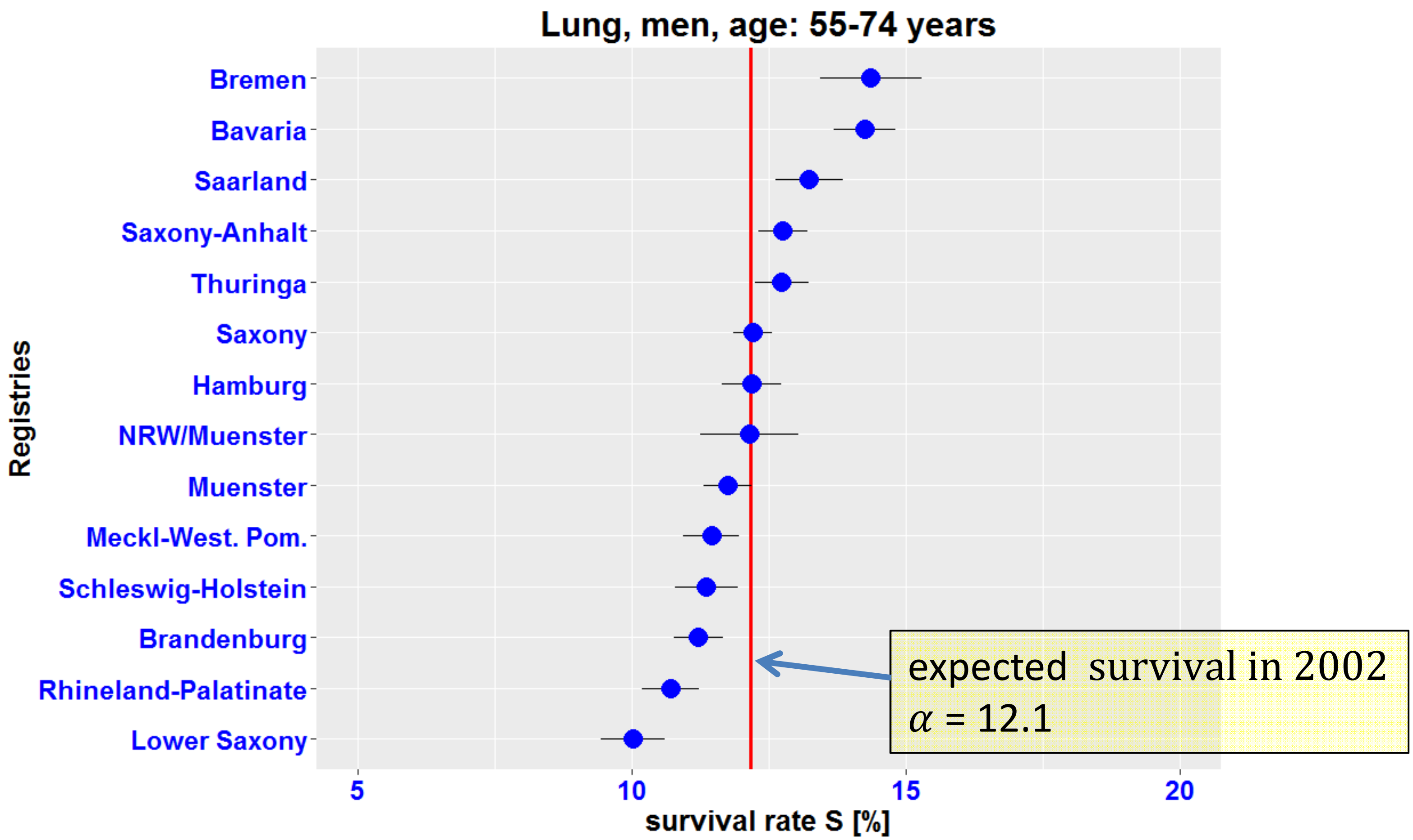
ROBERT KOCH INSTITUT

Lung (ICD10 C33, C34), 5-year relative survival



Method

Random intercepts for registries



ROBERT KOCH INSTITUT

Predicted survival rates at DCO proportion *p = 0 %*

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

ROBERT KOCH INSTITUT

Predicted survival rates at DCO proportion *p = 0 %*

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \cancel{\beta \cdot p_{ij}} + \varepsilon_{ij}$$

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \varepsilon_{ij}$$

Predicted survival rates at DCO proportion *p = 0 %*

$$S_{ij}(p = 0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

$$S_{ij}(p = 0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \cancel{\beta \cdot p_{ij}} + \varepsilon_{ij}$$

ROBERT KOCH INSTITUT

Predicted survival rates at DCO proportion *p = 0 %*

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \beta \cdot p_{ij} + \varepsilon_{ij}$$

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \cancel{\beta \cdot p_{ij}} + \varepsilon_{ij}$$

$$S_{ij}(p=0) = \alpha + random\ intercept(Reg_i) + trend \cdot year_j + \varepsilon_{ij}$$

Over all registries:

$$S_j(p=0) = \alpha + trend \cdot year_j + \varepsilon_j$$