The use of cluster analysis to identify factors that influence the establishment of Health Technologies Assessment (HTA) agencies

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Aims

- Provide an overview and simplified classification of the HTA organisations present in the OECD.
- To investigate the factors that can influence the setting up of Health Technology Assessment (HTA) agencies across OECD countries.

Background

- Phenomenon emergence HTA organisations early 90s: partially in line with:
  - the growth of specialized agencies Western countries
  - 2nd phase debate priority-setting in health care
- Delegation decision-making powers to arm's-length agencies (Majone 1986,87):
  - making credible policy commitments in controversial / unpopular decisions
  - need for expertise highly complex or technical matters
  - free public administration from partisan politics
- "Responsible for assessment new/existing healthcare technologies as to their effectiveness, appropriateness, and/or cost-effectiveness" (INAHTA).

Data sources

- OECD Health Database (2004)
- INAHTA database of HTA country profiles [35 members, http://www.inahta.org, May 2005].
- Literature review, mainly HiT country profiles by the European Observatory on Health Care Systems and OECD reports.

Framework of variables

(1) Number HTA agencies

(2) Public health expenditure (% GDP)

(3) Public expenditure on pharmaceuticals (% GDP)

(4) Form of health care decentralisation

[Collins's definition (1994)]

(5) Type of health care system

[Gordon (1988), Saltman et al. (2000, 2001) typologies]

(6) Principal shared-rule arrangement in the country (unitary - federal political system)

[Elazar (1994) and Watts (1999) classification]

Table 1. Parameters used in the cluster and discrimant analysis

Country	Agencies	No. INAHTA Agencies	Type of health care system	Decentralisation health care system	Form political decentralisation	Public health expenditure (%GDP)	Public expenditure on pharmaceuticals (%GDP)
Australia	ASERNIP, MSAC	2	SHI	Devolution	Federation	6.2	0.7
Austria	ITA	1	SHI	Devolution	Federation	5.4	0.9
Belgium	KCE	1	SHI	Deconcentration	Fed.arrang.	6.5	0.7
Canada	AETMIS, AHFMR, CCOHTA	3	SHI	Devolution	Federation	6.7	0.6
Czech Rep	-	1	SHI	Deconcentration	Unitary state	6.8	1.3
Denmark	DACEHTA, DSI	2	NHS	Devolution	Fed.arrang.	7.3	0.4
Finland	FinOHTA	1	NHS	Devolution	Fed.arrang.	5.5	0.6
France	HAS(ANAES), CEDIT	2	SHI	Centralised	Fed.arrang.	7.4	1.4
Germany	DAHTA@DIMDI	1	SHI	Devolution	Federation	8.6	1.2
Greece	-	0	NHS	Centralised	Unitary state	5	1
Hungary	HunHTA	1	Mixed	Deconcentration	Unitary state	5.5	1.3
Iceland	-	0	NHS	Deconcentration	Unitary state	8.3	0.8
Ireland	-	0	SHI	Deconcentration	Unitary state	5.5	0.7
Italy	-	0	NHS	Devolution	Fed.arrang.	6.4	1
Japan	-	0	SHI	Deconcentration	Fed.arrang.	6.4	1
Korea	-	0	Mixed	Centralised	Unitary state	3.2	0.7
Luxembourg	-	0	SHI	Centralised	Unitary state	5.3	0.6
México	-	0	Mixed	Deconcentration	Federation	2.8	0.1
Netherlands	CVZ, GR, ZonMW	3	SHI	Deconcentration	Fed.arrang.	5.5	0.6
New Zealand	NZHTA	1	Mixed	Deconcentration	Fed.arrang.	6.6	0.8
Norway	SMM	1	NHS	Devolution	Unitary state	7.4	0.4
Poland	-	0	Mixed	Deconcentration	Unitary state	4.4	0.7
Portugal	-	0	NHS	Deconcentration	Fed.arrang.	6.5	1.3
Slovakia	-	0	SHI	Deconcentration	Unitary state	5.1	1.8
Spain	AETS, AETSA, CAHTA, OSTEBA, UETS	5	NHS	Devolution	Federation	5.4	1.2
Sweden	CMT, SBU	2	NHS	Devolution	Unitary state	7.9	0.8
Switzerland	MTU/SFOPH	1	SHI	Devolution	Federation	6.5	0.8
Turkey	-	0	Mixed	Deconcentration	Unitary state	4.2	1
UK	CRD, IAHS, NCCHTA, NHS QIS, NHSC	5	NHS	Devolution	Fed.arrang.	6.4	0.7
USA	AHRQ, CMS, VATAP	3	Mixed	Devolution	Federation	6.6	0.4

Methods

Techniques of multivariate analysis: appropriate for situations when the random variation in several variables is to be studied simultaneously (Armitage 1971)

Cluster analysis:

- Classifies a set of observations into 2 or more unknown groups (minimize within-group variation, maximize between group variation).
- Groups are nested and represented in 2D dendrogram.
- Hierarchical or K-means?: no prior knowledge number groups and small sample (Everitt et al. 2001)
- *Proximity matrix* - method Euclidean distance

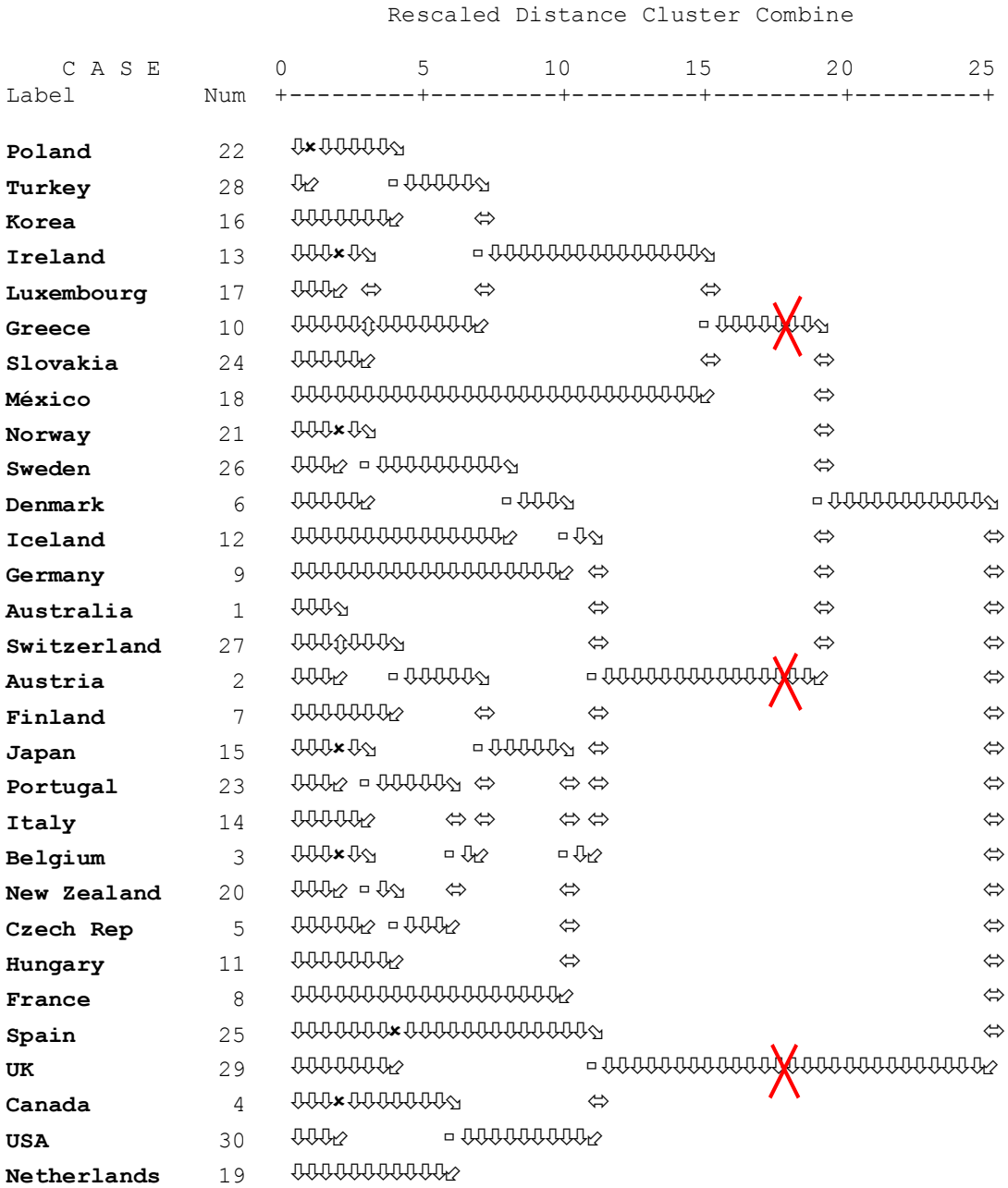
$$\text{Distance } (A,B) = \sqrt{\sum (A_i - B_i)^2}$$

- Linkage method: Average distance between groups

Methods

Linear discriminant function analysis:

- Find the linear combination of x's variables (*predicting variables*) which best discriminates among the different categories of the *grouping variable* (n=>2, defined by the clusters).
- *Fisher' s linear function* - maximizes the ratio of the between-groups sum of squares (SSq) to the within groups SSq.
- Number of linear function = K-1 (grouping variable).
- F1, or highest latent root - gives the coefficients in the linear function that maximizes the ratio of SSq.
- F2 - function with the highest ratio of SSq, subject to the condition that is uncorrelated with F1.



Results - cluster analysis

Group 1 (n= 8)

- Countries with no HTA agencies
- Public health expenditure < Average OECD
- Unitary states; centralised / deconcentrated

Group 2 (n=17)

- No. Agencies: 1 to 2 (exception: 4 no agency)
- Public health expenditure > Average OECD
- 50% NHS, 50% SHI
- Heterogeneous (traditional federal countries, Scandinavian…)

Group 3 (n=5)

- High number HTA agencies (>=3)
- Health expenditure average OECD
- All devolved systems (except Netherlands); 3 Federations

STANDARDIZED CANONICAL DISCRIMINANT FUNCTION COEFFICIENTES

	Function	
	1	2
PUBEXP	.861	.481
PUBPHARM	.116	.272
TYPESYST	-.062	.189
RULE ARRANGEMENT IN THE COUNTRY	.553	-.592
DECSYST	.316	-.195

MULTIVARIATE TESTS OF SIGNIFICANCE

Tests of Equality of Group Means

	Wilks' Lambda	F	df1	df2	Sig.
PUBEXP	.430	17.928	2	27	.000
PUBPHARM	.954	.650	2	27	.530
TYPESYST	.851	2.372	2	27	.112
RULE ARRANGEMENT IN THE COUNTRY	.701	5.765	2	27	.008
DECSYST	.623	8.166	2	27	.002

Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1 through 2	.251	34.551	10	.000
2	.844	4.245	4	.374

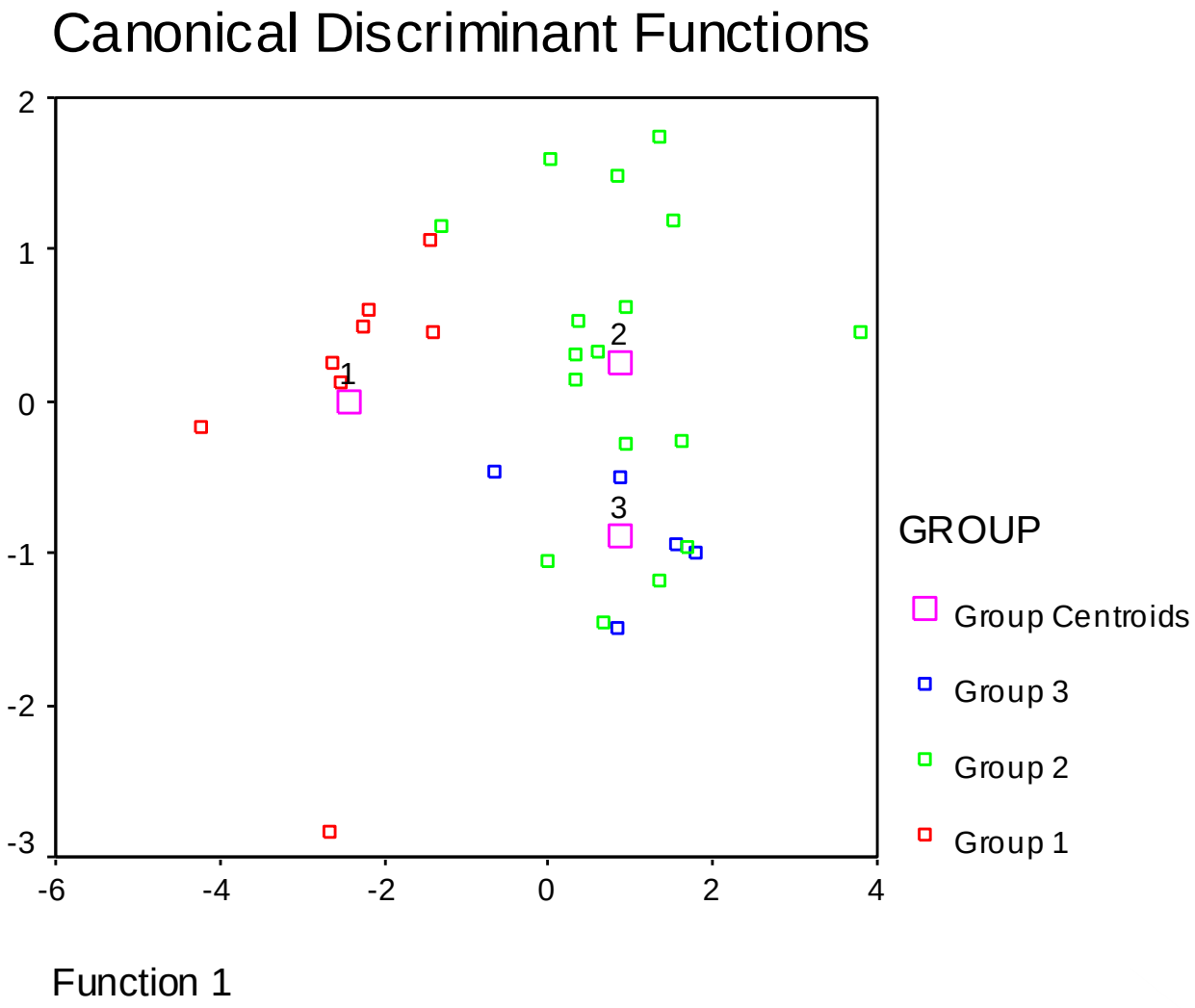
PREDICTED GROUP MEMBERSHIP AND MISCLASSIFICATIONS

Classification Results[b]

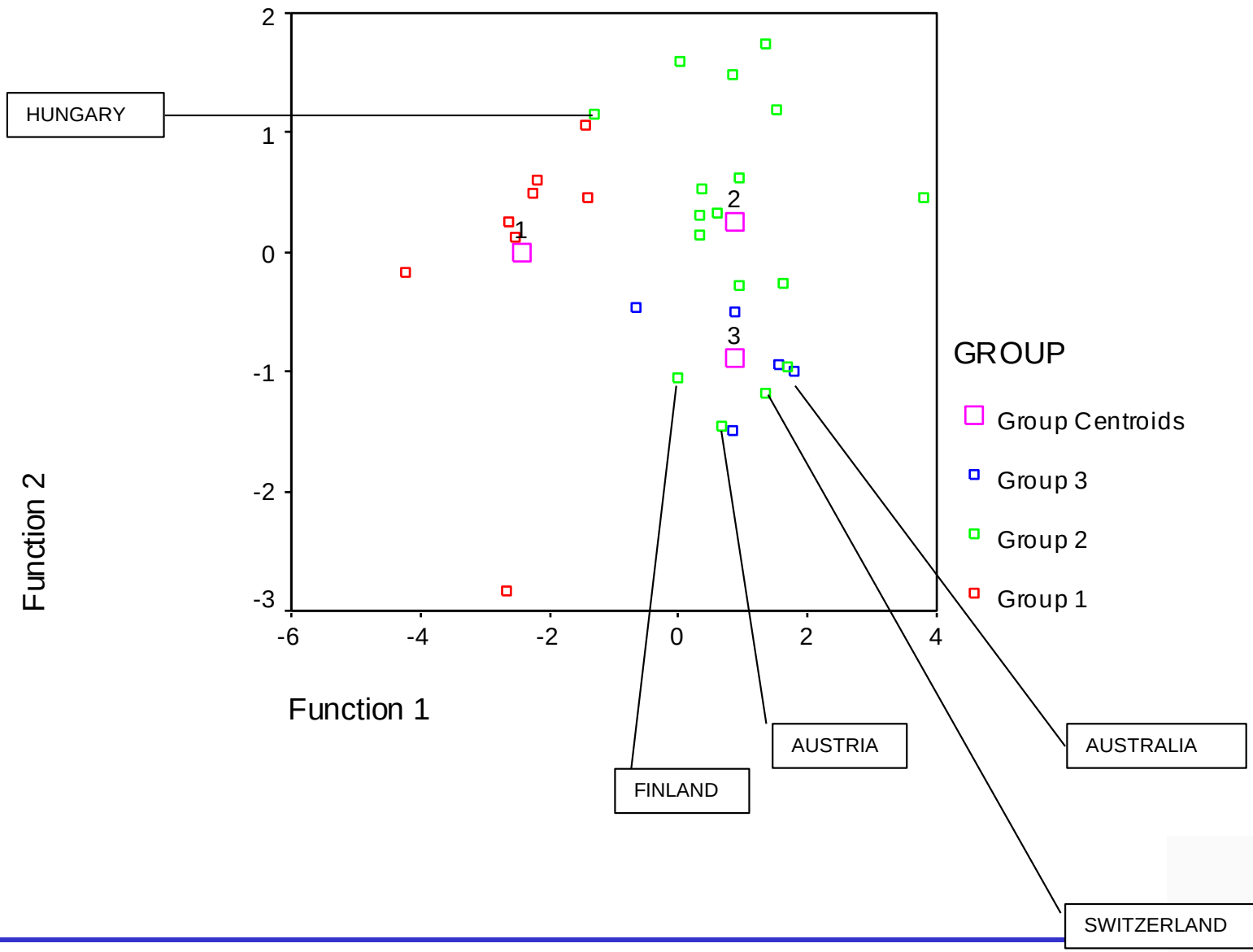
			Predicted Group Membership			
		GROUP	1	2	3	Total
Original	Count	1	8	0	0	8
		2	1	12	4	17
		3	0	0	5	5
	%	1	100.0	.0	.0	100.0
		2	5.9	70.6	23.5	100.0
		3	.0	.0	100.0	100.0

b. 83.3% of original grouped cases correctly classified.

ALL-GROUP SCATTER PLOT WITH MISCLASSIFIED CASES



Canonical Discriminant Functions



Results - discriminant analysis

- Canonical correlation: About 70% variability in the discriminant scores is attributable to between-group differences for F1.
- Canonical coefficients - largest contributor is public expenditure, followed by political decentralisation & form of health care decentralisation.
- Degree of prediction of the 5 variables is high: 83% cases correctly classified.
- Scatter plot: F1 divides cases into two basic sections (group 1 on the left; groups 2+3 right).
- Discrimination power linear function 2 is not as good as F1 (blurred area between groups 2 and 3).

Conclusions

- Results suggest that a high level of public expenditure in health care and a decentralised decision-making context favour the setting up of HTA organisations.
- % Public expenditure in pharmaceuticals no relevant factor - counterintuitive
- 12 /18 countries with HTA agencies have devolved health decision-making authority to regional or local government

  – local political accountability
  – public awareness financial size problem

Can put pressure on governments to make a move towards explicit rationing

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Discussion

- Cluster analysis results always considered with caution (certain degree subjectivity)
- Model provides a certain capacity prediction of future developments in the HTA area.
- This research shows the value of hierarchical cluster analysis in conjunction with discriminant function analysis for the classification of complex cases (See Nixon 2000).
- Normal distributional assumptions for traditional discriminant analysis are not satisfied. However, it is common practice to employ above procedures as a first analysis, since method produce satisfactory results even for scenarios where distributional assumptions cannot be met (Asparoukhov and Krzanowski 2001)

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