Comparing *comparables*[*]: an approach to accurate cross-country comparisons of health systems for effective healthcare planning and policy guidance

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[*] Comparable is an adjective, not a noun. Until now.

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Motivation

Handling healthcare workforce planning with care: where do we stand?

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Abstract

Background: Planning the healthcare workforce required to attend to the health needs of the population while providing service levels that maximize the outcome and minimize the financial costs is a complex task. The problem can be stated as assessing the right number of people with the right skills in the right place at the right time to provide the right services to the right people. The literature available on the subject is vast but sparse, with no consensus established on a definite methodology and technique, making it hard for the analyst or policy maker to adopt the recent developments, or for the academic researcher to improve such a critical field.

Methods: We revisited more than sixty years of documented research to better understand the chronological and historical evolution of the area and the methodologies that have stood the test of time. The literature review was conducted in electronic publication databases and focuses on conceptual methodologies rather than techniques.

Results: Four different and widely used approaches were found within the scope of supply, and three within demand. We elaborated a map systematising advantages, limitations and assumptions. Moreover, we provide a list of the data requirements necessary to implement each of the methodologies. We have also identified past and current trends in the field, and we have elaborated a proposal on how to integrate the different methodologies.

Conclusion: Methodologies abound, but there is still no definite approach to address HHR planning. Recent literature suggests that an integrated approach is the way to solve such complex problem, combining elements both from supply and demand, and more effort should be put in improving that proposal.

Keywords: review; healthcare workforce planning; supply; demand; needs; health policy

1 Introduction

Healthcare human resource (HHR) planning has been identified as the most criti-

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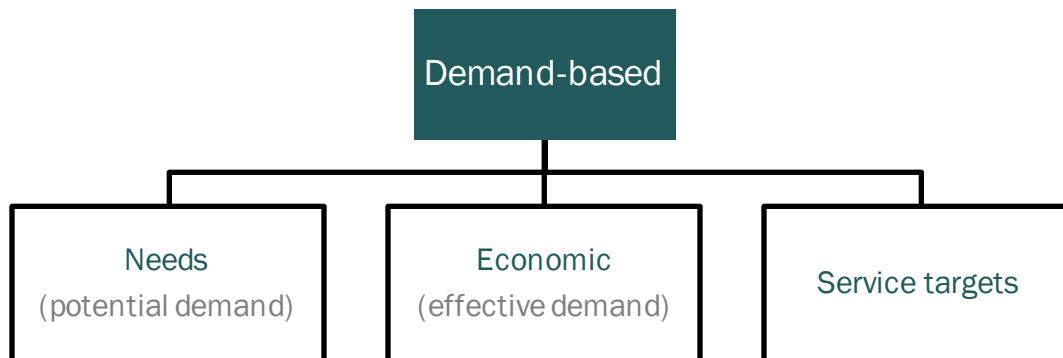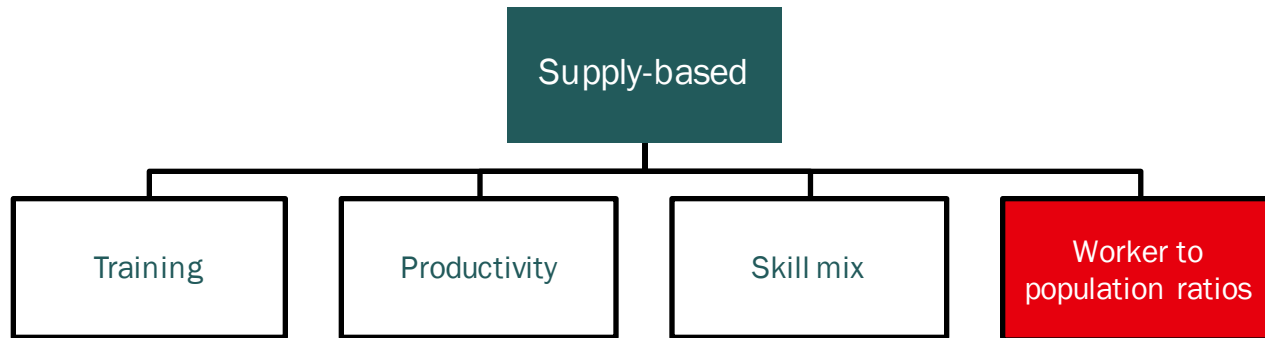
Motivation

Motivation

- **Benchmarking, comparative analysis** and simple **worker-to-population ratios** are frequently used to inform healthcare planning and health policy

  – These techniques *don't* require a lot of data[1]

1 - Amorim Lopes et al (2015): Handling healthcare workforce planning with care: where do we stand? Journal Human Resources for Health, publication pending.

Motivation

Does Portugal have enough physicians?
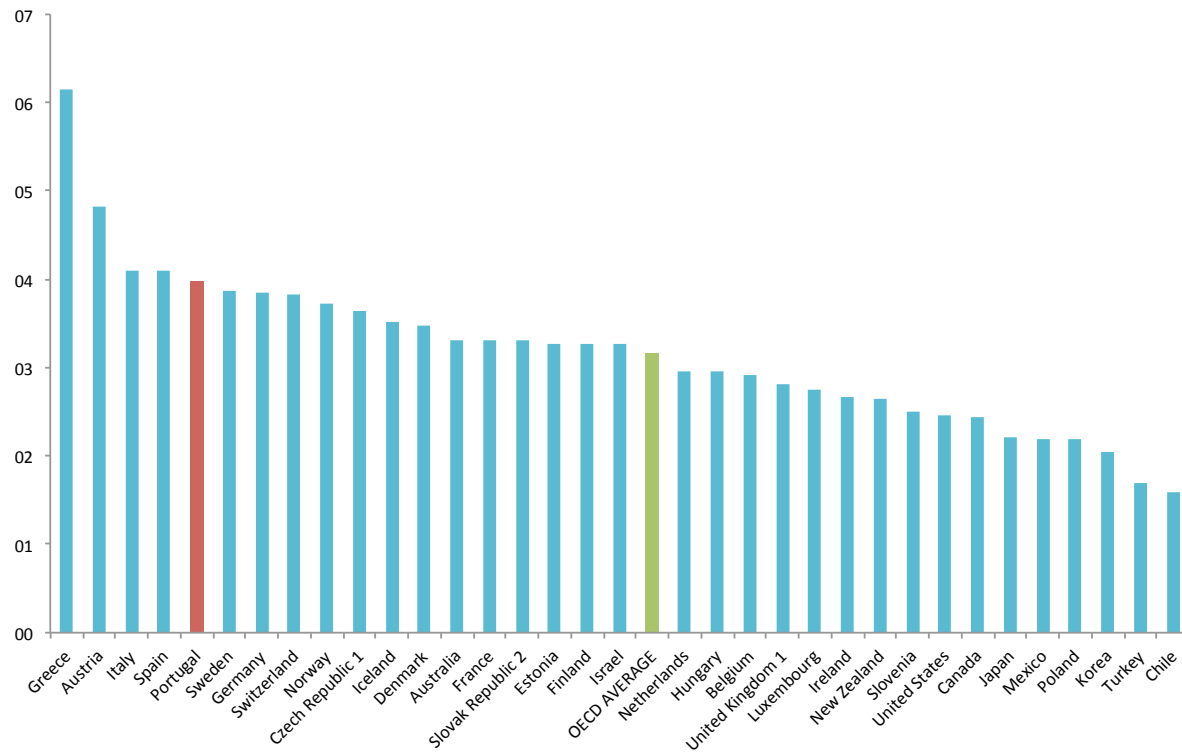
Motivation

- Should Portugal compare against the **OECD average**, the **EU17/18/27 average**, or the **world average**?

Motivation

- British authorities **increased by 60%** the number of intakes to the NHS

  - Why? Because the **physician-to-population ratio** was **low** in comparison to other OECD countries

- Subsequent research showed this was a **bad decision**

  - **Differences between healthcare systems** weren't properly taken into account

Source: Bloor et al (2006): Do we need more doctors? Journal of the Royal Society of Medicine 99(6), 281–287 (2006)

Idea
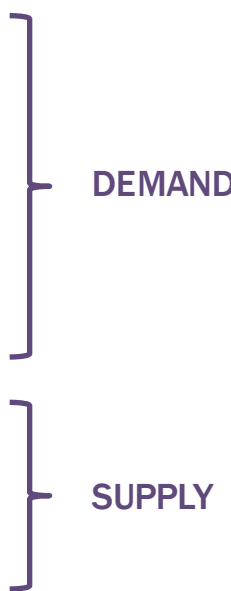
Identify groups of countries featuring similar health systems and then benchmark against these smaller and similar groups

Methodology

1. Using a two-stage clustering algorithm form **clusters of similar countries** for each of the group of indicators

2. Form super-clusters with countries that are part of the same group in more than one cluster for both **demand** and **supply**

3. **Benchmark within clusters**

How?

- WHO's **Health for All Database** contains healthcare indicators from 27 countries

  – Mortality-based indicators

  – Morbidity-based indicators   **DEMAND**

  – Healthcare utilization

  – Physical resources

  – Human resources   **SUPPLY**

Methodology (in detail)

1. Choose data sources

2. Select indicators

3. Data treatment, standardization and aggregation

4. Two-stage clustering algorithm

   1. **Hierarchichal clustering algorithm (HCA)** with **Ward's method** do determine cluster centers

   2. **K-means algorithm** used to generate ANOVA statistics

5. Validation and interpretation

Data treatment

Five main groups of indicators from HFA-DB

Multicollinearity analysis (bivariate correlations)

Indicators are correlated

Indicators are not correlated

If indicators are hierarchically linked, the top-level one is selected

If not, the one with the highest coefficient of variance is selected

Estimation of missing values

If time-series are linearly correlated, unknown value is extrapolated

If not, data from the last available year is used (up to 3 years back)

Otherwise, indicator excluded from analysis

Final set for each group of indicators

Example: Mortality

Step 1: Select indicators

	MORTALITY-BASED INDICATORS		
Included			
Code	**Name**	**Target**	**Sample**
1320	SDR, diseases of circulatory system	all ages	per 100k
1520	SDR, malignant neoplasms	all ages	per 100k
1740	SDR, motor vehicle traffic accidents	all ages	per 100k
1820	SDR, infectious and parasitic diseases	all ages	per 100k
1830	SDR, diseases of respiratory system	all ages	per 100k
1850	SDR, diseases of digestive system	all ages	per 100k
1870	SDR, endocrine, nutritional and metabolic diseases	all ages	per 100k
1900	SDR, mental disorders, diseases of nervous system and sense organs	all ages	per 100k
1910	SDR, disease of genitourinary system	all ages	per 100k
1920	SDR, symptoms, signs and ill-defined conditions	all ages	per 100k
1960	SDR, acute respiratory infections, pneumonia and influenza	< 5 years	per 100k
Excluded			
1340	SDR, ischaemic heart disease	all ages	per 100k
1360	SDR, cerebrovascular diseases	all ages	per 100k
1540	SDR, trachea/bronchus/lung cancer	all ages	per 100k
1560	SDR, cancer of the cervix uteri	all ages	per 100k
1590	SDR, malignant neoplasm female breast	all ages	per 100k
1840	SDR, bronchitis/emphysema/asthma	all ages	per 100k
1860	SDR, chronic liver diseases and cirrhosis	all ages	per 100k
1880	SDR, diabetes	all ages	per 100k
1890	SDR, diseases of the blood, blood forming organs and certain immunity disorders	all ages	per 100k
1930	SDR, tuberculosis	all ages	per 100k
1940	SDR, diarrhoeal diseases	< 5 years	per 100k
1970	SDR, selected alcohol-related causes	all ages	per 100k

Example: Mortality

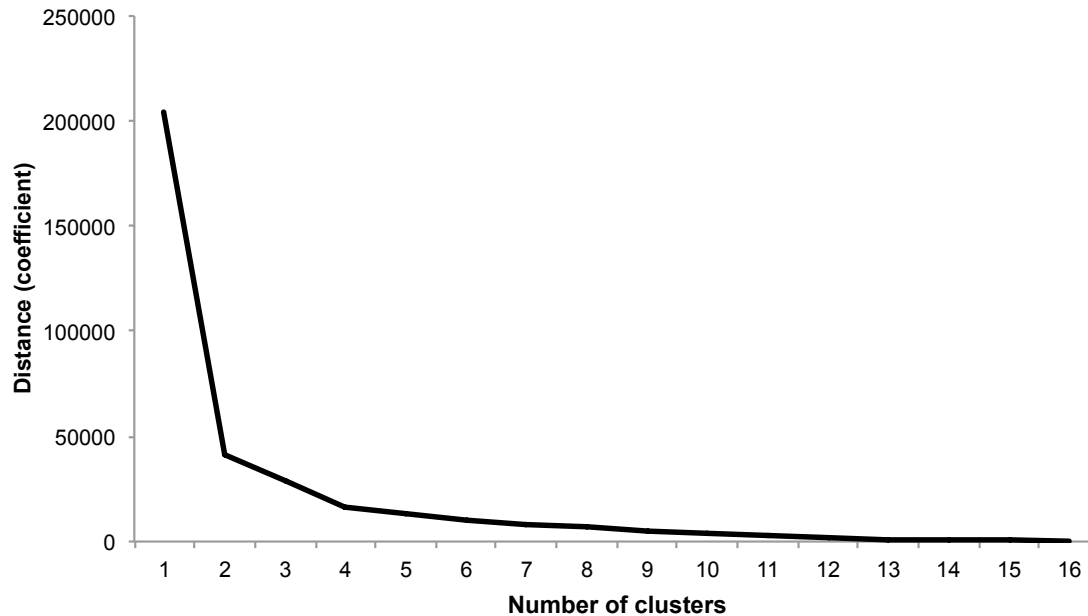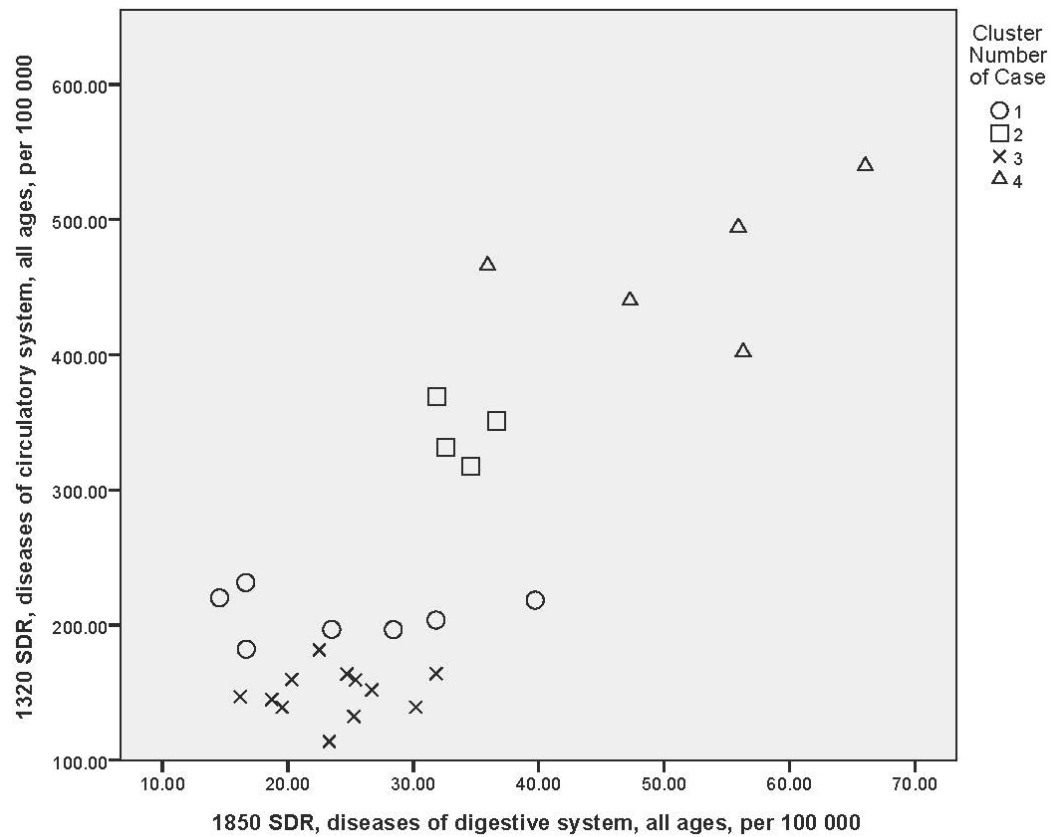Step 2: No data normalization was necessary as mortality indicators are provided in pre-normalized SDRs.

Example: Mortality

Step 3: Apply HCA and generate dendogram.

Dendrogram using Ward Linkage
Rescaled Distance Cluster Combine

004 Austria	1
018 Germany	7
045 Sweden	25
015 Finland	6
030 Malta	12
019 Greece	8
043 Slovenia	24
022 Ireland	20
052 United Kingdom	27
029 Luxembourg	11
024 Italy	21
046 Switzerland	26
034 Norway	14
007 Belgium	18
033 Netherlands	13
044 Spain	17
013 Denmark	4
036 Portugal	16
016 France	19
012 Czech Republic	3
035 Poland	15
010 Croatia	2
014 Estonia	5
027 Latvia	10
028 Lithuania	22
042 Slovakia	23
020 Hungary	9
038 Romania	28

Example: Mortality

Step 4: Elaborate a scree plot and select the number of clusters

Example: Mortality

Step 4: Run k-means with 4 clusters and interpret ANOVA statistical tests.

ANOVA F-test results

	F-test	Sig.
Mortality-based indicators		
1320 SDR, diseases of circulatory system	183.844	.000
1520 SDR, malignant neoplasms	10.404	.000
1740 SDR, motor vehicle traffic accidents	5.073	.007
1820 SDR, infectious and parasitic diseases	1.959	.147
1830 SDR, diseases of respiratory system	2.836	.059
1850 SDR, diseases of digestive system	20.126	.000
1870 SDR, endocrine, nutritional and metabolic diseases	.331	.803
1900 SDR, mental disorders, diseases of nervous system and sense organs	3.699	.026
1910 SDR, disease of genitourinary system	.832	.490
1920 SDR, symptoms, signs and ill-defined conditions	.710	.555
1960 SDR, acute respiratory infections, pneumonia and influenza	2.163	.119

Example: Mortality

Step 5: Validate results
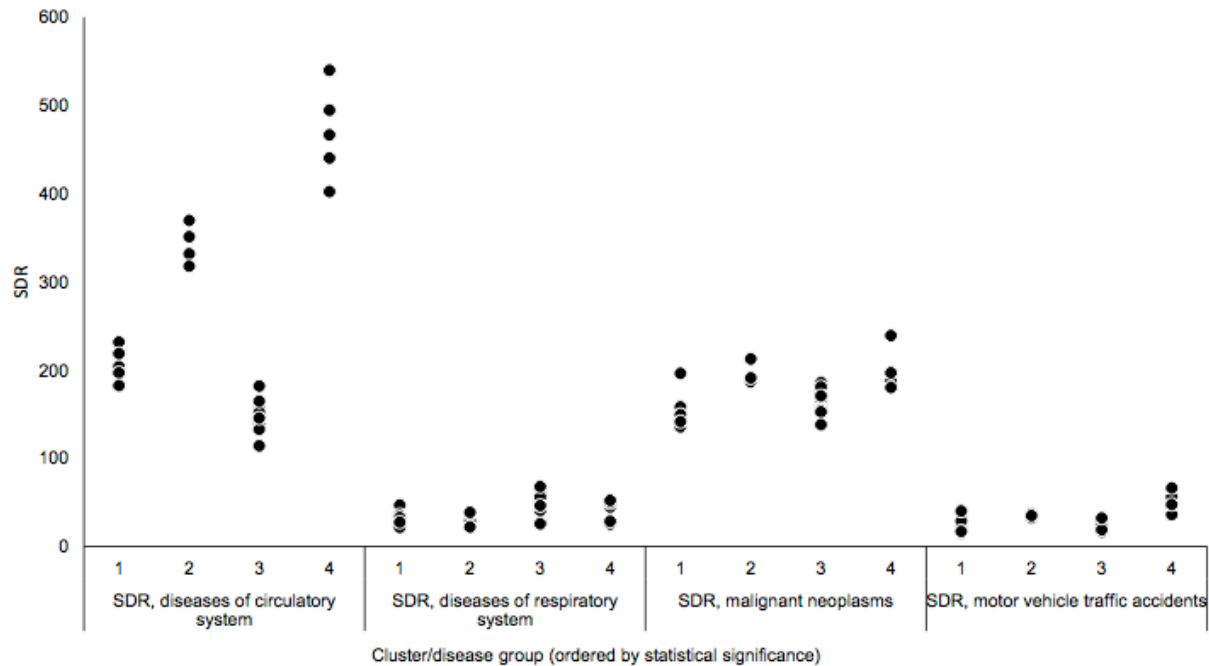
Example: Mortality

Step 5: Validate results

Example: Mortality

- We obtained 4 clusters

- Western and central EU countries
- Low mortality

| Austria |
| Finland |
| Germany |
| Greece |
| Malta |
| Slovenia |
| Sweden |

| Belgium |
| Denmark |
| France |
| Ireland |
| Italy |
| Luxembourg |
| Netherlands |
| Norway |
| Portugal |
| Spain |
| Switzerland |
| United Kingdom |

| Croatia |
| Czech Republic |
| Estonia |
| Poland |

| Hungary |
| Latvia |
| Lithuania |
| Slovakia |
| Romania |

- Eastern European countries
- High mortality

Demand (mortality and morbidity)

- Following the same procedure for morbidity, we can aggregate both mortality and morbidity and obtain super clusters

Demand (mortality and morbidity)

Hospital discharges vs SDRs by disease
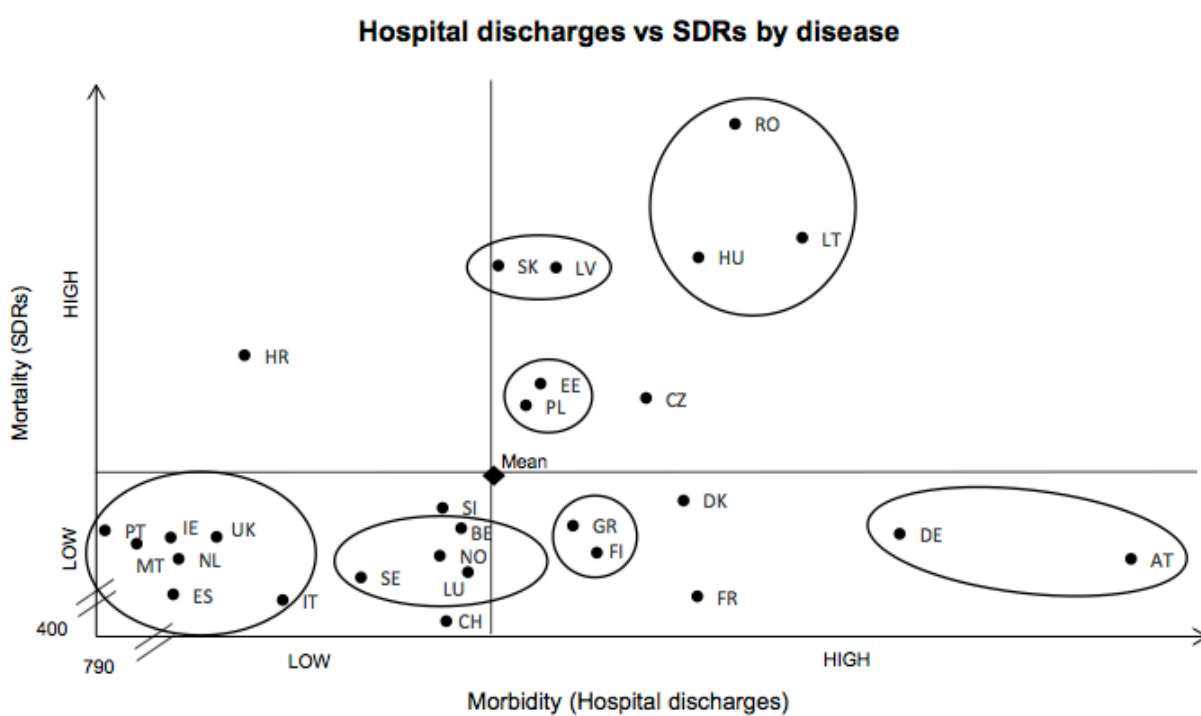
Supply (human and physical resources)

Capital versus labour intensity by country
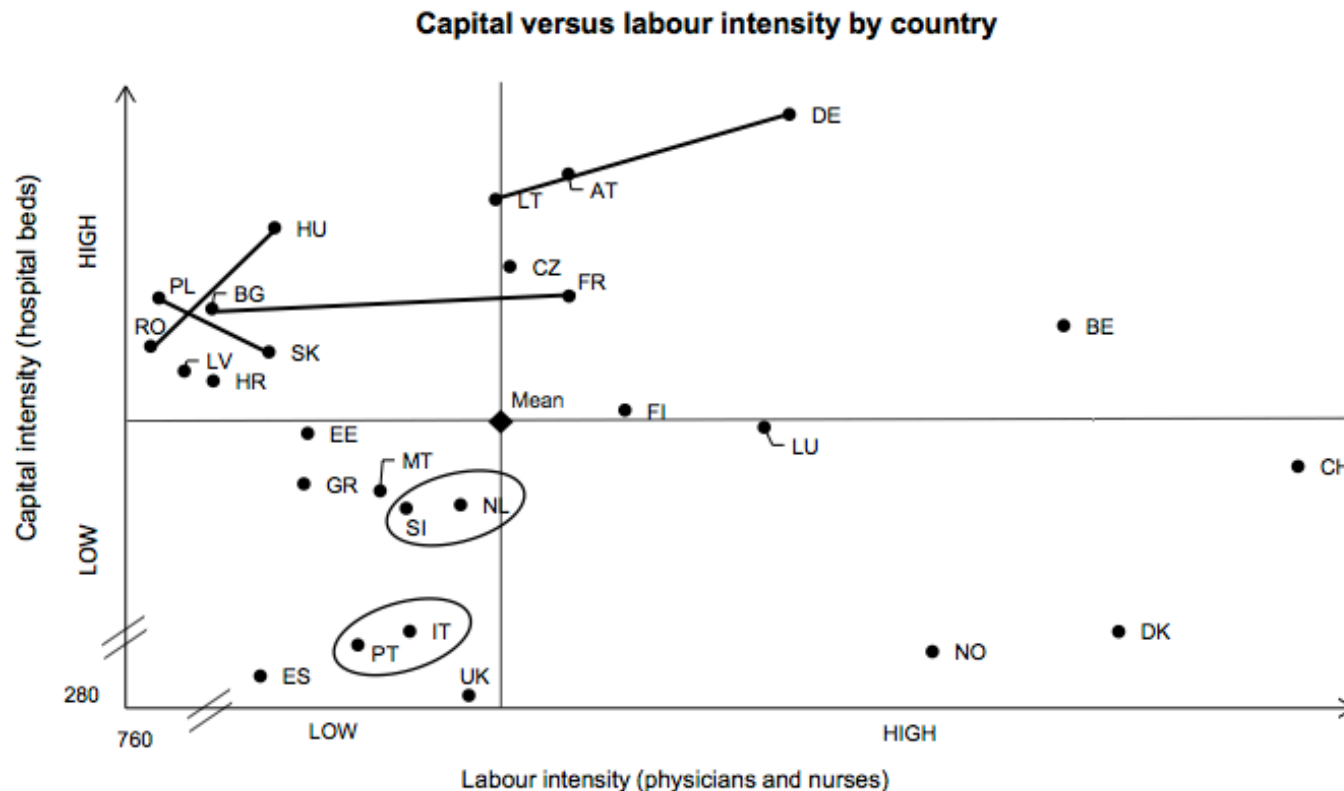
Similarity matrix

- If two countries feature in the same cluster, 1 point is given

	AT	BE	BG	HR	CZ	DK	EE	FI	FR	DE	GR	HU	IE	IT	LV	LT	LU	MT	NL	NO	PL	PT	RO	SK	SI	ES	SE	CH	UK
AT																													
BE																													
BG																													
HR		2	1																										
CZ	1		1	2																									
DK		1			1																								
EE		1	1	3	3	1																							
FI	1	1	1			1	1																						
FR		1	2	1	1	1	1	2																					
DE		**4**		1				2	1																				
GR	2				2	2	1	2		1																			
HU	1				2						1																		
IE	1				1		2				1	1																	
IT	1	1		1				1	1		1		3																
LV		1		1	1	1	3	1					1	2															
LT	2		1					1	1	3		2		1	1														
LU	1	**4**	1	1	1	1	1	1				1	1	1	1	1													
MT	1	1	2					1						1	1	1	1												
NL		2	2			1		1					1	2	2	1	1	2											
NO		3				2		1	1				1	3	2			3	1										
PL	1		1	3	1	2	1							2	1			1	1	1									
PT	1	1		1	1			1	1		3	**5**			1	1			1	2	2								
RO	1				1						1	**4**		2	2	1			1		1								
SK	1		3	1	1	1					2	3		2	1	1	1			3			2						
SI	1	3			2			1	1				1	1	1		2		2	2	2	1		1					
ES		1			1		1	1			3	**4**	1		1	1			3	2				**4**	1		1		
SE	1	1				1	1	1			2			2	1		1		1		3				1	2			
CH		2		3	1			1			1			2	1	1		2			1	3			1	1	1	2	
UK		1			1		2	1			1			3	2			1	2	2	2	2	1	2		1	2	1	2

Similarity matrix

- **Portugal and Italy** feature in the same cluster for every indicator (maximum similarity)

  - **Portugal and Spain** feature in 4 out of 5 indicators

- **Portugal and Greece** never appear together in the same cluster

For policy guidance

- With a similarity of four, we can establish Spain as

  Portugal's benchmark reference

  – Spain achieves **lower mortality rates** with a **lower share of capital**

    and **labour** (more efficient)

For policy guidance

- Also useful to understand which countries should *not* be compared directly

  - e.g. Despite exhibiting a **lower mortality rate** (in comparison to Portugal), Switzerland has a **much higher labour and capital intensity**

  - On the other hand, with a similar (lower) labour and capital intensity, Spain and Italy both exhibit a lower mortality rate compared to Portugal

Future work

- Use better and more comprehensive data sources to extend the health data used to generate the clusters

- Understand how this methodology may be applied interchangeably to other benchmarks or comparative performance analysis

- How can this be coupled with DEA?

- Derive further insights from the health systems comparison (a typology?)

THANK YOU