EUROPEAN HEALTH CARE OUTCOMES,
PERFORMANCE AND EFFICIENCY

Costing in multi – country evaluation Studies: EUROHOPE

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euroHOPE

Playt du jour!

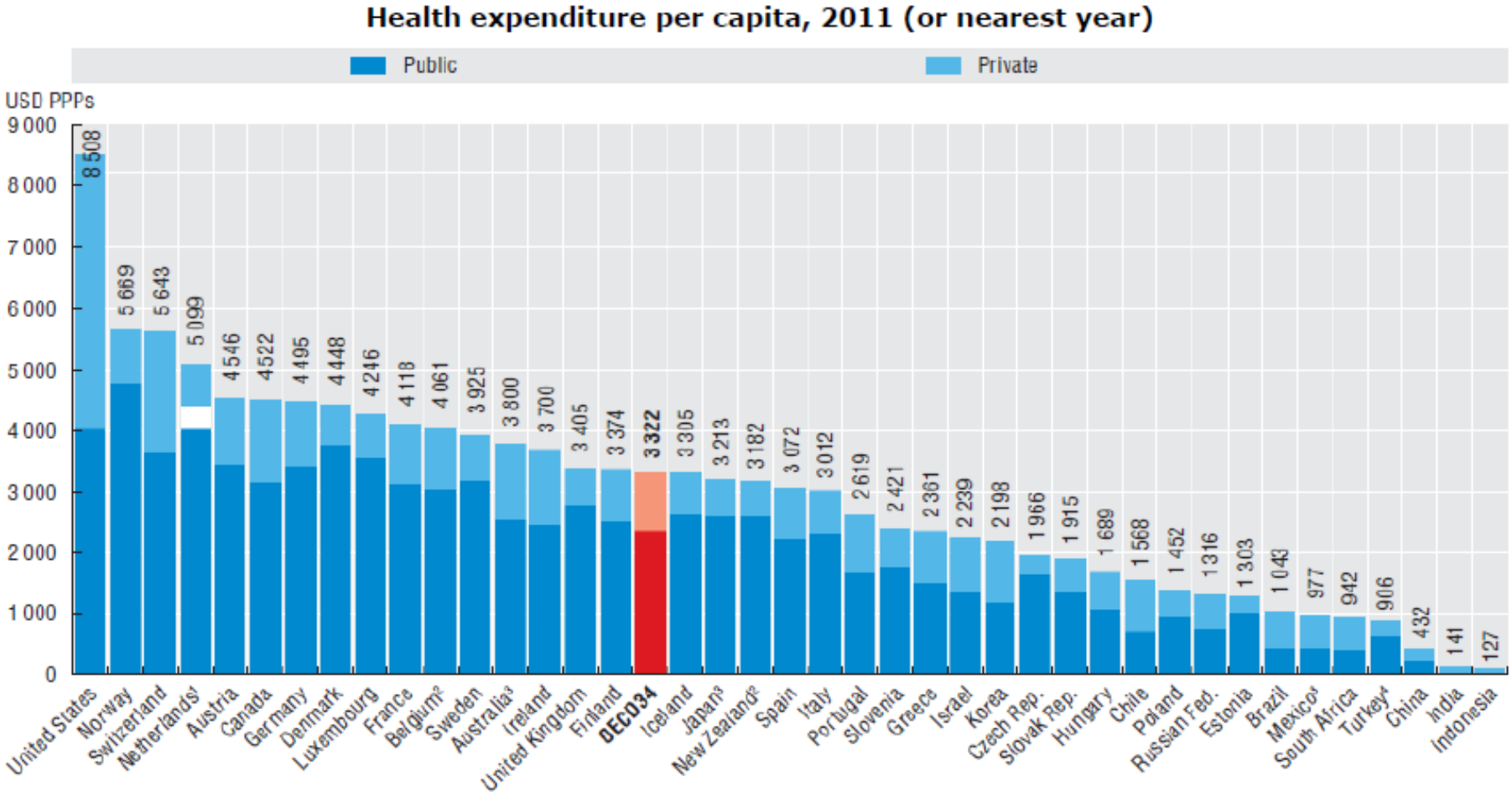
Comparing use of resources between hospitals and countries

- International comparisons show huge variation in resources allocated to health care across countries

- But: Quality of comparability is low

=> A SOLID REASON FOR TODAY'S TOPIC!

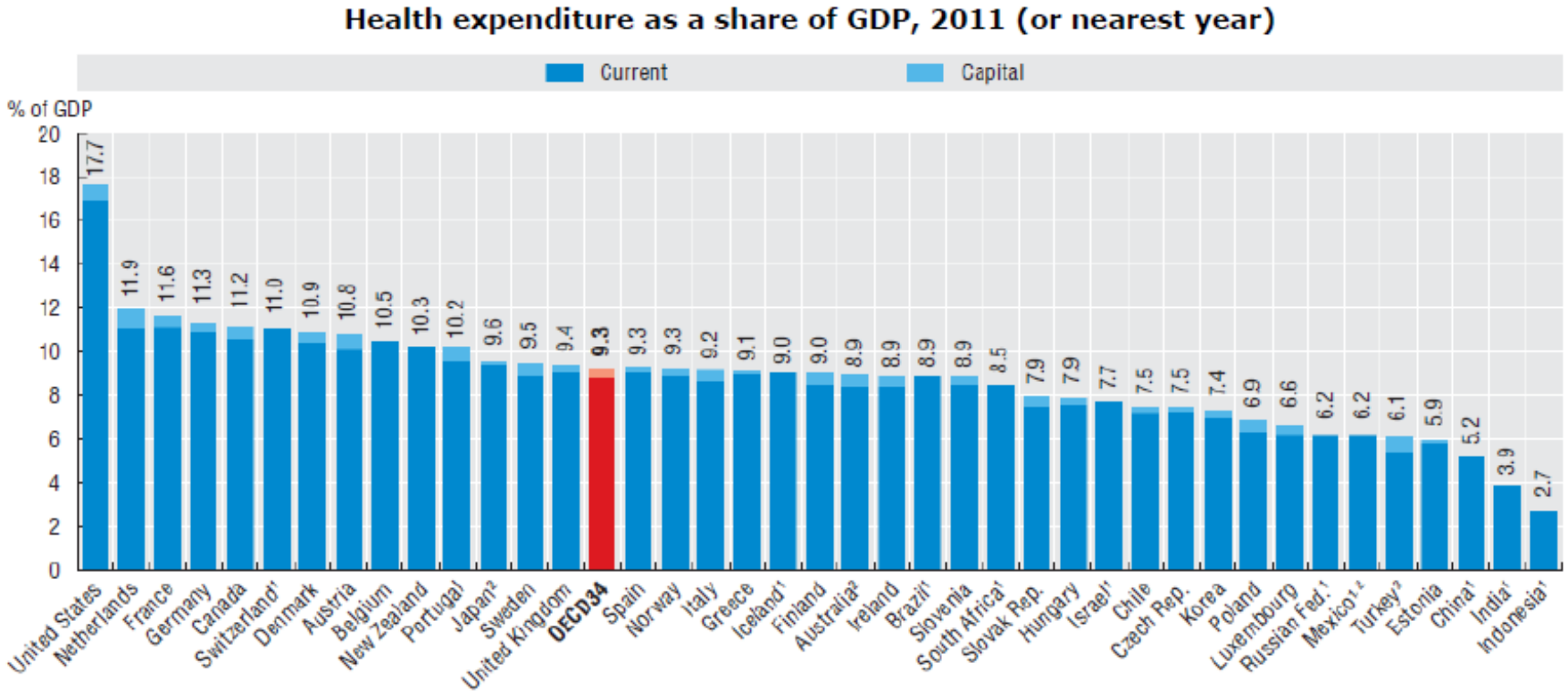
Health expenditure per capita varies widely across OECD countries. The United States spends two-and-a-half times the OECD average



1. In the Netherlands, it is not possible to clearly distinguish the public and private share related to investments.
2. Current health expenditure.
3. Data refer to 2010.
4. Data refer to 2008.

***Source*: OECD Health Statistics 2013, OECD (http://www.oecd.org/health/healthdata)**

OECD countries allocated 9.3% of their GDP to health in 2011, ranging from over 17% in the United States to around 6% in Estonia, Mexico and Turkey



1. Total expenditure only.
2. Data refer to 2010.
3. Data refer to 2008.

***Source*: OECD Health Statistics 2013, OECD (http://www.oecd.org/health/healthdata)**

Suggestions for the variation

- Differences in occurrence of disease
- Similar diseases are given different treatments in different countries
- The boundary of the health care sector is different across countries
- Efficiency in terms of required resources to produce specified services varies between countries
- Differences in the general cost level and wage level that may not be appropriately accounted for

Important to go beyond macro figures to know if the level of use of resources is a problem that should be addressed

EuroHOPE – Stylised facts - What and why?

- Develops methods to measure outcomes and costs of care of specific diseases for evaluation of care given during **the whole cycle of care**

- Provides with benchmarking for
  - arranging and ways of treatment and its practice
  - for costs of treatment (episodes and longer follow-up)
  - effectiveness on regional and country level

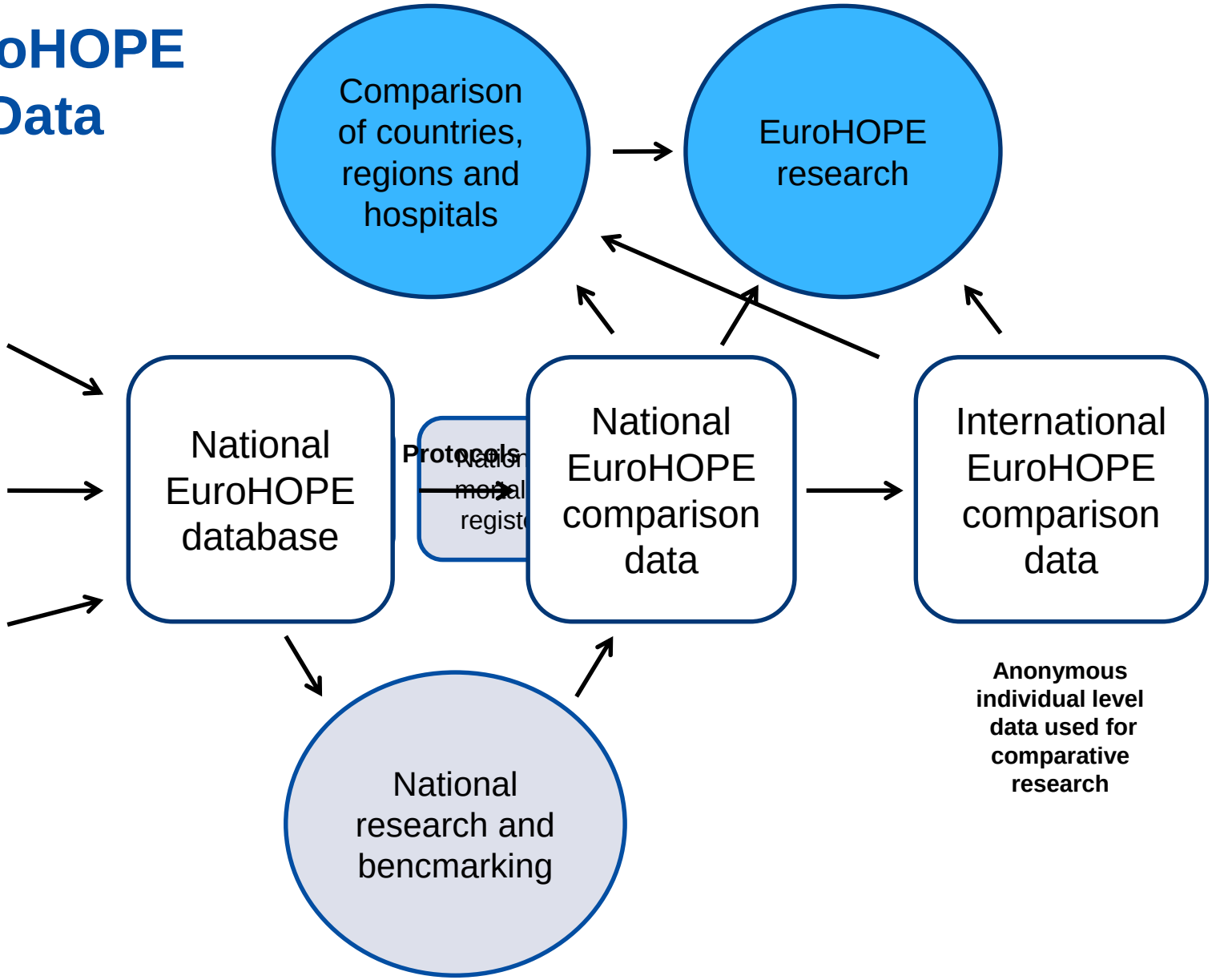
- Compares health care systems'
  - functionality
  - relative performance

- **Especially, yields information for the decision makers and other stakeholders to improve health care in own region, hospital or country**

EuroHOPE – Stylised facts - How?

- Accurate patient level data 2006-08 (2009 Norway)
  - Treatments: discharge registries
  - Direct costs: prescriped medication purchase registries
  - Cause of death: cause of death registries
- One year follow up (and –down)
  - Horizon: *index admission* → 365d follow-up
  - No admissions due to same reason in past 365d
- Research data by linking
- Comparability by risk-adjustment
  - Health care services
  - Medication usage
  - Data 365d on daily basis prior index admission

EuroHOPE Data



Playground for costing issues

Challenges for across country comparison with micro-data at the patient level consists of

- the development of methods for calculating resource use
- modelling the distribution of the estimated risk-adjusted cost function
- finding a method for ranking of outcome and cost in order to determine differences between countries.

Main objective: Adapt methodology that makes ranking work and explore the robustness of ranking countries

Guinea pig: Acute Myocardial Infarction (AMI) as an example

Three approaches: I

A measure of the total cost of care at the individual patient level is not available.

Approach I

- Registration of main components of resource use (services) from *discharge registers* and *pharmaceutical prescription* data bases.
  - The registered components are mainly related to procedures and hospital length of stay. Combined with weights from Swedish Cost per patient data.

AMI: Items of resource use according to Approach I

A	Hospital costs - individual patient level
A1	Total number of coronary by-pass surgery (CABG)
A2	Total number (regular, stent, drug eluting stent) of percutaneous coronary intervention (PCI)
A3	Total number of admissions related to AMI (ICD 10: I20-I25 and I44-I50)
A4	Total number of admissions for other diagnoses
A5	Total number of inpatient days related to AMI (ICD 10: I20-I25 and I44-I50)
A6	Total number of inpatient days for other diagnoses
A7	Total number of outpatient consultations irrespective of diagnosis
B	Cost of medicines outside hospitals
B1	Calculate from the prescription register the total sum of medicines (irrespective of ATC code) dispensed outside hospital calculated at the pharmacy's retail price in local currency with VAT included
B2	Calculate from the prescription register the sum of medicines with an ATC related to AMI dispensed outside hospital calculated at the pharmacy's retail price in local currency with VAT included.
C	Assigning Hospital Costs Unit cost is based on data from the Swedish cost-per-patient (CPP) data base provided by Swedish Association of Local Authorities and Regions (SALAR).
C1	Hospital cost components from the Swedish CPP data base (outliers are excluded) are calculated for procedures (CABG and PCI), basic ward cost per day for AMI patients, mean cost per day for all inpatient stays and for outpatient visits.
D	Adjust for cost level in Sweden using Eurostat PPP: for GDP are used for pharmaceuticals and PPP for hospital services (input-based) for procedures and ward related cost.

Calculating costs

- Sum of the items multiplied by a deflator
  - Hospital costs: Eurostat PPP index for hospital services
  - Cost of medicines: Eurostat PPP index for GDP

$$C_{jklt} = c_{hlt}\{\sum_i p_{iklt} x_{ijklt}\} + c_{mlt} m_{jklt}$$

Where c = deflator, p = cost of hospital item, x =amount of hospital items, m = amount of medication items, i = cost item, j = individual, k = disease, l = country, t = time period, h = hospital, and m = medication

Three approaches: II & III

Approach II

- Each country contributes with *their best cost estimate* given their *own system of cost calculations*.
  - In the majority of countries, cost estimates generated by variants of the DRG system are used and costs of medicines based on data from the prescription register are added

Approach III (Finland, Norway and Sweden)

- Approach III uses the *common Nordic DRG grouper*.
  - When patient-level discharge data from each country is fed into the grouper, the assignment of DRG groups is similar in each country.

Descriptives: Approach I

Descriptive statistics of treatment costs using Approach I according to treatment period, country and health status. Finland and Norway (2009), Hungary and Sweden (2008) in EURO

Time period	*Country*	*#obs*	*Mean*	*Median*	*St.dev*	*Min*	*Max*	*Skew-ness*	*Kurtosis*
First hospital episode	**Finland**	*8178*	*7595*	*6805*	*5586*	905	*35606*	*1.8*	*6.8*
	Hungary	*13170*	*7965*	*7596*	*4242*	*633*	*42170*	*1*	*5.6*
	Norway	*10622*	*7239*	*6805*	*4924*	633	*35252*	*1.9*	*8.2*
	Sweden	*22346*	*7223*	*6805*	*5136*	633	*98659*	*2.3*	*13.5*
One- year costs	**Finland**	*8016*	*11843*	*8254*	*11302*	1266	*259245*	*3.95*	*44*
	Hungary	*14130*	*15812*	*11780*	*14114*	633	*221132*	*2.74*	*17.6*
	Norway	*10719*	*13002*	*9406*	*11743*	633	*140906*	*3.07*	*19.2*
	Sweden	*22954*	*14971*	*9337*	*16159*	633	*295757*	*3.47*	*24.4*

Descriptives: Approach II

Descriptive statistics of treatment costs using Approach II according to treatment period, country and health status. Finland and Norway (2009), Hungary and Sweden (2008) in EURO

Time period	*Country*	*#obs*	*Mean*	*Median*	*St.dev*	*Min*	*Max*	*Skew-ness*	*Kur-tosis*
First hospital episode	**Finland**	*8178*	*8807*	*6149*	*8397*	477	*144964*	*3.8*	*33.1*
	Hungary	*13170*	*8913*	*9606*	*5630*	995	*53823*	*0.5*	*3.3*
	Norway	*10622*	*7025*	*5656*	*5795*	856	*96828*	*3.23*	*20.8*
	Sweden	*22332*	*8691*	*6562*	*9183*	432	*180485*	*4.2*	*30*
One- year costs	**Finland**	*8016*	*13917*	*9528*	*14534*	1214	*221154*	*3.79*	*29.3*
	Hungary	*14130*	*12756*	*12908*	*8620*	995	*86129*	*1.1*	*5.6*
	Norway	*10719*	*16886*	*11778*	*16186*	856	*248028*	*3.04*	*21.8*
	Sweden	*22946*	*17694*	*9347*	*23175*	432	*585043*	*5.65*	*76.2*

Cost estimation

- The costs are modeled as a function of risk-adjustment factors (age, gender, comorbidities) and a country-specific effect (fixed effect) .The country-specific effect could be interpreted as unobserved supply-side differences between countries, due to differences in productivity and quality of health
- Alternative specifications:
  - OLS,
  - Log-linear model (with smearing factor)
  - GLM (with log link and gamma variation)
  - GLM (with best performing link and variation)

  Specification tests
  - Link test
  - Pearson correlation test
  - Heteroskedasticity (Breusch-Pagan test)
  - Copas test on predictive ability

  Goodness- of- fit: R^2, mean absolute prediction error (MAPE), mean predicted error (MPE)

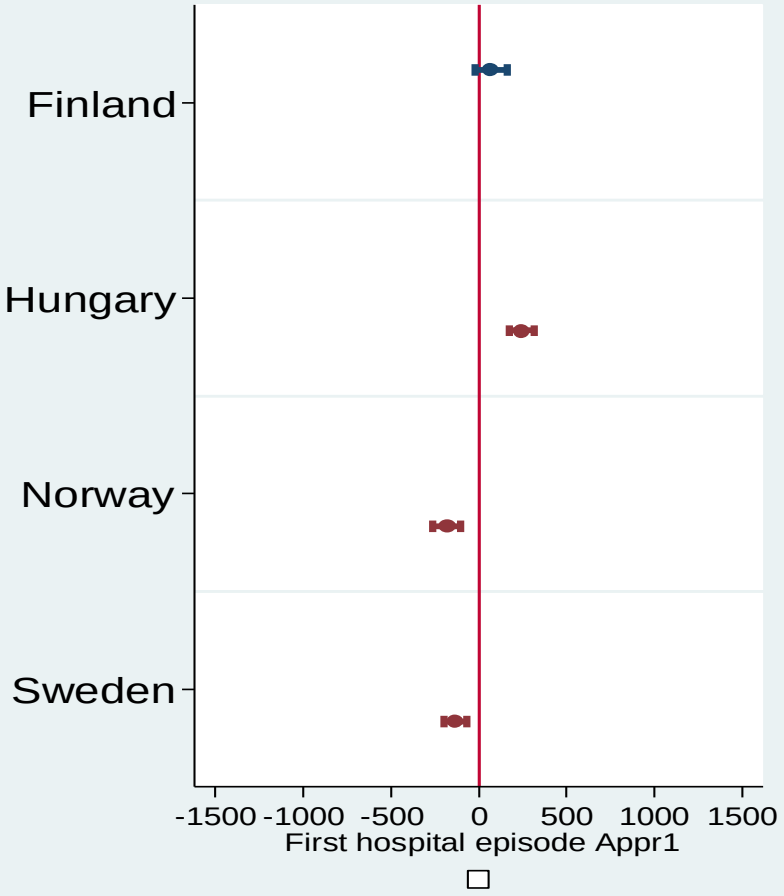
Specification tests and goodness of fit for first hospital episode with Approach I according to type of cost function . Best values in each column red

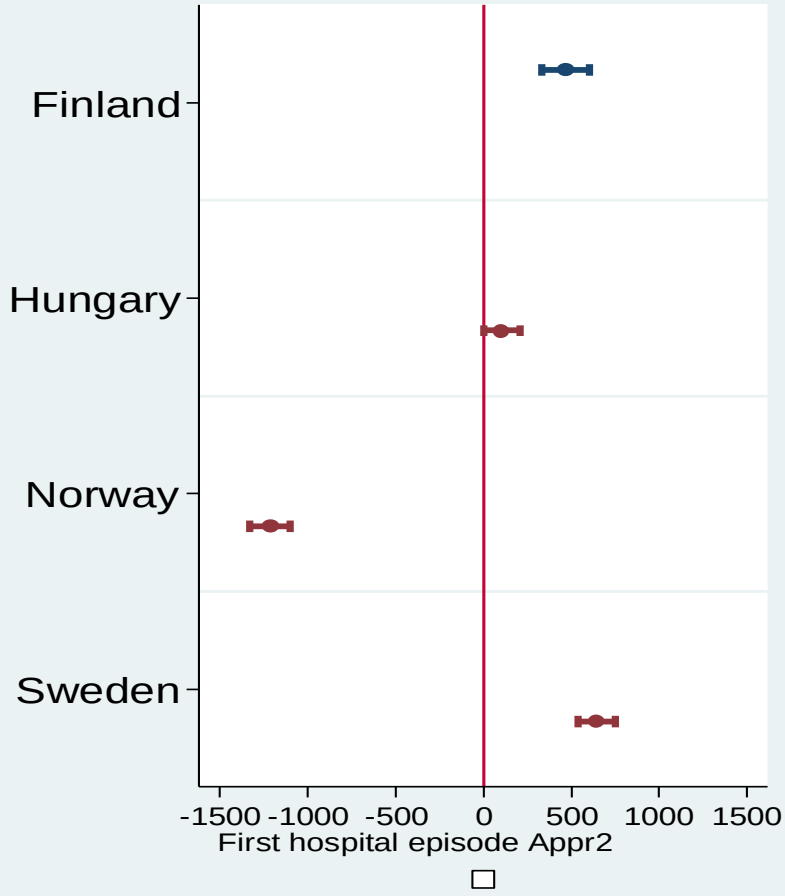
Type of regression	Linktest (p-value)	Pearson correlation p-value	Hettest p-value	Copas test (p-value)	R^2	RMSE	MAPE	MPE
OLS on y	0.000	-	0.000	0.967 (0.152)	0.058	4.83	3.29	-0.00
OLS on ln(Y)	0.009	-0.000	0.000	0.835 (0.000)	0.056	4.85	3.32	-0.06
GLM log – gamma	0.000	0.607		0.977 (0.320)	0.061	4.83	3.29	0.00
GLM Power 2.2 - gamma	0.875	0.002		1.003 (0.893)	0.057	4.84	3.29	0.07
GLM Power 2.2 - Poisson	0.439	0.006		1.016 (0.507)	0.058	4.84	3.29	0.00

Estimation results for first hospital episode and one year costs. Approach I and GLM log-gamma with data from Finland, Hungary, Norway and Sweden. Country fixed effects not given

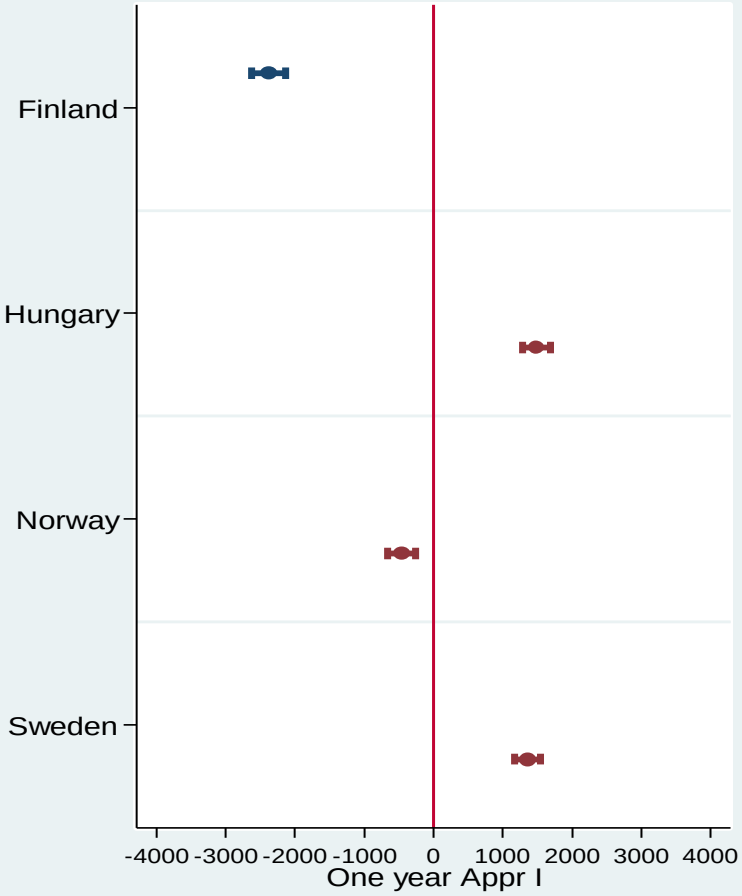
Variable	First hospital episode	One year
	Coeff	Coeff
18-49	-0.082***	-0.186***
50-54	-0.055***	-0.143***
55-59	-0.019	-0.085***
60-64	-0.018	-0.059***
65-69	-0.001	-0.030*
(70-74) Ref		
75-79	-0.031**	0.001
80-84	-0.166***	-0.123***
85-89	-0.299***	-0.238***
90+	-0.415***	-0.362***
Male	0.042***	0.038***
Hypertension	-0.006	0.099***
Diabetes	0.018**	0.146***
CAD[1]	-0.051**	0.117***
COPD[2]	0.003	0.096***
Depression	-0.026***	0.002
Minor depression	-0.082***	-0.066**
Stroke	-0.028	-0.017
LOS year before	-0.060***	0.159***
Constant	2.118***	2.354***
Pseudo R squared	0.059	0.048
# observations	54316	55819

Estimated fixed country effects (95 % confidence intervals) with GLM log-gamma model for first hospital episode: Approaches I and II. Deviation from grand mean





Estimated fixed country effects (95 % confidence intervals) with GLM log-gamma model for one year cost Approaches I and II. Deviation from grand mean



Conclusions (I)

- Hospital discharge registers do not contain sufficient information on treatment procedure to calculate cost estimators for all diseases.

- Registered indicators of disease severity are able to explain only small proportion, 5-10 percent, of the variation in the calculated cost across patients.

- The ranking of countries depend on the cost indicator used.

Conclusions (II)

- The ranking of countries depend on the length of the time-period taken into account.
- The ranking of countries does neither depend on risk-adjusters included nor the specification of the cost function.
- **Implication:** The ranking of countries according to crude cost gives the same result as ranking of countries according to the estimated expected cost adjusted for variation in disease severity.

Analysis of costs at hospital level

- Cost: use of resources during the first acute hospital episode (i.e. including hospital transfers). Based on number of hospital days and use of procedures weighted by their relative costs (Approach 1)
- Individual patient level data from Finland, Hungary, Italy Norway and Sweden from the years 2007-2008 (Norway 2009)
- Multilevel random effect model (ln costs)

Variables used in estimations

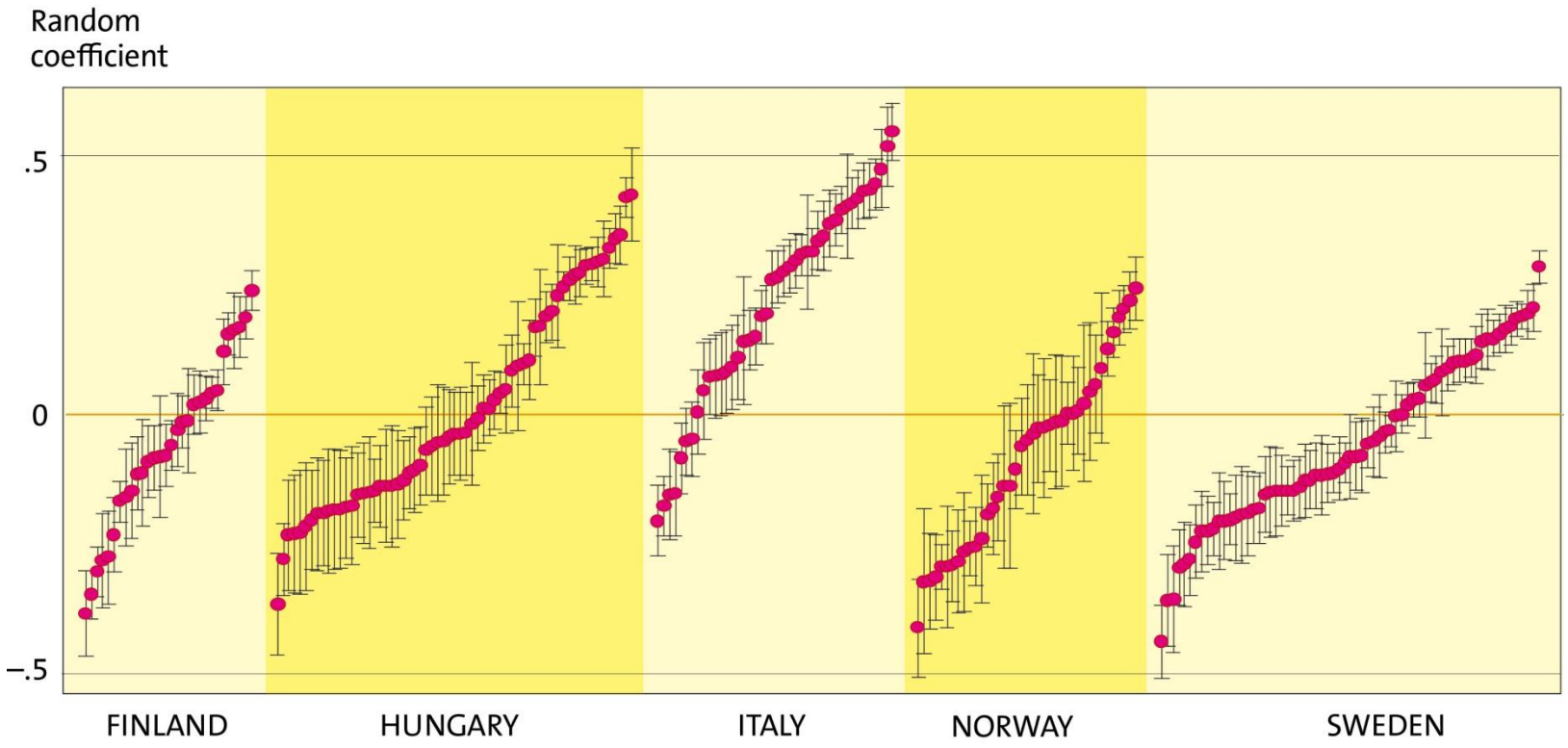
Patient level variables used in performance analysis (risk adjustment):

- Age (classified)
- Gender
- Comorbidities based on medical history of the previous year
- Hospital transfer to higher level

Hospital and regional level variables:

- Teaching/university status
- Availability specific services and resources (catheterisation laboratory)
- Regional concentration of care (Herfindahl-Hirschman Index (HHI)
- GDP per capita
- Population density

Hospitals cost performance in care of AMI patients based on empirical Bayes estimates of random coefficient



What explains high resource use?

- Existence of a catheterisation laboratory in the hospital (+)
- University/teaching status Finland, Italy and Sweden (+)
- Lower concentration care in all countries except Italy (+)
- Lower GDP per capita in Finland and Sweden (+)
- The differences are not related the characteristics of the health care system, but inclusion of hospital or regional variables change somewhat the ranking of countries.

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