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The relationship between quality of care and hospital costs in Europe.

Unto Häkkinen and EuroDRG teams in Finland, France, Germany, Spain and Sweden

The approaches cost/quality relationship

- Cost functions with cost as the dependent variable: quality measures as explanatory variables (in given cost function)
- Quality as dependent variable, where hospital cost is one explanatory variable
- Estimation of cost and quality functions independently ➔ aim to evaluate whether the joint evaluation of cost and quality affects ranking of hospitals relative to comparison based on costs alone.

How quality affects costs

- Much evidence that complications, hospital infections and medical errors increase the cost of hospital care (e.g. Carey and Stefos 2010) at individual patient level.
- At aggregate (department or hospital) level, it has been hypothesised that net cost form a U-shaped curve (Hvenegaard et al. 2010)

Hvenegaard et al. 2010

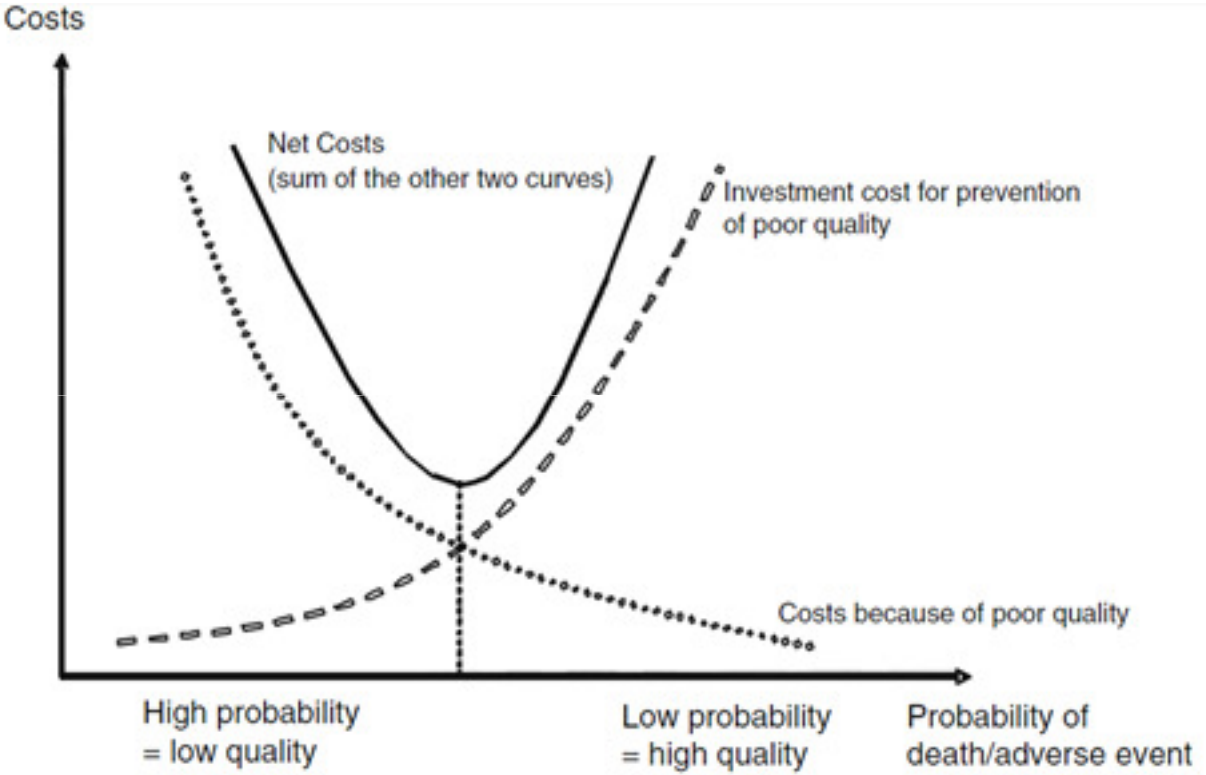


Fig. 1 The theoretical relationship between costs and quality

Measuring quality /outcome by mortality complicates the analysis

- Costs are low if patient dies at earlier days of admission
- Much of resources are allocated to patient during their last days before death

=> simultaneous relationship

Cost and quality in AMI episodes

- Aim: to investigate whether cost and quality (measured by in hospital mortality) are related to each other at hospital level in five European countries
- Patient level data collected for EuroDRG project in Finland, France, Germany, Spain and Sweden

As costs are formed differently for died and survived patients, we believe that quality should be controlled for in the cost equation, making the system recursive
Model was operationalized:

$$c_{ik} = x'_{1ik}\beta_1 + \delta q_i + u_k + \epsilon_{1ik}$$

$$q^*_{ik} = x'_{2ik}\beta_2 + v_k + \epsilon_{2ik}$$

where c_{ik} are costs for patient i in hospital k, quality (death) is measured by the observed variable

$$q_{ik} = \begin{matrix} 1\ if\ q^*_{ik} \geq 0 \\ 0\ if\ q^*_{ik} < 0 \end{matrix}$$

Explanatory variables describing patients age, gender, co-morbidities etc. are contained in the given x-vectors, β_1 and β_2 are parameter vectors, u_k and v_k are hospital specific effects which are here treated as fixed, ε_{1jk} ε_{2jk} are individual error terms assumed to be bivariately normally distributed

Estimation strategy in practice

Quality: Fixed effects probit model for death

Cost:

1) Fixed effects OLS for (log) cost without quality variable

2) Fixed effect OLS for (log) cost including generalized residuals calculated from quality (Probit) model.

Thee estimation will yield hospital specific effects taking into account for the correlation between the error terms. The model also provides a test for zero correlation. If the correlation turns out to be zero, then separate estimation of the models had been enough.

The hospital effects from quality and cost models will be examined with correlation diagrams.

AMI EPISODE

Hospital inpatient admission due to AMI (ICD 10 I21-I22) as main diagnosis

Excluded:

- bypass surgery
- los=0
- los=1 if patient transferred to an other hospital
- Outliers with a bilateral trim based on 3 times the Standard Deviation of the cost distribution
- Hospitals with less than 50 patients

Description of samples

	Number of cases	Number of hospitals	Cost/patient (€)			Lengtht of stay			Mortality %		
			Average	Min hospital	Max hospital	Averege	Min hospital	Max hospital	Average	Min hospital	Max hospital
Finland	1253	5	4684	2118	5826	5,5	4,6	5,7	6,4	5,2	11,7
France	8415	38	5197	2961	8010	6,0	3,5	8,1	4,9	1,2	16,9
Germany	6009	21	4229	2560	5410	8,3	5,1	15,1	11,7	6,4	28,0
Spain	2781	6	6705	2140	7334	7,7	5,9	10,5	6,7	4,6	16,6
Sweden	15305	33	5113*	2110*	7310*	5,5	4,3	7,3	7,1	3,3	13,5

*trasferred to € using exchange rate

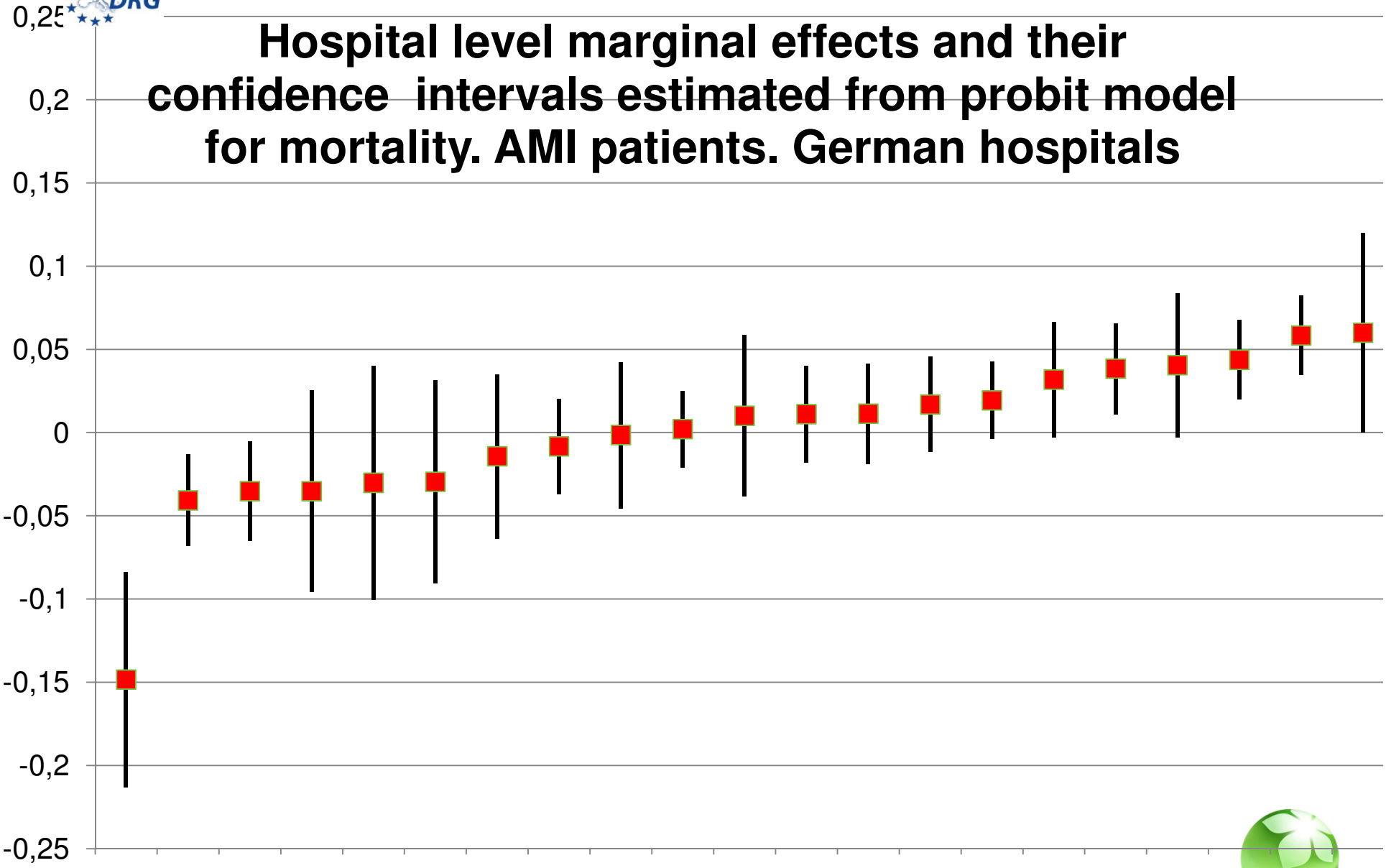
Patient level (X) variables used in estimations

- Age using four dummy variables (60, 71-80, 81-85, 86+)
- Gender.
- Total number of different diagnoses coded in medical records. Includes all diagnosis (primary/main and secondary).
- Patients transferred to the hospital from other institutions
- Patients discharged from the hospital to another institution
- Emergency, describing if patient admitted from emergency department, ward or similar institution as relevant in each country.
- Two variables of Charlson index describing single non severe co morbidity" and "two co morbidities and more (or one single severe one)" respectively

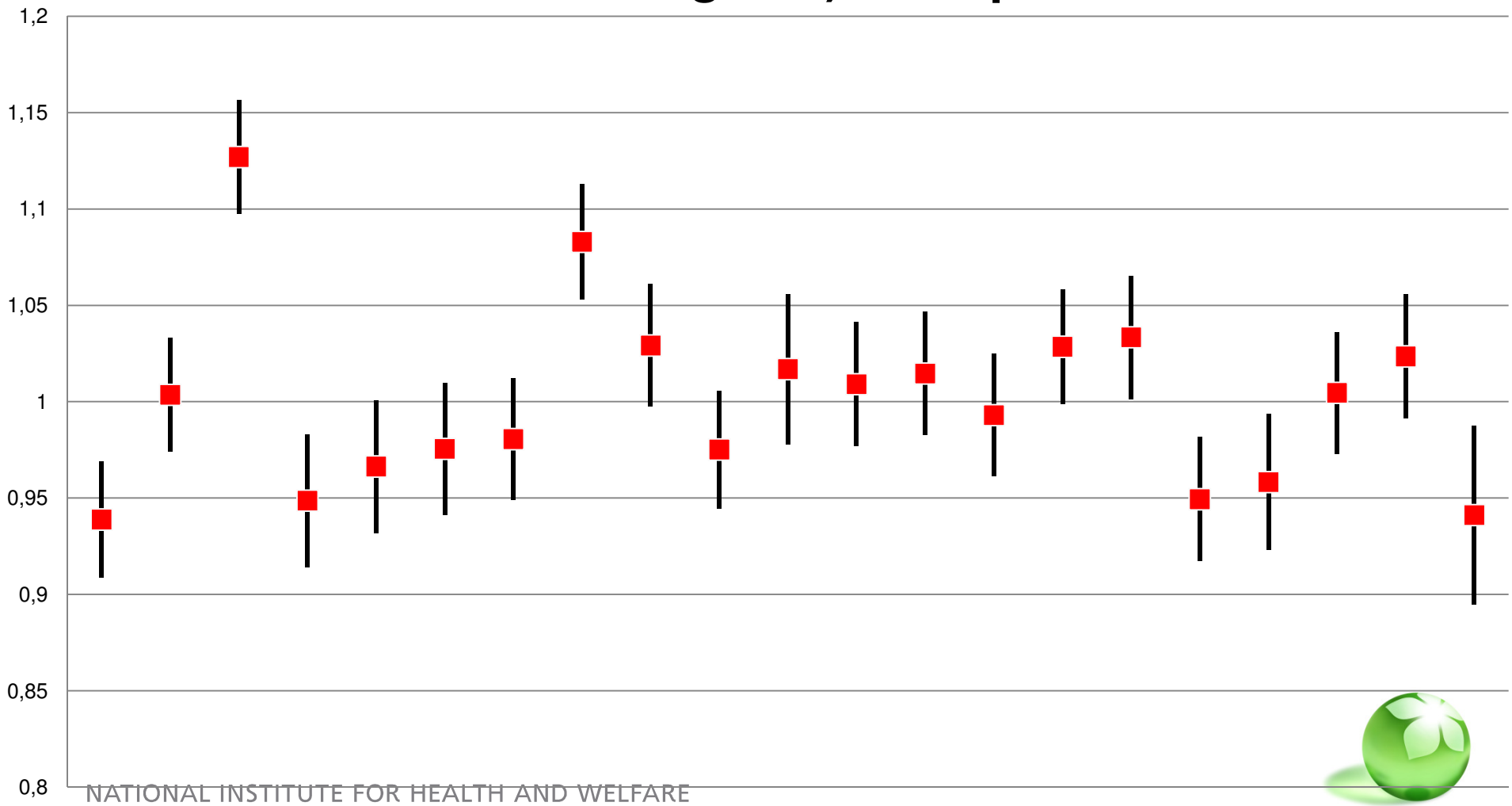
Estimation results

- In each country there exists a correlation between the error terms → suggests to estimate cost function with generalized residuals. However, both alternatives for cost function gave very similar hospital effects
- Describing the results
  - Death: marginal effects (probit model) of hospital dummy variables (effect coding)
  - Cost level, fixed effects scaled to country average 1

Hospital level marginal effects and their confidence intervals estimated from probit model for mortality. AMI patients. German hospitals



Cost level in German hospitals, hospitals are sorted according to adjusted mortality level (from lowest to highest) . AMI patients



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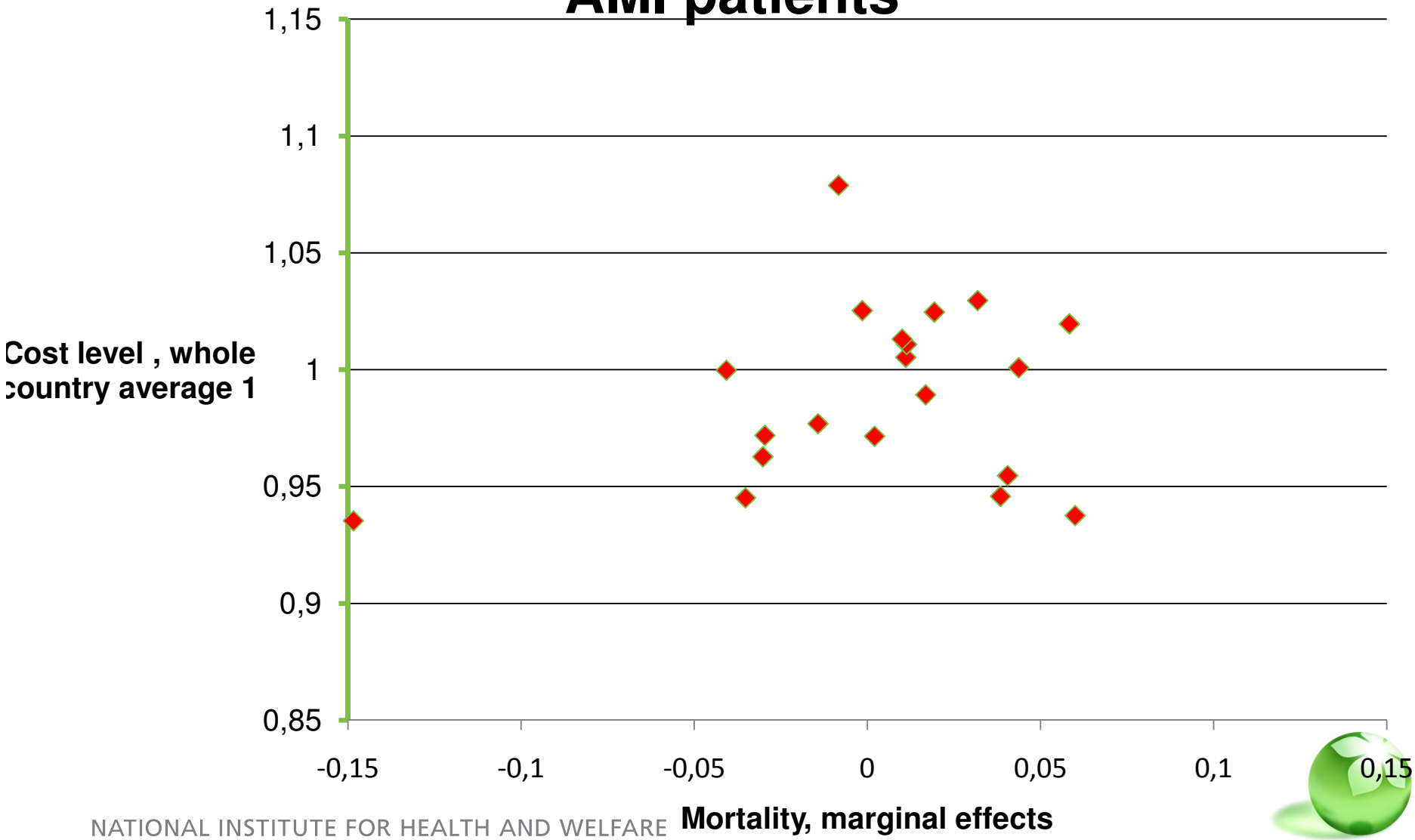
Cost and quality among German hospitals, AMI patients



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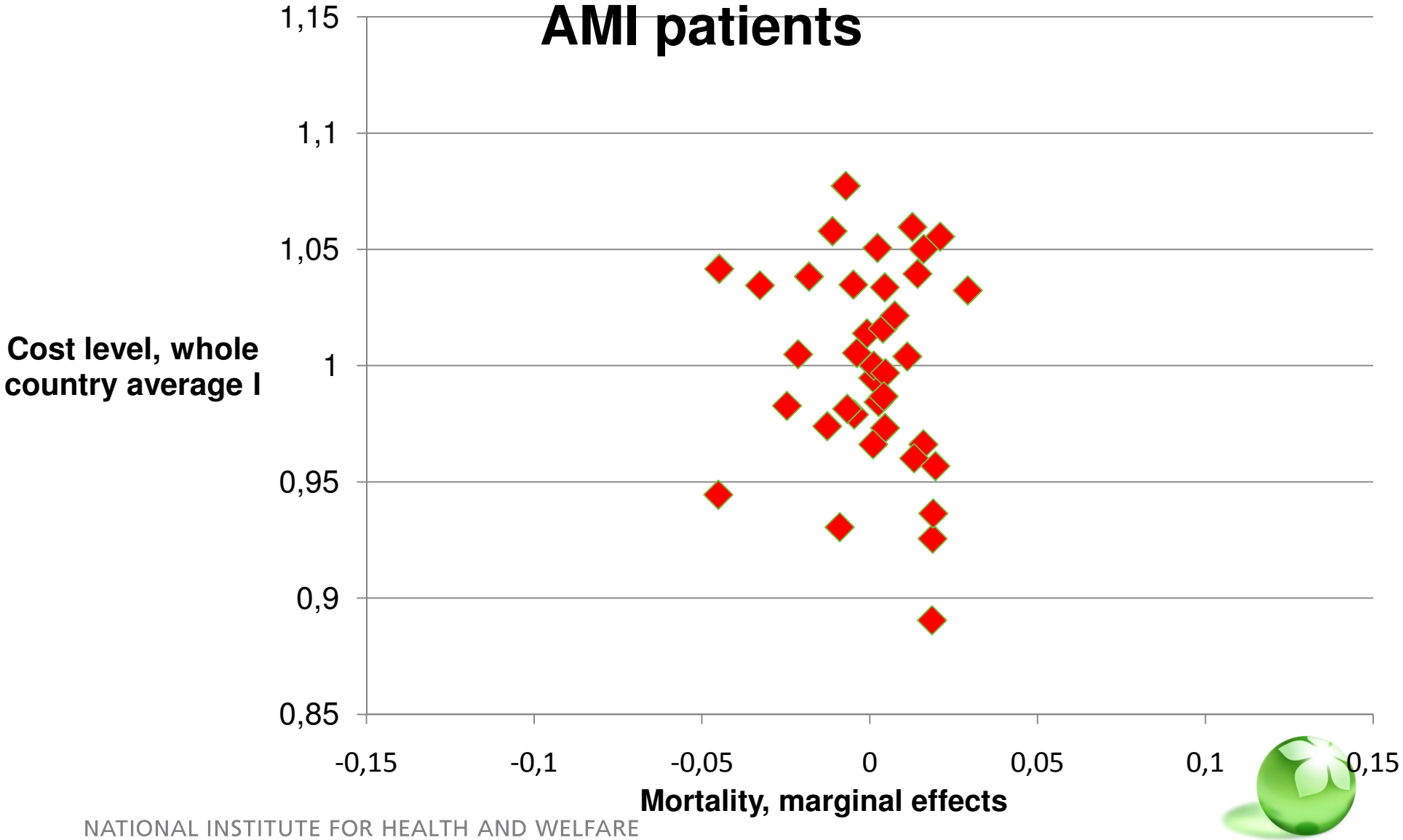
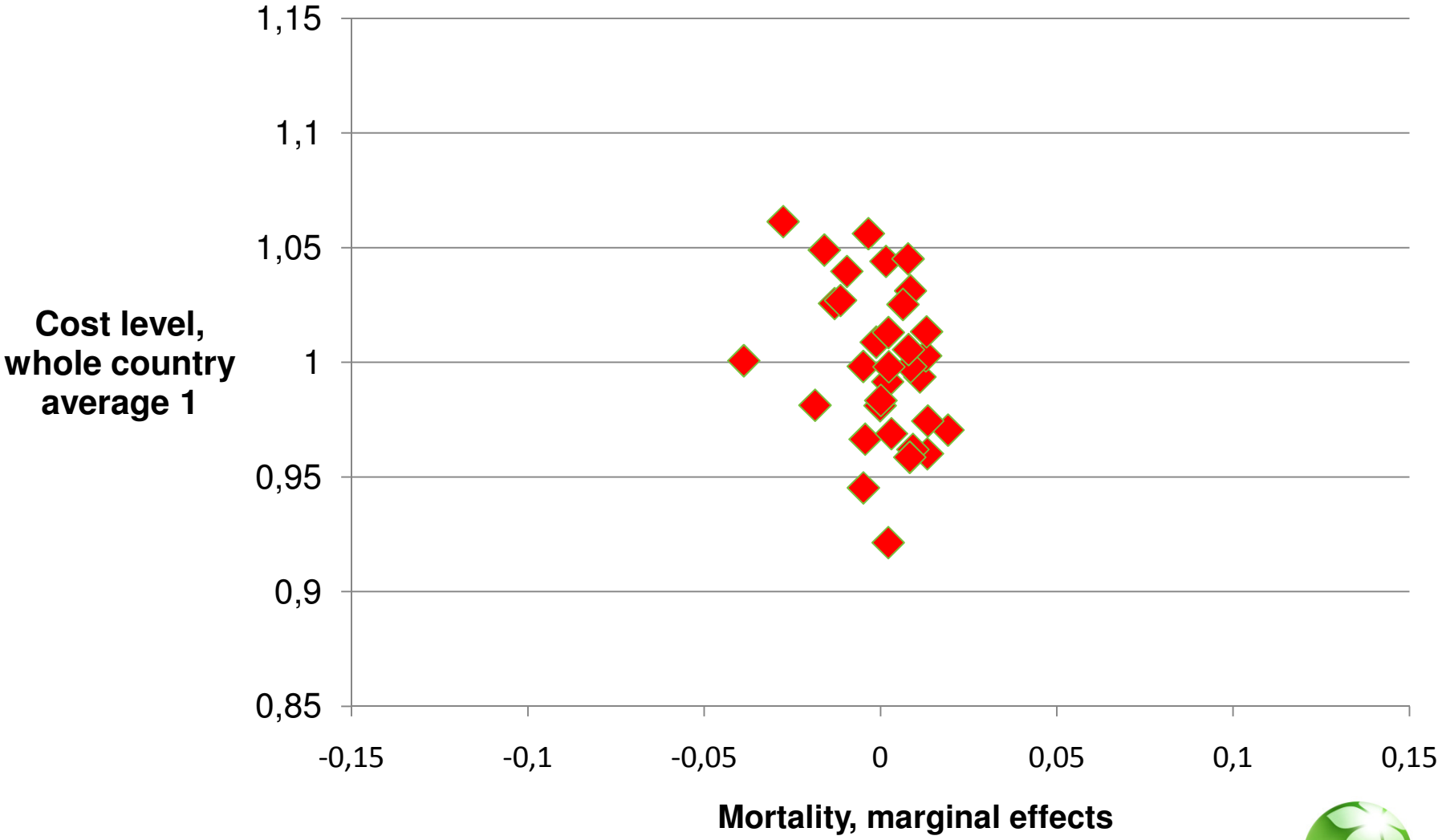
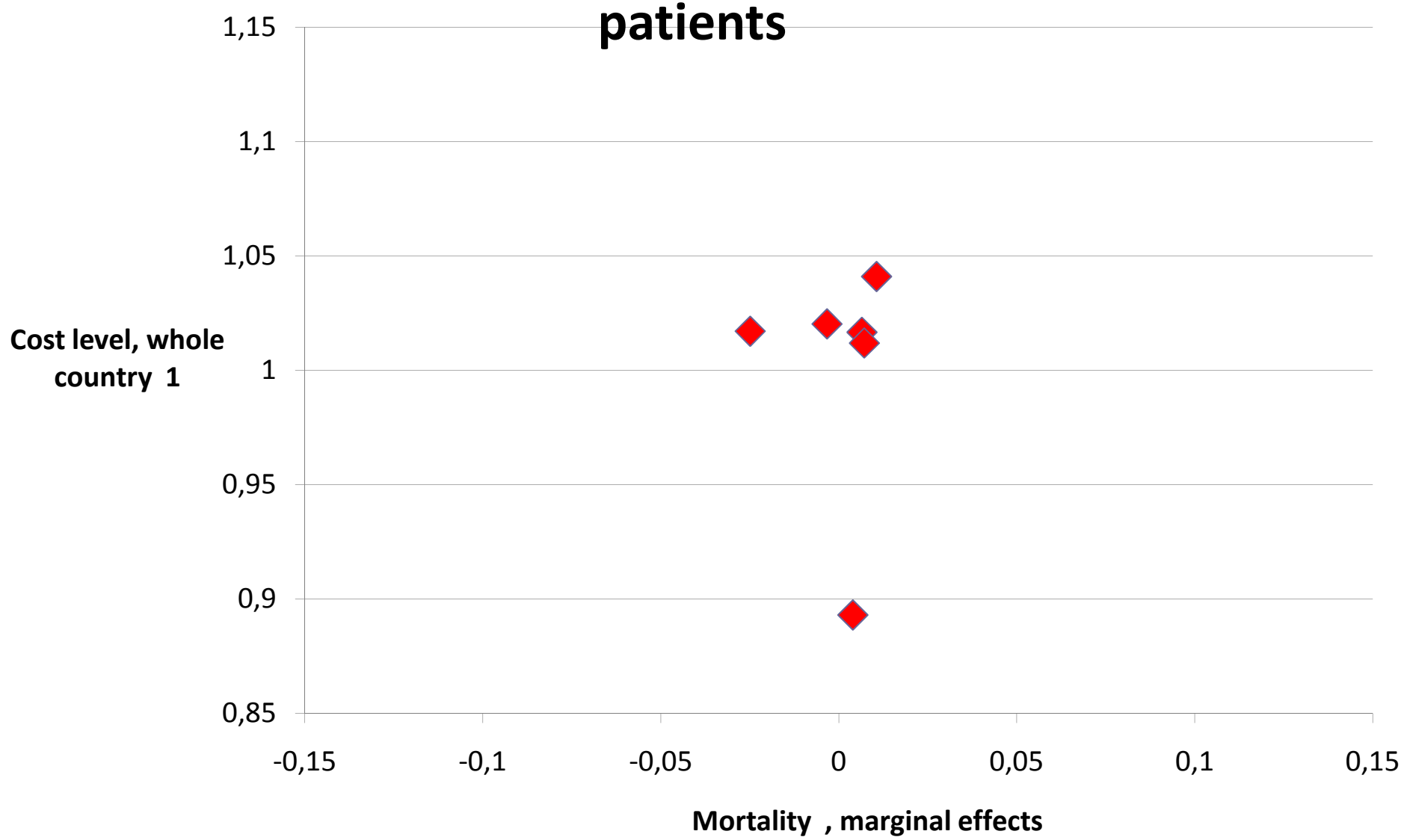
Cost and quality among French Hospitals, AMI patients



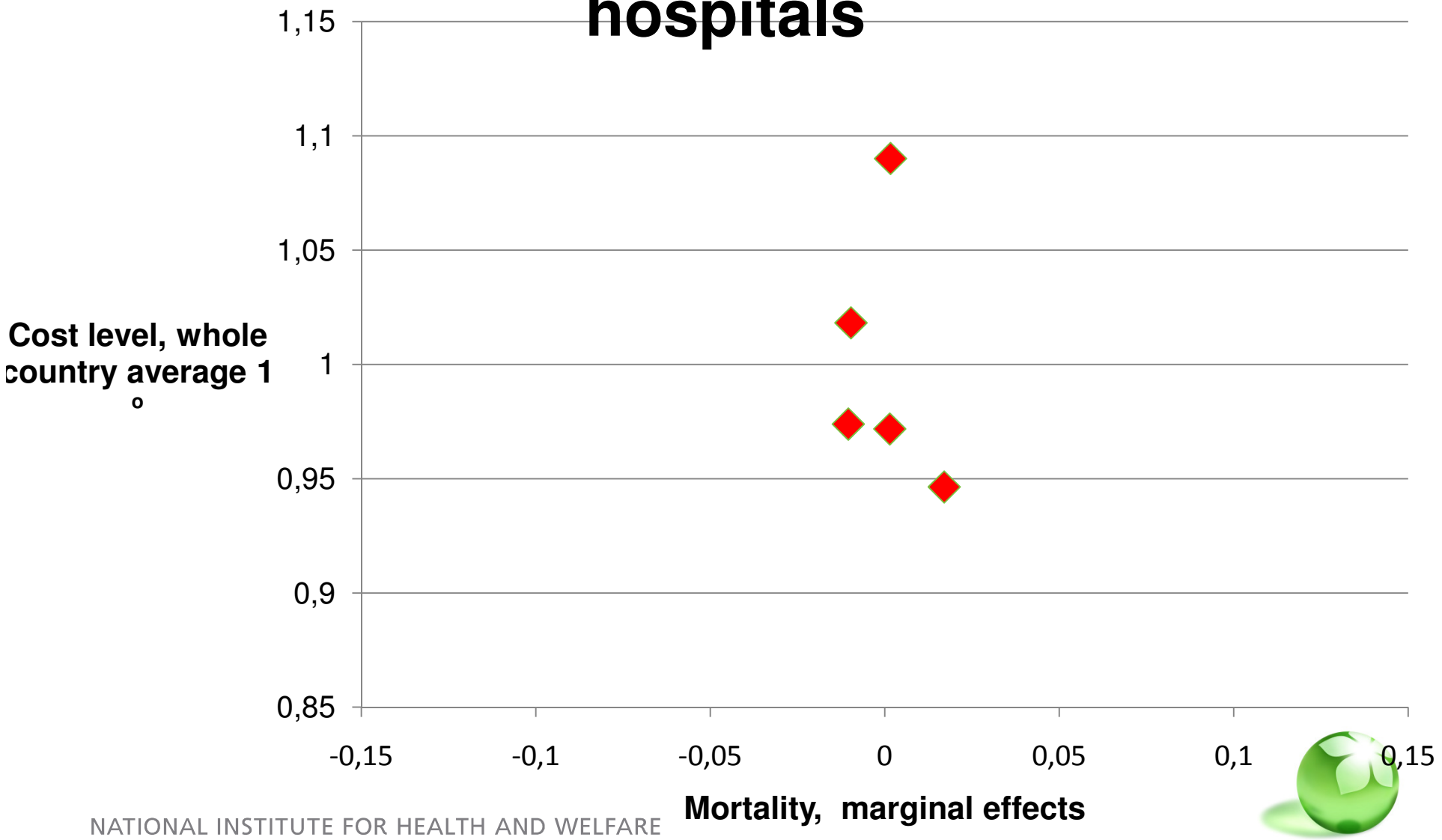
Cost and quality among Swedish hospitals, AMI Patients



Cost and quality among Spanish hospitals, AMI patients



Cost and quality among Finnish hospitals



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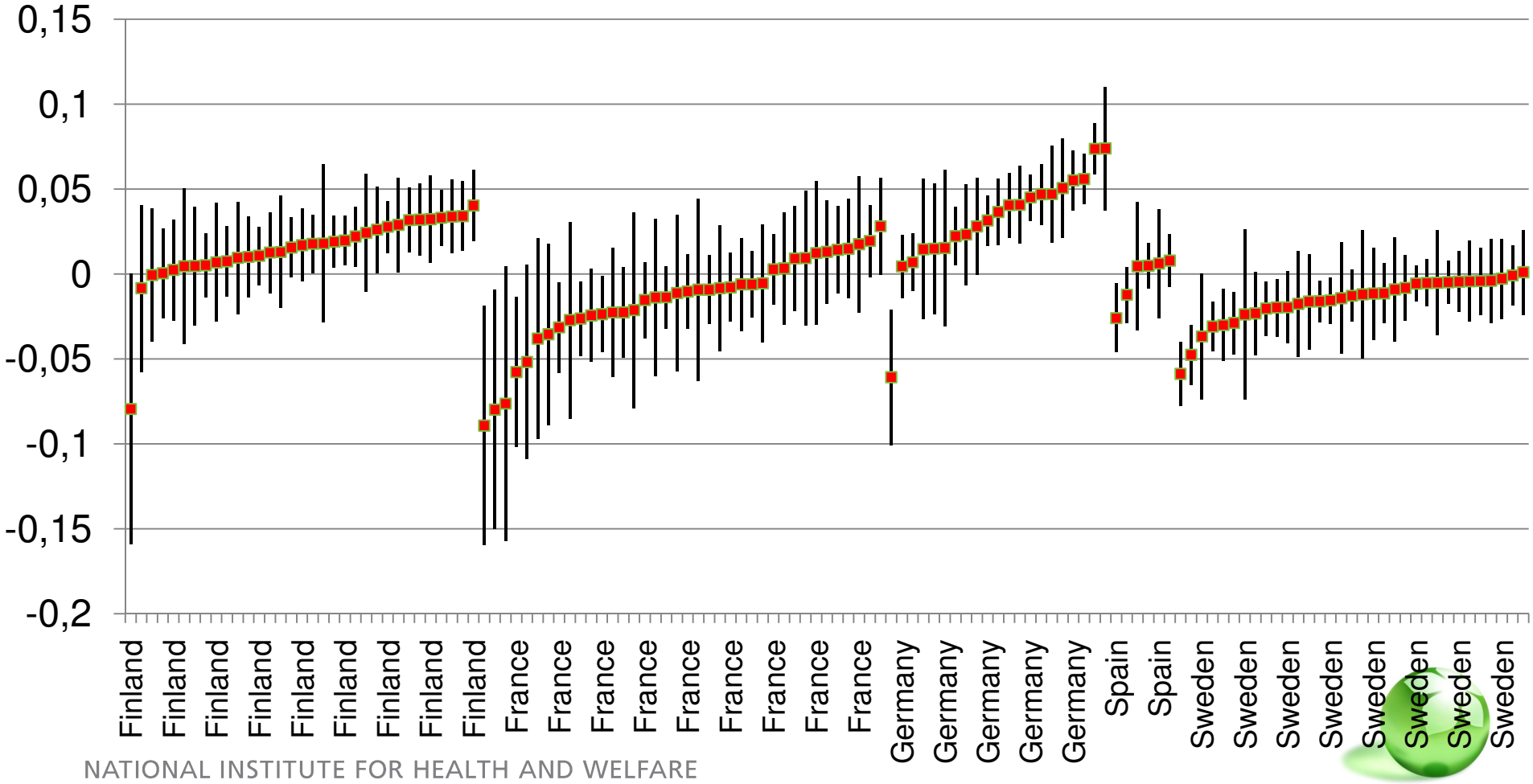
Preliminary conclusions

- No clear relation between cost and quality within countries ➔ potential for improving performance by containing cost or improving quality/outcome
- Differences between countries:
  - In German high variation in quality
  - In France high variation in cost
  - In Sweden low variation in cost and quality

Next steps

- Sensitivity analysis using alternative specifications
- Joint confidence intervals for costs and quality
- Pooling the data from different countries into one data base
- Extending the analysis to Stroke
- Extend the analysis to Hip and Knee replacement (adverse effects as a quality measure)

Example of a pooled analysis: mortality, marginal effects of 131 European hospitals. AMI patients



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