What are the drivers of the overall increase in healthcare expenditures? A new look on technological innovation

Ana Pinto Borges

Universidade Lusíada Porto and CEF.UP. PORTUGAL

Erika Laranjeira

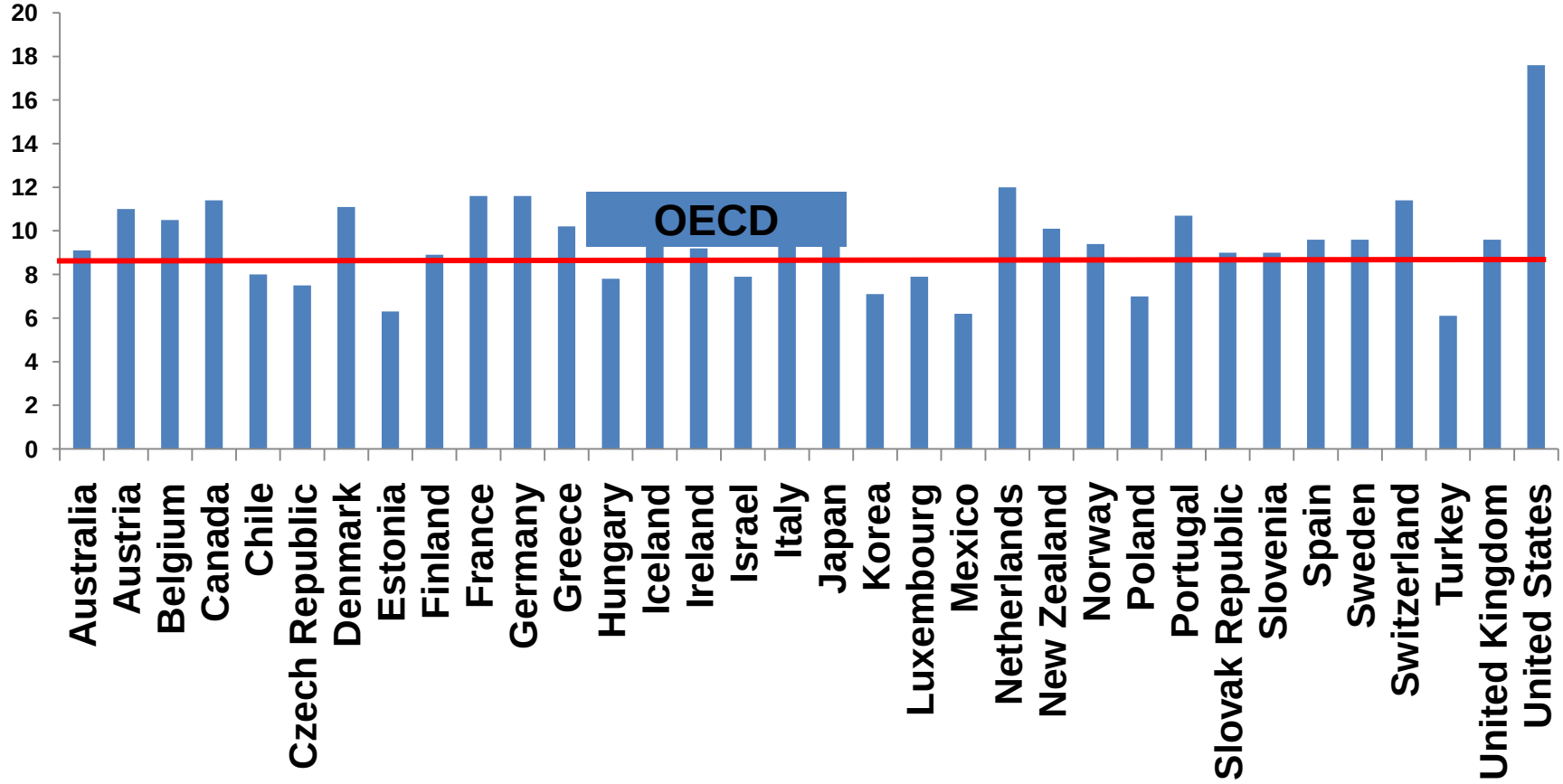
Faculdade de Economia. Universidade do Porto and CEF.UP. PORTUGAL

Santander, 21st of june 2013

XXXIII Jornadas de Economía de la Salud

- MOTIVATION
- THE MAIN RESULTS IN LITERATURE REVIEW
- METHODOLOGY
- RESULTS
- CONCLUSIONS

Total expenditure on health as a % of gross domestic product (GDP), 2010



Source: OECD Healthdata, 2012

- We obeserve a lot of work that study the factors that contributed to the healthcare spending.

- But they only use a cross-section or time-series data. In this literature, there are just two papers that used panel data: McGuire *et al.* (1993) and Gerdtham *et al.* (1998).

- The purpose of this paper is to determine the main factors that have contributes to the increase in healthcare spending, explicity focusing on the impact of technological innovation on healthcare sector.

- Furthermore, we intend to expand this literature in two way:

  - one the one hand, using Multiple Imputation technique in order to overcome the problem of missing data by using a panel data analysis; and

  - on the other hand, by directly analyzing the impact of technological innovation through the creation of composite technological index.

- The studies published until now share in common some conclusions that have been very consistent from study to study about which drivers are the most important in healthcare spending.

- For example:
  - the effect of income on health expenditure is positive and significant;
  - aging population plays only a minor role;
  - the existence of “gatekeepers” and of a public sector provision of health services are usually insignificant;
  - there exists a positive relationship between the number of doctors and health expenditure as well as between the ratio of inpatient expenditure to total health expenditure and the total amount of health expenditure; and
  - technological change is the most important driver of spending increases over time.

- The database was compiled from different OECD sources and from the World Bank. The dataset covers 27 OECD countries for a 35-years period (1975 to 2010).

- The set of the countries in the sample is constituted by Australia, Austria, Canada, Czech Republic, Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, New Zealand, Portugal, Slovak Republic, Slovenia, Switzerland, Turkey, United Kingdom (UK), and United States of America (USA).

- The **dependent variable** used is the total health expenditure *per capita* in US dollars, converted at economy-wide Purchasing Power Parity (PPP) – **$THEX_{pc}$.**

Table n.º 1 - Explanatory variables

Factors	Name	Definition
Socio-demographic variables	GDP_{pc}	Gross Domestic Product *per capita* in US dollars - PPP
	POP14	The proportion of population 14 years and under
	EMV	The proportion of population over the average life expectancy
	LEX	Life expectancy at birth
	IM	The number of infant mortality, deaths per 1.000 live births
	URB	Proportion of urban population
	UNEMP	Unemployment rate
Human behaviors	ALCOOL	Alcohol consumption in liters *per capita*
	SMOK	Tobacco consumption – cigarettes *per smoker per day*
Institutional variables	OUTP	Percentage of private expenditure on health
	PHARM	The total pharmaceutical sales per capita in US dollars - PPP
	GOV	Health expenditure financed by General Government as a % of GDP
	INDEX	Technological composite index

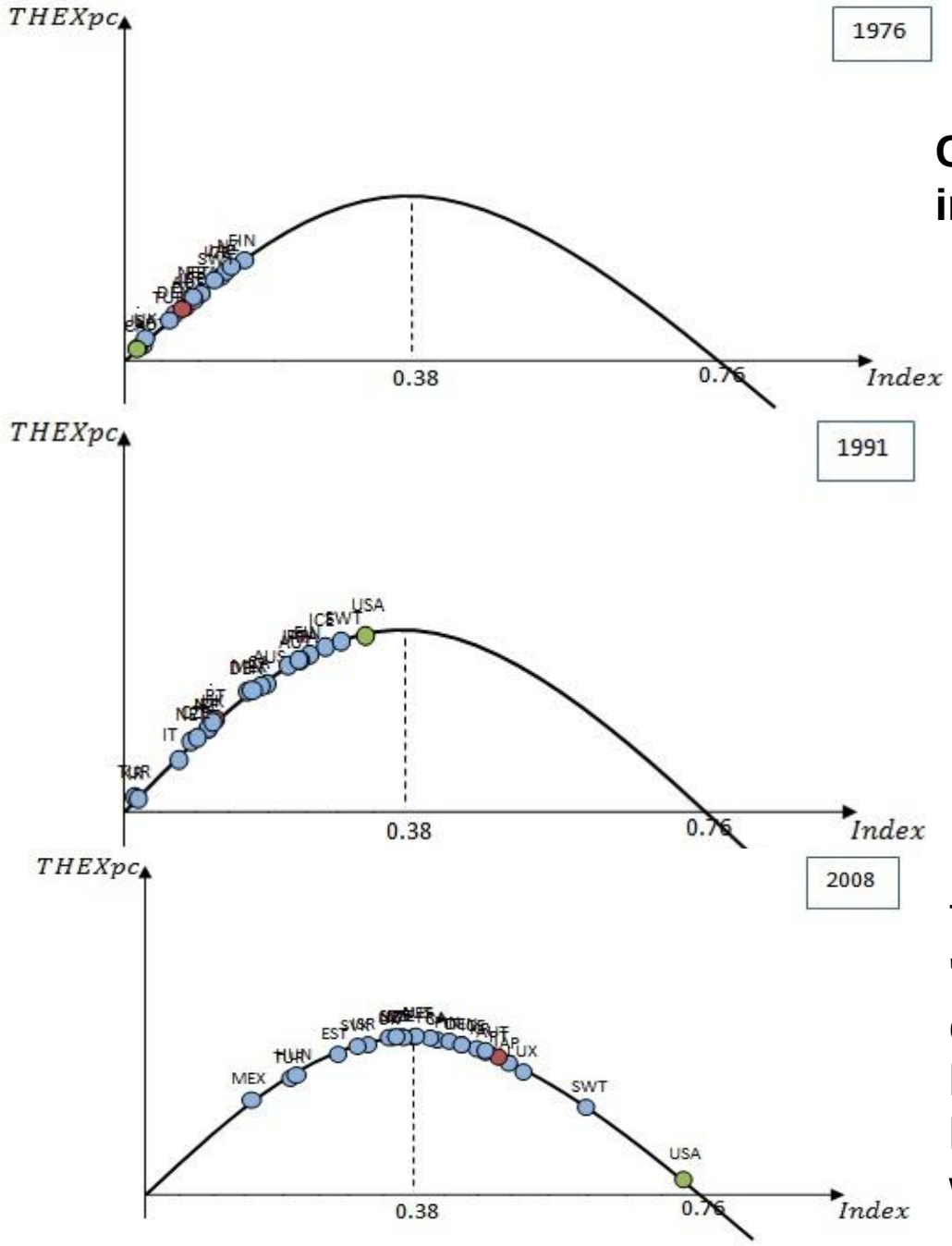
Table n.º 2 – Variables which constitute the composite innovation index with their respective weights

	Variable	Describe	Weight
Healthcare machinery available in the country	MRI	Magnetic Resonance Imaging units, total - Per million population.	0.06402
	PET	PET scanners, total - Per million population.	0.08426
	GAMMA	Gamma cameras, total - Per million population.	0.03028
	DSA	Digital Subtraction Angiography units, total - Per million population.	0.05627
	MAM	Mammography, total - Per million population.	0.07364
	RTE	Radiation therapy equipment, total - Per million population.	0.07441
	LITH	Lithotripters, total - Per million population.	0.02428
	MRIE	Magnetic Resonance Imaging exams, total - Per million population.	0.02805
Innovative medical procedures of the past few years	END	End-stage renal failure patients - Per 100 000 population.	0.09165
	DIA	Patients undergoing dialysis - Per 100 000 population.	0.0972
	FUKIDNEY	Functioning kidney transplants - Per 100 000 population.	0.05794
	BONE	Bone marrow transplants - Per 100 000 population.	0.05373
	HEART	Heart transplants - Per 100 000 population.	0.07295
	LIVER	Liver transplants - Per 100 000 population.	0.06361
	LUNG	Lung transplants - Per 100 000 population.	0.06422
	KIDNEY	Kidney transplants - Per 100 000 population.	0.06352

Estimated coefficients by 2-Fixed Effects Model (FEM) for $THEX_{pc}$

Models / Variables	1	2[d]	3
GDP	0.822[a]	0.826[a]	0.816[a]
POP14	0.134[a]	0.130[a]	0.1313[a]
EMV*	0.016[b]	0.014[b]	0.0171[b]
LEX	0.162	0.163	0.164
IM	-0.096[a]	-0.117[a]	-0.098[a]
URB	-0.256[b]	-0.286[a]	-0.236[b]
UNEMP*	0.012[b]	0.008	0.012[b]
ALCOOL*	0.05[a]	0.050[a]	0.053[a]
SMOK*	0.001	0.013	0.012
OUTP	-0.051[a]	-0.046[a]	-0.053[a]
PHARM	0.015[c]		0.014[c]
GOV*	0.647[a]	0.644[a]	0.6415[a]
INDEX	0.405[a]		0.418[a]
INDEXSQ	-0.534[a]		-0.518[a]
Constant	-0.544	-0.513	-1.28
INDPHARM		0.769[a]	
INDPHARM		-0.683[a]	
R^2	0.8167[e]	0.8148[e]	0.8109[e]
F-statistic	1973.88	2310.85	1877.80
F-test	0.000	0.000	0.000
F-test against 1 - FEM, C	119.65[a]	164.01[a]	105.36[a]
F-test against 1 - FEM, P	3.05[a]	3.12[a]	2.96[a]
F-test against 0 –FEM	73.93[a]	75.94[a]	64.26[a]

Definitions: a, b, c represent 1%, 5% and 10% levels of significance. d:In this regression the variable PHARM was integrated in the technological index, represented by the variable INDPHARM. e: This value was estimated.
*: Imputed variables. Country and time-dummies are not present.



Contribution of technological innovation to healthcare costs

The countries are beyond the "turning point“ (where the weight of innovation on healthcare costs becomes increasingly lower), efficiently save resources with technological innovation.

- Australia, Austria, Canada, Denmark, France, Finland, Iceland, Italy, J apan, Korea, Luxembourg, Netherland, Portugal, Switzerland, UK and USA are on the **right side of the turning point**. This suggests that an increase in innovation will lead to efficiency gains that allow for a reduction in the contribution of technology to total healthcare costs.

- Czech
  Republic, Estonia, Greece, Hungary, Ireland, Israel, Mexico, New Zealand, Slovak Republic, Slovenia and Turkey are in left side of “turning point”.

- Our paper considers different factors that affect healthcare spending using panel data and multiple imputation technique.

- The technological composite index suggests, that technology has a differential impact on costs depending on a country's stage of development of technology.

- Analysing the non-linear effects of technology, we observe that the increase in the health expenditure *per capita* driven by technological innovation has diminishing returns. This means that: more investment in technological innovation can efficiently save resources. Despite the initial effort of required investment, from certain point, additional investments are offset from efficiency gains through the use of technology.

Thanks for your attention!!!

Ana Pinto Borges

e-mail: aborges@por.ulusiada.pt

Twitter: @AnaPintoBorges

Santander, 21st of june 2013

XXXIII Jornadas de Economía de la Salud