Health care expenditure and GDP: An international panel smooth transition approach

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Abstract

In this paper, we investigate the potential threshold effects in the relationship between national expenditures on health care and national income. Using a panel threshold regression model, we derive country-specific and time-specific income elasticities for 17 OECD countries over the period 1975–2003. In contrast to many previous analyses, our empirical results show that health care is a necessity rather than a luxury. Further, the relationship between health expenditure and income seems rather nonlinear, changing over time and across countries.

JEL classification: C12

Keywords: Health expenditure; Income elasticity; Panel smooth threshold regression models

1. Introduction

It is well known that a significant relationship exists between national expenditures on health care and national income. Thirty years ago, Joseph Newhouse (1977) observed on the basis of an analysis of a cross-section of thirteen developed countries that over 90 percent of the variation between countries in per capita medical care expenditure could be explained by variations in per capita GDP. In an Engel curve context, this means that health care is a ''luxury'' good. Afterwards, growing attention has been paid for the determinants of aggregate health care expenditure (Parkin et al., 1987; Gerdtham et al., 1992; Hitris and

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Posnett, 1992; Hansen and King, 1996; Blomqvist and Carter, 1997; Di Matteo and Di Matteo, 1998; Okunade and Karakus, 2001; Clemente et al., 2004; Dregers and Reimers, 2005; OECD, 2006; Tosetti and Moscone, 2007; Hartwig, 2008; etc.). Most estimates of the income elasticity of health care spending obtained, especially those derived from aggregative cross-section or time series data, exceed unity. But, as pointed by Blomqvist and Carter (1997) "the idea that health care spending should behave as a luxury good when aggregate data are used appears puzzling". In the same way, Clemente and al. (2004) argued that this finding seems counter-intuitive from an economic point of view.

Two potential reasons can be advanced to explain why the demand for health care may mistakenly have an income elasticity in excess of unity. The first one is the potential non-stationarity of the data. As explained by Jewel et al. (2003), when examining the relationship between health expenditures (HE) and GDP it is important to determine whether or not these two variables are stationary. Empirical tests that ignore this issue can lead to spurious regressions and meaningless results. Recently, many studies, using both country-by-country and panel data techniques, have attempted to analyze the time series pattern of these two variables. (Mc-Coskey and Selden, 1998; Roberts, 1999; Gerdtham and Lothgren, 2000; Okunade and Karakus, 2001; Jewell et al., 2003; Carrion-i-Silvestre, 2005; Dreger and Reimers, 2005). Most of these found that HE and GDP are non-stationary (for example, Hansen and King, 1996; Blomqvist and Carter, 1997; Roberts (1999); Gerdtham and Lothgren, 2000). The second reason, which is specific to the panel data models, concerns cross-section heterogeneity. Pesaran and Smith (1995) and Hsiao (2003) have already indicated that ignorance of this issue causes biases to appear. Thus, in presence of heterogeneity, assuming a common elasticity of output with respect to health expenditure within international panels may be misleading. Hansen and King (1996) argued that cross-country data are characterised by strong heterogeneity that, if not properly incorporated in econometric models, could lead to the estimation of an income elasticity greater than one.

One solution to deal with this heterogeneity problem is to specify a Panel Smooth Threshold Regression (PSTR) model, recently developed by Fok et al. (2004), González et al. (2005), Colletaz and Hurlin (2005) and Fouquau et al. (2008), which allows for smooth changes in country-specific correlations and cross-country heterogeneity and time instability of the elasticity. Such an approach is then suitable to capture both cross-country heterogeneity and time variability of the GDP-HE correlations[2].

The remainder of the paper is organised as follows. In section 2, we discuss the threshold specification of the determinants of health care expenditure. The choice of the threshold variable, linearity tests and estimates for the parameters are presented in section 3. The data and the results are presented in section 4, while the final section concludes.

2. A PSTR model of health care expenditure

Our ambition in this paper is to test whether or not health care expenditure is a luxury good. To address this question, we consider the following model:

$$he_{it} = \alpha_i + \beta.capita_{it} + \varepsilon_{it}, \quad i = 1,...,N, \quad t = 1,...,T \tag{1}$$

where he_{it} and $capita_{it}$ denotes, respectively, the logarithm of real per-capita health expenditure and the logarithm of real per-capita income in the i[th] country at time t, both expressed in purchasing power parity (PPP). α_i is an individual fixed effect, and ε_{it} is the error term. As argued by Hitris and Posnett (1992), the use of health specific PPP to convert health spending provides a comparison of the real quantity of health care services purchased with given expenditure.

[2] For more details and discussions on the utility of PSTR models, see, for example, Colletaz and Hurlin (2005) and Fouquau et al. (2008)

Nevertheless, this model suffers from two major problems. Firstly, many other factors, in addition to income, could affect health care expenditure. The share of the elderly, medical progress and relative prices are often mentioned to be the main non-income factors underlying health expenditure growth in the OECD countries. Many studies have previously found a positive and significant relationship between health care spending and the proportion of population over 65 (see for example Kleiman, 1974; Leu, 1986; Hitiris and Posnett, 1992, Felder et al., 2000). As highlighted by Hansen and King (1996), the elderly consume more health per capita than people of working age. Recently, the OECD (2006) points out that across all health expenditures types, expenditure on those aged over 65 is around four times higher than on those under 65. Further, between 1981 and 2002, average growth of public health spending was by 3.6% per year for OECD countries, of which 0.3% point was directly linked to demographic effects. On the other hand, Leu (1986) and Kleiman (1974) found a significant relationship between health expenditure and the proportion of population under 15. Kleiman (1974) reports a negative correlation between these two variables. He explained his result by the low per unit cost of the goods and services young people consume, such as vaccinations.

Whatever the relationship between the population structure and health spending may be, population ageing is a common fact in developed countries. Progress in medical technology and treatment is advanced to be one of the most important determinants of health outcomes during the last century. As suggested by Blomqvist and Carter (1997) and later by Tosetti and Moscone (2007), the rising of health care expenditure has been to a large extent driven by changes in technology and treatment. Newhouse (1992) and Wanless (2001) have already explained that technical progress causes a decrease of the relative price of health goods and services. If so, the more elastic is the demand for health care, the more increasing will be expenditures.

Another determinant of health care expenditure that has been identified by the literature is the share of public financing. In OECD countries, health care is mainly financed through public funds. Leu (1986) argued that the share of public financing increases health care expenditure to the extent that it reduces the price to the consumer. However, his argument is not confirmed by recent empirical studies. Gerdtham et al. (1992) and recently Tosetti and Moscone (2007) have found a negative relationship between the proportion of health care expenditure that is publicly funded and total health expenditure.

Thus, given the potential interrelations between health care expenditure and these non-income factors, they should be included in the regression model as additional explanatory variables to check the robustness of the estimated income elasticity. But even in doing so, the problem is not resolved since the conditional relationship between income and health spending is always assumed homogeneous. In fact, equation (1) assumes the same income elasticity across the N countries of the panel, i.e. $\beta_i = \beta, \forall i = 1,...,N$. Such an assumption is somewhat restrictive since there is substantial differences among OECD countries in the financing and organization of health services production, which may causes differences in the aggregate demand functions of health services (Clemente et al., 2004).

Besides, equation (1) implies that the income elasticity is constant for the set time period of the model. This assumption seems to be misleading especially when dealing with large time dimension panels. Clemente and al. (2004) believe that it is too restrictive to assume an unchangeable relationship between health spending and the GDP for OECD countries.

Usually, it is difficult to resolve heterogeneity and time variability problems simultaneously. But one issue proposed in the literature consists in introducing threshold effects in a linear panel model specification. Let us consider a Panel Smooth Threshold Regression (PSTR) model (Colletaz and Hurlin, 2005; Fouquau et al., 2008). Such a model assumes parameters to change smoothly as a function of a threshold variable. In the case of two extreme regimes and one transition function, the model can be presented by[3] :

$$he_{it} = \alpha_i + \beta_0.capita_{it} + \beta_1.capita_{it}.g(q_{it};\gamma,c) + \varepsilon_{it} \tag{2}$$

The transition function is then given by :

$$g(q_{it};\gamma,c) = \frac{1}{1+\exp[-\gamma.(q_{it}-c)]}, \quad \gamma > 0 \tag{3}$$

Thus, the income elasticity is defined as a weighted average of parameters β_0 and β_1. For a given threshold variable, the elasticity of health care spending with respect to income for the i^{th} country at time t is equal to:

$$e_{it}^{y} = \frac{\partial he}{\partial capita} = \beta_0 + \beta_1.g(q_{it};\gamma,c), \quad \text{with } \begin{cases} \beta_0 \le e_{it}^{y} \le \beta_0 + \beta_1 & \text{if} \quad \beta_1 > 0 \\ \beta_0 + \beta_1 \le e_{it}^{y} \le \beta_0 & \text{if} \quad \beta_1 < 0 \end{cases} \tag{4}$$

Note that parameters β_0 and β_1 do not correspond to income elasticity. A positive (negative) value of β_1 simply indicates an increase (decrease) of the elasticity with the value of the threshold variable.

3. Estimation and specification tests

In a threshold model, there are two main problems of specification: the choice of the threshold variable and the determination of the number of regimes. Following Colletaz and Hurlin (2006) and Fouquau et al. (2008), we adopt a three-step procedure for estimating the final PSTR model. First, we test the linearity against the PSTR model. Then, if linearity is rejected, we determine the number of transition functions. Finally, we remove individual-specific means and then we apply non linear least squares to estimate the parameters of the transformed model.

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[3] Note that the PSTR model can be generalised to r + 1 extreme regimes as follows:

$$he_{it} = \alpha_i + \beta_0.capita_{it} + \sum_{j=1}^{r} \beta_j.capita_{it}.g_j(q_{it};\gamma_j,c_j) + \varepsilon_{it}$$

3.1 Choice of the threshold variable

What determines the size of the income elasticity? There are at least two factors which could affect the shape of the income/expenditure relationship: price variation and technological progress.

As advanced by Baumol (1967), health sector is highly labor-intensive. Besides, it produces commodities for which the price elasticity is very low. Then, relying on this assumption, the relative price of these commodities tends to rise with income (Blomqvist and Carter,1997) and so does health expenditure. Clemente et al. (2004) consider that "with the price of health care growing faster than the average, health expenditure grows at a faster rate than income". Nevertheless, as pointed out by Hartwig (2008), medical care price indices should not be used as explanatory variables, especially in cross-country studies, because, he reported, "price trends in health care must be expected to be as diverse as national schemes of price regulation". Besides, Newhouse (1977) argued that price cannot be considered as a relevant determinant of health care spending in west countries because non-market rationing dominates.

Another factor being thought to play a major role in determining the shape of the income/expenditure relationship is medical progress. Baumol (1993) believes that health care is "an industry whose costs are driven by technological imperatives to rapid rise". Feldstein (1995) argues that "the rising cost of hospital care has been driven by changes in the technology or style or quality of care". Although someone should expect technical progress to be cost-saving, in the sense that it reduces the relative price of health facilities and permits, consequently, a decrease in health expenditure[4], it appears that such a proposal is to some extent unreliable. Many studies suggest that technical change has a strong cost-increasing effect in health care (see for example, Weisbrod, 1991; Blomqvist and Carter, 1997; Clemente

[4] Under the assumption that the demand for health care at the aggregate level is price-inelastic.

et al., 2004). Blomqvist and Carter (1997) explained that what is really purchased by individuals is ‘good health’, not health services. Then, “technical change takes the form of progress in our ability to transform health services into ‘good health’, rather than reducing the resource cost of producing health services”. The same idea has been developed by Clemente et al. (2004). They argue that individuals are increasingly interested in the quality of their life more than in the quantity of health care they consume. This explains why individuals devote an increasing fraction of their income to health services. The candidate for the threshold variable considered in this study is technical progress. Following Dreger and Reimers (2005), life expectancy is employed as a proxy, since data on medical technologies are incomplete.

3.2. Linearity tests

As explained by Fouquau et al. (2008), to test linearity in the PSTR model (equation 2) we replace the transition function $g(q_{it};\gamma,c)$ by its first-order Taylor expansion around $\gamma = 0$. We then obtain an auxiliary regression:

$$he_{it} = \alpha_i + \theta_0.capita_{it} + \theta_1.capita_{it}.q_{it} + \varepsilon_{it} \tag{5}$$

Thus, the linearity test consists of testing $H_0 : \theta_1 = 0$. If linearity is rejected, a sequential approach is used to test the null hypothesis of no remaining nonlinearity in the transition function[5]. If we denote SSR_0 the panel sum of squared residuals under H_0 (linear panel model with individual effects) and SSR_1 the panel sum of squared residuals under H_1 (PSTR model with two regimes), the corresponding F-statistic is then given by:

$$LM_F = \frac{\left[\left(SSR_0 - SSR_1\right)/K\right]}{\left[SSR_0/\left(TN - N - K\right)\right]} \tag{6}$$

[5] Testing for non remaining nonlinearity consists of checking whether there is one transition function ($H_0 : r = 1$) or whether there are at least two transition functions ($H_1 : r = 2$). For more details, see Fouquau et al. (2008).

where K is the number of explanatory variables . Under the null hypothesis, the LM statistic is distributed as a $\chi^2(K)$ and the F-statistic has an approximate $F[K, TN - N - (r+1)K]$ distribution.

4. Data and results

The data set consists of a pooled sample of time-series and cross-section observations covering 17[6] OECD countries for the 29 years 1975-2003: a total of 493 observations. Some countries were excluded from the study because it was not possible to obtain detailed health care expenditure statistics starting from 1975. Our data are taken from OECD Health Database (2007) and World Development Indicators (WDI, 2005).

In this study, we propose to estimate a multivariate regression model. Real per capita health expenditure (*he*) is modelled conditioned on real income per capita (*capita*), the share of the elderly (*POP65*), the proportion of population under 15 (*POP15*) and the share of public financing (*PUB*). The threshold variable chosen is life expectancy, as a proxy for technical progress. We begin the analysis by estimating the basic model proposed by Newhouse (model 1). Then, we introduce new variables reflecting changes in population structure and institutional arrangements (model 2 and model 3).

The econometric framework of our analysis is the following:

$$\textit{Model 1}: he_{it} = \alpha_i + \beta_0.capita_{it} + \beta_1.capita_{it}.g(q_{it};\gamma,c) + \varepsilon_{it} \quad (7)$$

$$\begin{aligned} \textit{Model 2}: he_{it} &= \alpha_i + \beta_0.capita_{it} + \eta_0.POP65_{it} \\ &+ \sum_{j=1}^{r}\left[\beta_j.capita_{it} + \eta_j.POP65_{it}\right]g_j\left(q_{it};\gamma_j,C_j\right) + \varepsilon_{it} \end{aligned} \quad (8)$$

$$\begin{aligned} \textit{Model 3}: he_{it} &= \alpha_i + \beta_0.capita_{it} + \xi_0.PUB_{it} + \lambda_0.POP15_{it} \\ &+ \sum_{j=1}^{r}\left[\beta_j.capita_{it} + \xi_j.PUB_{it} + \lambda_j.POP15_{it}\right]g_j\left(q_{it};\gamma_j,C_j\right) + \varepsilon_{it} \end{aligned} \quad (9)$$

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[6] Australia, Austria, Belgium, Canada, Denmark, Finland, Germany, Iceland, Japan, Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, United Kingdom, United States.

The first step is to test the log-linear specification of the three models. The results of these linearity tests and specification tests of no remaining nonlinearity are reported on Table 1. As explained by Fouquau et al. (2008), the threshold variable may have a direct effect on the dependant variable. In this case, one could misleadingly find switching. To check this point we conduct a second test of non remaining linearity with direct effects in which the threshold variable is used as an explanatory variable.

Table 1. Tests of linearity

LM$_F$ test for remaining linearity			
Specification	*Model 1*	*Model 2*	*Model 3*
Explicative variables	*Real capita*	*Real capita, POP 65*	*Real capita, PUB, POP 15*
$H_0: r=0$ vs. $H_1: r=1$	*131,153(0,00)*	*31,142(0,00)*	*65,058(0,00)*
$H_0: r=1$ vs. $H_1: r=2$	*0,231(0,631)*	*1,181(0,308)*	*0,171(0,916)*
$H_0: r=2$ vs. $H_1: r=3$	-	-	-

LM$_F$ test for remaining linearity with direct effects			
Specification	*Model 1*	*Model 2*	*Model 3*
Explicative variables	*Real capita*	*Real capita, POP 65*	*Real capita, PUB, POP 15*
$H_0: r=0$ vs. $H_1: r=1$	*8,493(0,00)*	*12,833(0,00)*	*25,523(0,00)*

Notes: The threshold variable is life expectancy. The corresponding LMF statistic has an asymptotic $F\left[K, TN-N-(r+1)K\right]$ distribution under H_0, where *K* is the number of explicative variables. The corresponding p-values are reported in parentheses.

The linearity tests clearly lead to the rejection of the null hypothesis of linearity for all three models, whether direct effects are considered or not. The strongest rejection of the null of linearity is obtained when model 1 is considered. This result implies that there is strong evidence that the relationship between health expenditure and income is non-linear. Thus, using a linear panel model in which income elasticity is assumed homogenous across countries may possibly lead to fallacious estimates, since the estimated elasticity could vary from a country to another. Besides, for a given country, it is possible that the shape of the income/health expenditure relationship changes with time, in response to potential structural changes in financing schemes, health policies, economic conditions, etc. In this case, a linear approach which offers an average estimate of the different historical values of the income elasticity could hide information about the above structural changes.

Table 1 gives also information about the optimal number of transition functions. The specification tests of no remaining nonlinearity lead to the identification of two extreme regimes ($r = 1$).

Table 2. Parameters estimates for the final PSTR models

Specification	*Model 1*	*Model 2*	*Model 3*
Explicative variables	*Real capita*	*Real capita, POP 65*	*Real capita, PUB, POP 15*
*r**	*1*	*1*	*1*
Parameter β_0	*0,82(0,08)*	*0,8374(0,06)*	*-4,7712(0,54)*
Parameter β_1	*0,0961(0,01)*	*0,0458(0,03)*	*6,3131(0,59)*
Parameter η_0	-	*0,3943(0,08)*	-
Parameter η_1	-	*-0,0334(0,12)*	-
Parameter ξ_0	-	-	*11,3795(1,12)*
Parameter ξ_1	-	-	*-13,2138(1,31)*
Parameter λ_0	-	-	*-0,4703(0,98)*
Parameter λ_1	-	-	*0,1384(1,08)*
Location parameters C	*4,3517*	*4,3354*	*4,0317*
Slopes parameters γ	*23,5477*	*52,8099*	*6,6653*

Notes: The threshold variable is life expectancy. The standard errors for coefficients in parentheses are corrected for heteroskedasticity. The PSTR parameters can not be directly interpreted as elasticities.

Table 2 reports the parameter estimates of the final PSTR models. As explained in section 2, the estimated parameters cannot be directly interpreted as elasticities. Let us consider the basic model (model 1). The parameter β_1 is positive, which implies that when life expectancy increases, income elasticity increases. In other words, with population being ageing, preference of households for health increases. Becoming more interested in the quality of their life, they will spend an increasing amount of revenue (savings) to purchase advanced health facilities.

Table 3. Income elasticities of health care spending: average of individual PSTR estimates.

	Model 1		Model 2				Model 3					
	$\bar{e}^{y}$	$\bar{\sigma}$	$\bar{e}^{y}$	$\bar{\sigma}$	$\bar{e}^{pop65}$	$\bar{\sigma}$	$\bar{e}^{y}$	$\bar{\sigma}$	$\bar{e}^{pub}$	$\bar{\sigma}$	$\bar{e}^{pop15}$	$\bar{\sigma}$
Germany	**0,853**	(0,01)	**0,854**	(0,01)	0,382	(0,01)	**0,730**	(0,13)	-0,136	(0,27)	-0,350	(0,00)
Australia	**0,862**	(0,01)	**0,862**	(0,01)	0,376	(0,01)	**0,811**	(0,12)	-0,305	(0,26)	-0,348	(0,00)
Austria	**0,852**	(0,01)	**0,854**	(0,01)	0,382	(0,01)	**0,717**	(0,15)	-0,108	(0,31)	-0,350	(0,00)
Canada	**0,864**	(0,01)	**0,865**	(0,01)	0,374	(0,01)	**0,838**	(0,10)	-0,361	(0,21)	-0,347	(0,00)
Denmark	**0,851**	(0,01)	**0,852**	(0,01)	0,384	(0,01)	**0,731**	(0,06)	-0,137	(0,13)	-0,350	(0,00)
Spain	**0,863**	(0,01)	**0,863**	(0,01)	0,375	(0,01)	**0,825**	(0,10)	-0,334	(0,20)	-0,348	(0,00)
USA	**0,851**	(0,01)	**0,852**	(0,01)	0,384	(0,01)	**0,726**	(0,08)	-0,126	(0,18)	-0,350	(0,00)
Finland	**0,852**	(0,01)	**0,853**	(0,01)	0,383	(0,01)	**0,724**	(0,12)	-0,121	(0,25)	-0,350	(0,00)
Iceland	**0,871**	(0,01)	**0,871**	(0,01)	0,370	(0,01)	**0,892**	(0,07)	-0,474	(0,15)	-0,346	(0,00)
Japan	**0,874**	(0,01)	**0,871**	(0,01)	0,370	(0,01)	**0,907**	(0,11)	-0,506	(0,22)	-0,346	(0,00)
Norway	**0,863**	(0,01)	**0,863**	(0,01)	0,375	(0,01)	**0,829**	(0,07)	-0,342	(0,14)	-0,348	(0,00)
New-Zealand	**0,853**	(0,01)	**0,855**	(0,01)	0,382	(0,01)	**0,735**	(0,13)	-0,146	(0,28)	-0,350	(0,00)
Netherlands	**0,862**	(0,01)	**0,863**	(0,01)	0,376	(0,01)	**0,823**	(0,06)	-0,329	(0,13)	-0,348	(0,00)
UK	**0,854**	(0,01)	**0,855**	(0,01)	0,381	(0,01)	**0,745**	(0,11)	-0,167	(0,23)	-0,349	(0,00)
Sweden	**0,867**	(0,01)	**0,867**	(0,01)	0,373	(0,01)	**0,863**	(0,08)	-0,414	(0,17)	-0,347	(0,00)
Ireland	**0,848**	(0,01)	**0,850**	(0,01)	0,385	(0,01)	**0,686**	(0,12)	-0,042	(0,26)	-0,351	(0,00)
Portugal	**0,845**	(0,01)	**0,849**	(0,01)	0,386	(0,01)	**0,642**	(0,17)	0,050	(0,35)	-0,352	(0,00)
All countries	**0,858**	(0,01)	**0,859**	(0,01)	0,379	(0,01)	**0,778**	(0,13)	-0,235	(0,27)	-0,349	(0,00)

Notes: For each country, the average, $\bar{e}$, and standard deviation, $\bar{\sigma}$,of the estimated elasticities are reported. The threshold variable is life expectancy.

Given the parameters estimates of the final PSTR models, it is now possible to compute, for each country of the sample and for each date, the time varying elasticities of health care spending with respect to income (e_{it}^{y}), the share of the elderly (e_{it}^{pop65}), the proportion of population under 15 (e_{it}^{pop15}) and public spending (e_{it}^{pub}). These smoothed individual elasticities are given by the formula (4). The average estimated elasticities are reported in Table 3 for the three PSTR models. These estimated elasticities are based on the historical values of the transition variable, life expectancy, observed for the 17 OECD countries.

As can be seen, the income elasticity of health care spending is below unity for all the countries of the sample whatever the model considered. This result contrasts with that found in previous studies: here, health care is not a luxury good. Some remarks can be driven from table 3. When considering models 1 and 2, the income elasticity does not considerably change from one country to another. But, when public spending is introduced as an explanatory variable (model 3), our results slightly change. Except for Iceland and Japan, the income elasticity is being lower. Tosettiy and Moscone (2007) found the same result arguing that introduction of public spending in the regression weakens the link between income and the standard of care. Another interesting finding is that coefficients are being different from one country to another, ranging from 0,642 in Portugal to 0,907 in Japan. This result obviously shows the heterogeneity of the income elasticity among OECD countries.

Exhibiting cross-country heterogeneity is not the only advantage of a PSTR model. Such a specification permits in addition to study the time variability of the estimated income elasticities of health care spending. On the figure (1), the estimated elasticities e_{it}^{y} of health expenditure with respect to real income are plotted over the period 1975-2003 for the 17 countries of our sample.

Plots have been done only for model 3 in order to capture as large as possible cross-country heterogeneity. Besides, we can observe from table 2 that for model 3 the estimated slope parameter γ is relatively small. This implies that the transition between extreme regimes is smooth. But whatever the model considered, the finding is always the same: for all the countries, the estimated income elasticity is constantly increasing between 1975 and 2003.

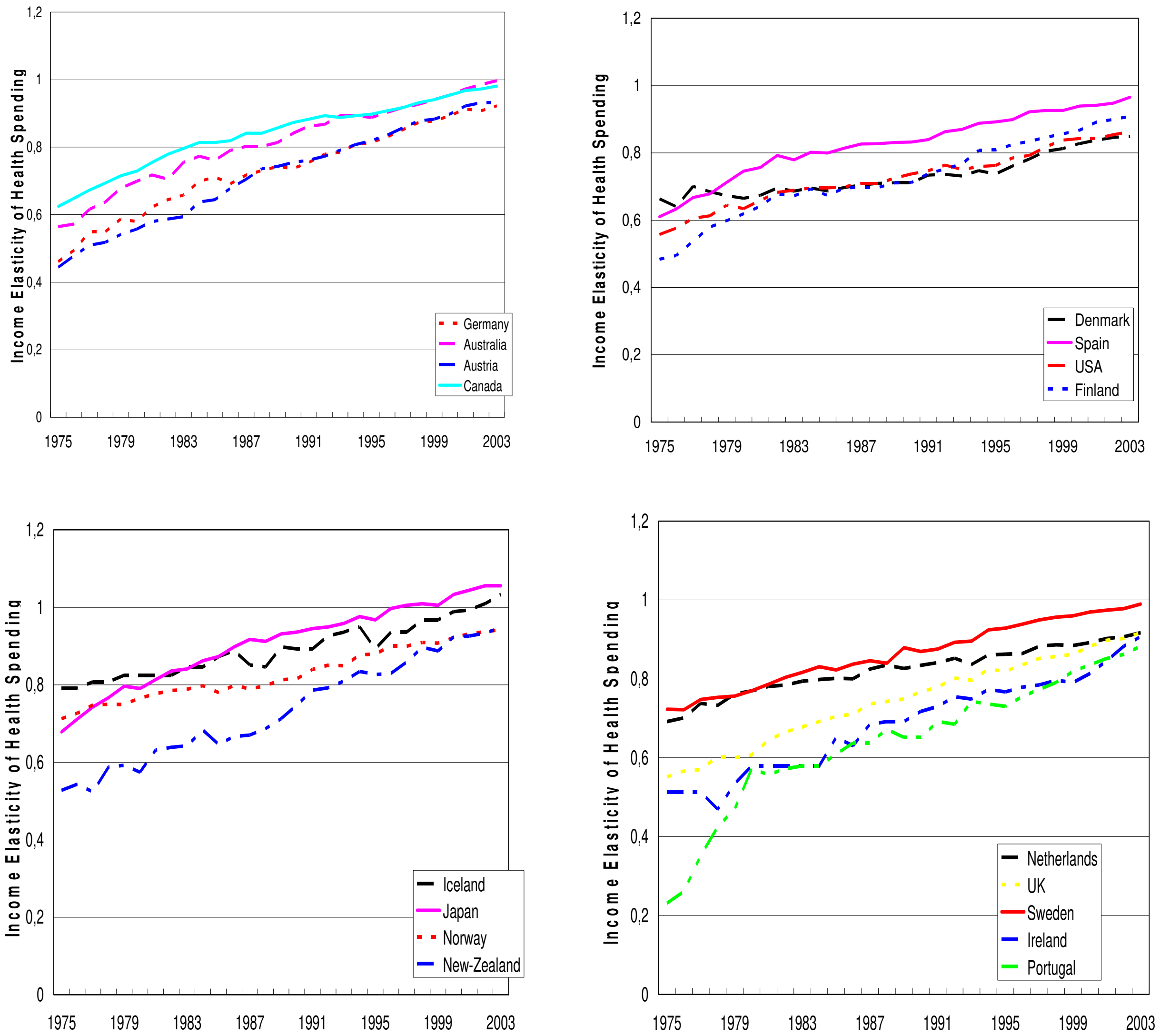

Figure 1 : Estimated individual income elasticities

Such a result sustains the proposal of a shift towards a growing and strongest relationship between health care spending and income in OECD countries. For nine countries of the sample (Germany, Austria, Spain, Finland, Norway, New-Zealand, Netherlands, United-kingdom and Ireland), income elasticity is superior to 0,9 at the end of the period. For three countries (Australia, Canada and Sweden), this elasticity is around unity. For Japan and Iceland, it exceeds unity. What these results tell us? Is health care really becoming a luxury good? Recall that these estimated elasticities are based on the historical values of the transition variable, life expectancy, observed for the 17 OECD countries. So, one plausible response to the question above is that when society gets aged, i.e., life expectancy exceeds a given threshold, the individual's preferences shift towards health at the expense of consumption goods, and additional resources are required to enjoy a longer life. As technology of life extension is subject to "sharp diminishing returns" (Hall and Jones, 2005), a more than proportionate part of income will be needed in order to extend life. Accordingly, the more the people get richer, the more the share of resources they are willing to devote to health care increases. Of course, life expectancy is used in our PSTR model as a proxy for medical progress. Many previous studies have already pointed out that technical change is the main factor underlying health expenditure growth in the OECD countries. In our opinion, this purpose particularly matters in societies whose age pyramid dramatically switches in favour of the elderly. To examine this, we have re-estimated our PSTR model by taking the share of the elderly as a threshold variable. Not surprisingly, we found an income elasticity well above unity[7]. From this point of view, the idea that health care is a luxury good, and that at the margin health care may contribute more to 'caring' than to 'curing' holds good.

5. Conclusions

Heterogeneity and nonlinearity can lead to biased results when trying to model the relationship between income and health care expenditure. If these two topics are not well incorporated in econometric models, it is likely that estimates misleadingly reveal an income elasticity greater than unity. Generally, it is difficult to resolve heterogeneity and nonlinearity problems simultaneously. But one issue proposed in the literature consists in introducing threshold effects in a linear panel model specification. Smooth transition regression models are straightforward to deal with cross-country heterogeneity and time instability of the elasticities by allowing coefficients to vary across individuals and over time.

In this paper we used a panel smooth transition regression model to estimate the relationship between income and health care expenditure for 17 OECD countries over the period 1975-2003. In contrast to many previous studies, we show that, on average, the income elasticity of

[7] These results have been omitted to conserve space, but are available from the author upon request.

health care spending is below unity for all the countries considered in the study. This finding is robust to the inclusion of other non-income determinants of health expenditure in the regression. But, in all likelihood, it seems that the shape of the income/expenditure relationship is changing over time, especially when introducing public health expenditure as an additional explanatory variable. Our estimates show that the income elasticity of health care spending is constantly increasing between 1975 and 2003. For fourteen countries, this elasticity grows to be close to unity at the end of the period. Questioning why the income elasticity increases over time, we have advanced the idea that when life expectancy exceeds a given threshold, the medical care needed by older people to enjoy longer life involves expansive technology and hospitalization. But, at this particular stage, health is directly affecting welfare and people are willing to purchase those expansive health care facilities as much as they afford it. As the population get richer and older, the share of health expenditure in the total resources raises and the income elasticity is increasingly high that the proportion of the elderly increases.

Finally, the main results of the paper can be summarized as follow: (i) the relationship between income and health care expenditure is nonlinear, (ii) on average the income elasticity of health care spending is below unity for the 17 OECD countries of the sample, (iii) the relationship between income and health spending is changing over time and across countries and, (iv) health expenditure seems to behave as a luxury good when life expectancy exceeds a critical threshold.

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